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The critical reconstruction of the Temple – Theatre complex in the Italic Sanctuary of Pietrabbondante.

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***Abstract* — This paper presents a research project developed on the archaeological site of Pietrabbondante (Italy) particularly important for its temple–theatre Italic complex. The research entailed not only the massive acquisition of the site through 3D laser scanning and image-based capturing but also the critical study and cataloging of the findings as a premise for the reconstructive hypothesis of the complex. This process of investigation has contributed to enhance the knowledge of the archaeological site, providing support and information to the local administration and helping the local communities to better appreciate the cultural value of the monument.**

Keywords— Archaeological Heritage, Italic Architecture, Pietrabbondante, Digital Reconstruction, Integrated survey

I. INTRODUCTION

Archaeological Sites often host only a small number of fragments of the original architectures and therefore the reconstruction of their original consistency becomes a prickly task and the adopted representation/communication technology play a crucial role in producing an effective and correct impact on scholars as well as on visitors.
The whole matter refers to *modelling*, that is to say to that process of abstraction that establishes a biunivocal correspondence between the *object* and its *representation* [4]. Geometric construction, obviously, as any entity that is or may be created is geometric. The 3D model is thus the synthesis of the process (intellectual rather than operative) through which the *modeller* shows his/her reconstructive hypothesis about the object under investigation [4]. The first step of the modelling workflow implies in this case the collection of data and information characterized by different levels of objective reliability: surveys, metric and geometric analysis, photographic documentation, reports, historical studies as well as travel notes, views, engravings, frescos and even suggestion or impressions aroused during a visit. [5]
It's the modeller who, working on these materials, gives body to the information in terms of three-dimensional elements that, eventually, compose his/her reconstructive hypothesis.
From this standpoint, the site we chose for our experimentation, the Temple–Theatre complex in the Italic Sanctuary of Pietrabbondante, is particularly relevant showing a significant part of the problems we intended to deal with (in situ remains, dispersed objects in different museums, landscape modifications overtime, lack of information and communication tools/products).
The workflow implemented during the project was designed so to make it applicable to different pieces of Cultural Heritage and especially to archaeological sites considering their highly complicated aspects connected with the idea of *ruin*. In fact, "the remains of an ancient monument" help us to capture the "presence of the past and the sedimentation of the age" [1]. Thus, the term *ruin* does not just depict the present condition of an asset, but on the contrary always refers to *something else*, suggesting what that object was in the past, what was its original appearance, what was used for, etc. This is why digital technologies and particularly virtual reconstructions represent outstanding means to create these *suggestions*.

II. THE SURVEY CAMPAIGN OF THE ITALIC SANCTUARY OF PIETRABBONDANTE

The monumental complex in Calcatello (Pietrabbondante, IS - Fig. 1) occupies the slope at the base of Mount Saraceno, a plateau at about 1000 m. above sea level. Most of the remains we see today (minor temple, theater and intermediate structures) have been brought to light since the middle of the XIX century by the Bourbon government, while the excavation of the main temple began only in 1959. All this remains are dated between III and I B.C. [3]. The surrounding areas are probably also occupied by archaeological remains, presently only identified. However, it is clear that what has been excavated so far represents the heart of this Samnite sanctuary.

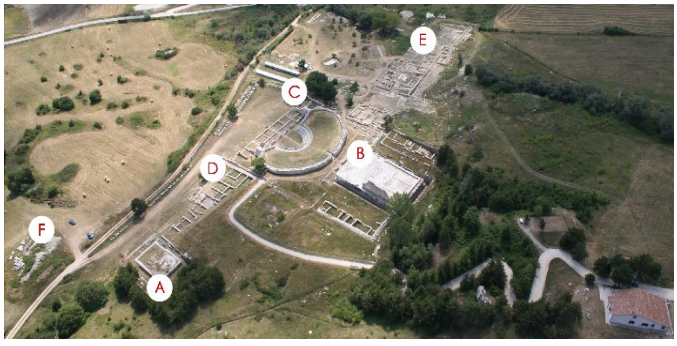

Fig. 1. Archaeological site of Calcatello (Pietrabbondante, Isernia). A. Minor temple; B. Major temple; C. Theatre; D. Tabernae; E. Public Domus and Stoa; F. New excavation.

To date, further excavations have been conducted in the vast archaeological area, which discovered between 2006 and 2010 [2], a public domus, some *sacelli*, the mausoleum of the Socellis roman family and finally a new building, probably an *aerarium*.

Despite important historical studies and the accurate

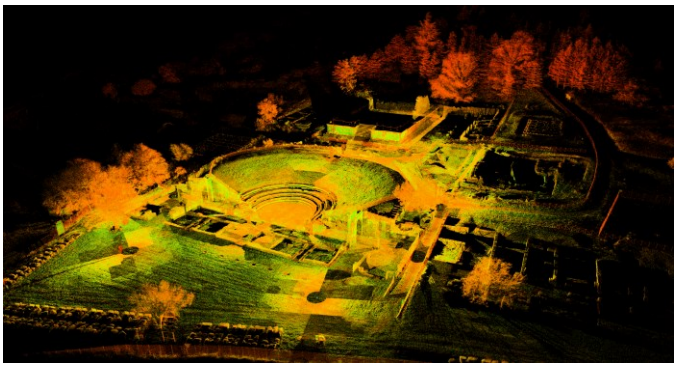

Fig. 3. Overview of the temple – theatre complex. General database used for processing.

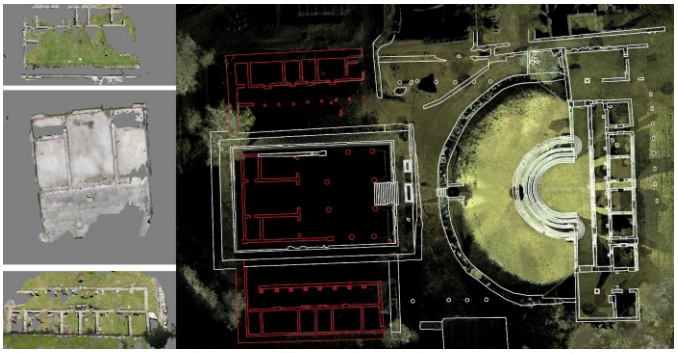

Fig. 4. On the left: photo modelling of the porticoed rooms and the temple podium. On the right: general planimetry. In white the elements surveyed with laser scanners, in red those surveyed with photo-

excavation campaign, the sanctuary still lacks for a systematic documentation with state-of-the-art technologies. In our opinion, this fact has affected so far the quality of the interpretation of the remains and the consistency of the reconstructive hypothesis.

Therefore, the objectives set by our research have been essentially the following:

- Perform an accurate survey to collect detailed information for studies and analysis of the monument.
- Interpret all the remains belonging to the main temple cataloguing them in order to draft a comprehensive reconstructive hypothesis of this building, able to enhance the overall knowledge about the monument.

In this last activity we took well into account the recommendations of the London Charter [14] referring to the value of computer-based visualizations of cultural heritage and the potential of new digital tools in managing the Dependency Relationships among different information through the systematic and iterative comparison between data and hypotheses.

In this framework, the temple–theatre complex was surveyed in a single campaign conducted in June 2016 combining different surveying methods and instruments. Accordingly, long range 3D laser scanner (Leica C10), image-based modeling and direct survey were combined and integrated [6] adopting though laser scanning as our leading capturing technology. Therefore, the point clouds generated from the 17 stations, automatically registered using the scanner in topographic mode, have become the reference numeric model for the orientation and scaling of those differently generated (i.e: SfM) covering some missing data especially in the temple area (Figg. 3 and 4).

The elaboration of these data led to the drafting of the conventional 2D representations in 1: 100 scale: plan of the monumental complex, elevation of the temple's podium and theater, a section along the *scenae frons* of the theater and two longitudinal sections.

III. 3D INTERPRETATION AND RECONSTRUCTION OF THE MAIN TEMPLE

Together with the survey of its visible structures, we performed an analysis of many findings of the main temple that in some cases we decide to survey with SfM. While we had an enough easy access to those stored directly in Pietrabbondante's archaeological area, some others were instead inaccessible, being in the National Archaeological Museum of Naples. However, some descriptions [7] published in catalogs allowed the recognition of the decorative typologies and the stylistic comparison with other pieces.

A. The reconstruction of the architectural elements

One of our main problem was the reconstruction of the height of the columns of the main temple. We first based on the SfM capturing of some of the shaft rings that make up the column, blocks in fossiliferous limestone that are in a poor state of conservation. However, we focused on the two best-conserved elements trying to define the inclination of their external surface. This process did not lead unfortunately to a satisfactory result especially due to the bad conditions of the blocks that did not show enough points on the original surface. (Fig. 2)

Moreover, it was possible to identify the order of the columns belonging to the main temple. It is Corinthian with the capital divided in two sections and an attic base directly resting on the stylobate without plinth. For the estimation of the height of the column, we considered seven of its blocks from which we extracted the diameter of the shaft at the *imoscapus* and at the *summoscapus*. Referring to its height instead, thanks to a previous survey documenting a shaft found in its collapse

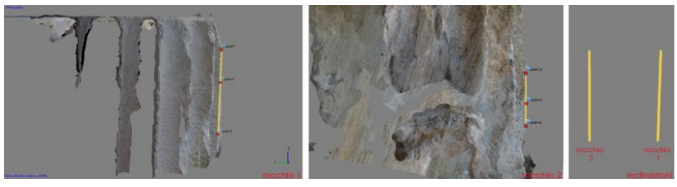

Fig. 2. Reconstruction of the elements in a SfM environment (Agisoft Photoscan). Markers have been taken along a groove edge on the two best-preserved blocks. The three points considered are joined by a segment that describes the inclination of the block, previously oriented and scaled. The two segments thus obtained are compared to try to obtain the most reasnable inclination of the column.

position [3] composed by 18 blocks we could define an "average ideal value" of a ring. Despite being the blocks presently much deteriorated and in a fragmented state, we could reliably measure only 7 of them and eventually deduce the total length of the column itself.

This value is the result of the following arithmetic mean and multiplication:

$$H \text{ ideal element } (H_{ie}) = \sum H \text{ blocks} / \text{number of blocks}$$

$$H_{ie} = 71+52+54+58+94+29+50 / 7 = 58 \text{ cm}$$

$$H \text{ column } (H_c) = H_{ie} \text{ x number of blocks}$$

$$H_c = 58 \text{ x } 18 = 1044 \text{ cm } (10.44 \text{ m})$$

This value conveniently fits into 38 *osco* feet, being one foot 27.5 cm. Furthermore, it well corresponds to 8 diameters of the column at *imoscapus*, the same proportion defined by Vitruvius for the Doric order (Fig. 8).

B. Reconstruction of decorative elements: the pediment

The reconstruction of temple's pediment based first on a systematic investigation of the remaining terracotta elements. For the missing ones instead, we proceeded with a stylistic comparisons referring to the coroplastic decorations of nearby sanctuaries, corresponding to the same period of construction [8] in Schiavi D'Abruzzo, Castel di Ieri [9] and Civitella di Chieti.

In this framework, we concluded that the original pediment had to be composed by a wooden structure covered with architectural terracottas. Important clues of this layout come both from two different types of *antepagmentum* and from some fragments, presently at the Museum of Naples, of different plates of uncertain reconstruction but that could belong in our opinion to the rampant gables (Fig. 5). Moreover, the ascertained intercolumniation, exceeding 6 meters, excludes the possibility of a stone lintel, but makes it plausible the coexistence of a wooden system in the part of the *pronaos* and stone one for the cell walls. The need to bring these two systems together in a temple with an eclectic architectural character, coherently with the syntax of the architectural language and with the measurements of the archaeological finds, led to the formulation of two reasonable layouts for the elevation of Pietrabbondante's temple. One compliant with the Etruscan-Italic style, the other with a more accentuated tendency towards the Hellenistic-Campano culture. For the stylistic comparisons related to the first hypothesis, we used the pediments of the temples A and B of Civitella, reconstructed within the museum of Chieti, and more in general, the features of the Capitolium of Cosa. This first solution led to align, on the north elevation, the Doric stone frieze with the cladding slabs of the wooden lintel, providing a clear reading of the temple's riva (Fig. 6).

In the second case, instead, we based on the consolidated structure of Hellenistic temples contaminated though by local construction technique and traditional materials. Accordingly, we took as a reference the reconstruction of the temple's pediment of Cuma before the Romanization (IV B.C.) inside the museum of Baia [10], where stone and terracotta systems

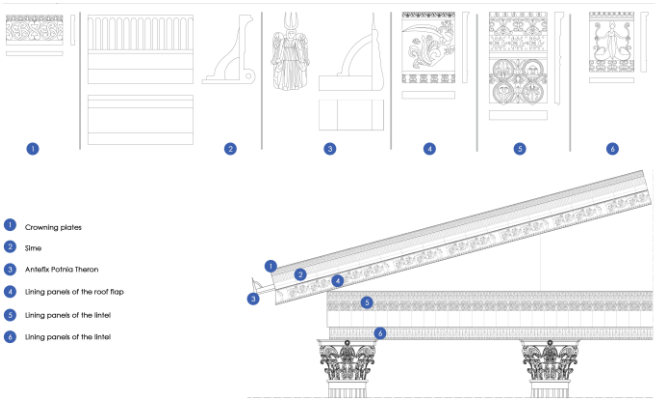

Fig. 5. Graphic process of reconstruction of the Corinthian column.

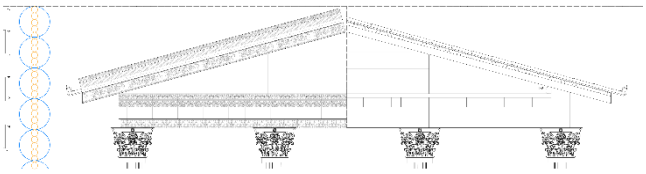

Fig. 6. First reconstruction hypothesis.

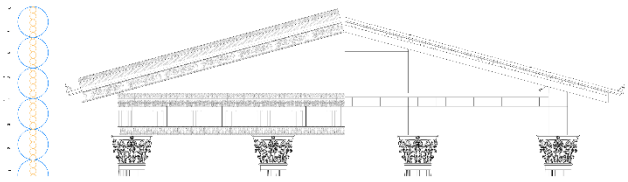

Fig. 7. Second reconstruction hypothesis.

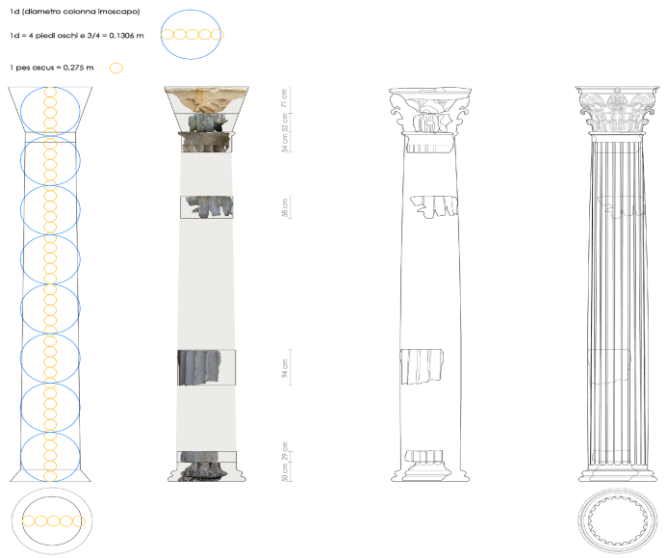

Fig. 8. Graphic process of reconstruction of the Corinthian column.

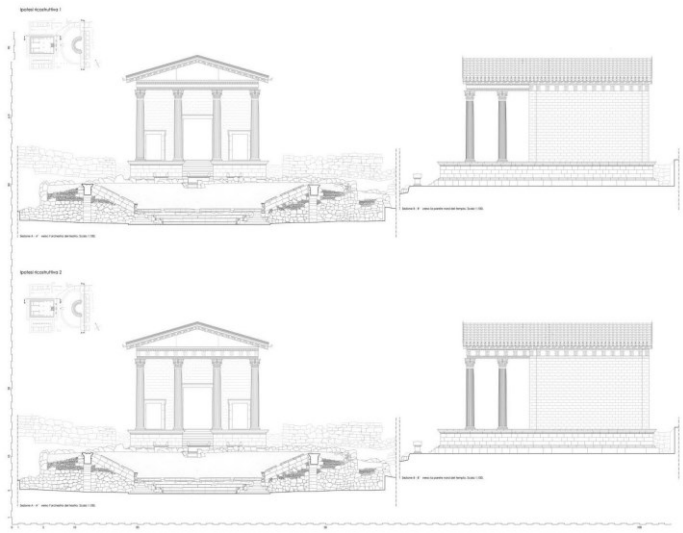

Fig. 9. Comparison between the two reconstructive hypotheses.

cohabit to form a complete architectural order. Furthermore, we considered the Capuano environment, where the Patturelli altar [11] appears a sort of small copy of the podium of Pietrabbondante temple. In this configuration (Fig. 9) the Doric frieze turns all around the temple: in stone on the cell walls and in terracotta in correspondence of the wooden beams on the *pronaos* as a covering. Once painted, the difference between the two types of frieze was actually almost invisible. Moreover, the use of fictile Doric friezes has been ascertained in the main temple of Schiavi d'Abruzzo, also dated at the end of II B.C. We have still hypothesized a walled tympanum, probably in *opus craticium*, with some pediment's statues that however are not among the finds of excavations (Figg. 7, 9). Finally, considering this second hypothesis more grounded both from a stylistic and architectural standpoint, we have performed a 3D reconstruction in accordance with a heuristic approach in the study of archaeological structures [13] (Fig. 10).

IV. CONCLUSIONS

The objective of our research concerned the documentation, analysis and critical reconstruction of the monumental complex of Pietrabbondante. This has been the result of an interleaved cooperation among architects, archeologists, historians able to merge their different methodologies. So through the study and reconstruction supported by digital technologies "the ruin" can still speak of itself, of what was in the past and what can still be and represent today.

In fact, the integrated archeology-architecture approach has led to the translation of archaeological data into architectural language by means of 3D virtual models, which have been constructed trying to comply as much as possible with an actual simulation of the original design and constructive process. In this framework, not only was our aim to provide a sound reconstructive hypothesis for this complex, but also to augment the reliability of the knowledge background and share it with the scientific community paving the way to future studies and refinements. Moreover, our future research perspectives will entail the extension of the study to the entire archaeological area, the creation of a digital platform for the dissemination [12] and implementation of an application for the immersive exploration of the monument.

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Fig. 10. 3D reconstruction of the main temple.

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