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THE ACQUAROSSA MEMORY PROJECT. RECONSTRUCTING AN ETRUSCAN TOWN

1. Introduction

Acquarossa (literally "red water", named after the red-coloured creek surrounding the site) is an Etruscan town near Viterbo, Italy. It lies in the heart of the Etruscan territory, situated on a tufa-plateau, close to the Lago di Bolsena. The town has been discovered in the 1960s by locals. Excavations carried out by the Swedish Institute in Rome revealed a series of Etruscan houses, inhabited from the late 8th century BC until shortly after the middle of the 6th century BC, when the town was suddenly and inexplicably abandoned. The houses were left to crumble and the remains of the foundations, the walls and the decorated roofs, as well as the thousands of household utensils, were all found *in situ*. It is one of the very few examples of an intact Etruscan townscape, with a unique set of family dwellings from the past. The excavations were never fully published, only the architectural terracottas received ample attention (Wetter, Östenberg, Moretti 1972 provided preliminary results; Östenberg 1975 on the houses; Nylander 1986 provided the first overview; Winter 2009, Chapters 1-2, studied the many roofs).

The remnants of the houses were partially consolidated in the 1980s, but otherwise left to be destroyed by weather conditions. The site was left to vanish completely. In the case of the monumental Zone F, a provisory roof was put over the foundations.

The site of Acquarossa has a new owner since 2012, and things have been changing. In 2014 a modest Archaeological Park was created with the help of the Swedish Institute. Since 2015, the 4D Research Lab of the University of Amsterdam has been involved in an interdisciplinary research project, in collaboration with the landowner and private partner Azienda Agrituristica Raffaele Rocchi, which focuses on the reconstruction of a set of houses in annotated 3D models. The private owner already has a so-called re-structured Franciscan tower on the site which is used for holiday purposes. The intention was to use these models to develop a larger complex for the Agriturismo. The 3D models will be the base for "actual" guest-houses at the site itself, for which permission from the Italian state (the local Soprintendenza) has been granted. The houses of Zone B have been selected for this purpose. The actual houses are going to be reconstructed at the far western end of the plateau, where no archaeological remains are left, there it is mere bare rock (Fig. 1).

In our research project, the houses of Zone B have been thoroughly analysed and reconstructed in an annotated model and primarily serve the

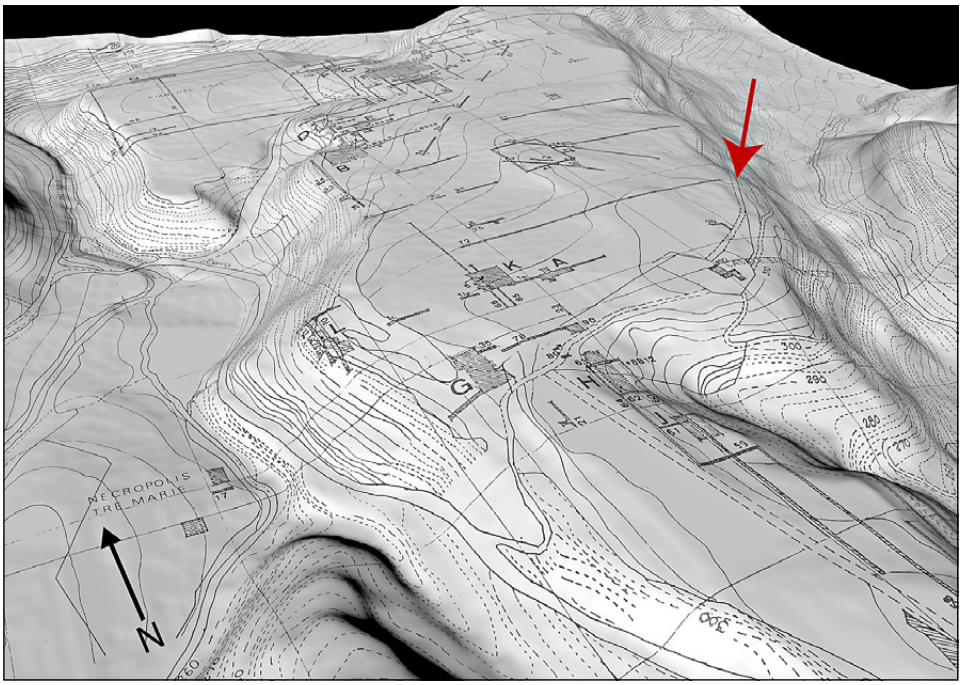

Fig. 1 – Plan of Acquarossa in 3D, with indication of the new building site. Author: M.H. Sepers, 4D Researchlab.

scientific community to analyse building structures from the Etruscan period and *chaîne opératoire* in the past (Opgenhaffen, Sepers 2015). The annotated models can then be used to serve the architects that will build the actual holiday homes, however based on proper research and recent publications on ancient architecture and building methods. Building of the holiday homes will start in 2018 in close collaboration with our research team.

One of the things we plan to do is to bring together the results of our Amsterdam research tradition in the field of heritage, memory, material culture, archaeology and restoration of the site of Acquarossa and with the modern presentation of the site. An important way to connect these and to reach a wider public is the production of an App that shows a model at the very point where the foundations of the houses are covered and invisible. The National Etruscan Museum in Viterbo (Museo Rocca Albornoz) had relatively recently designed a new exhibition of the finds from Acquarossa in modern surroundings, mostly the decorated roofs of the houses, showing series of decorated plaques and antefixes, all from the early 6th century BC.

2. Theoretical framework, concepts and methodology

Built structures and their roofs are complex material objects (Lounsbury 2010). Transformations of architecture and roofs – being constructed, destroyed, rebuilt or repaired – need complex and technically demanding *chaînes opératoires* (Audouze 2002; Dobres 2010). The study of technology is an essential method for understanding the materiality of the construction sequence of archaic roofs (Roux 2009; Lulof 2016), while stressing the importance of human "agency" in the transfer of these technologies. Like the potter's wheel, the mould is, as a craft tool, one of the most important technical inventions at the time, making the production of architectural terracottas practical and profitable. Moulds and finished products are important to trace interactions and networks between production centres and reveal professional and artistic identities (Knappett 2012). How, why and in what ways did roof decoration change over time and how did these transformations connect with the networks between local elite, artists and workshops? This last concept should seek the larger social dynamics of network interactions and the types of relationships between those in practice and in power. 4D modelling is an excellent research tool, when used for reconstructing best practices and tracing production processes. As a theoretical concept and methodology it is relatively unprecedented, but it has great scientific potentiality (Frischer 2008; Hermon, Nikodem 2008; Earl 2013). The application of 3D modeling during the research into built environments offers new insights and a new approach for analyzing data. The many perspectives on the actual building itself, i.e. the spatial context, and the possibility of visualizing the architectural phases through time (the "4D" element), makes visual computing an innovative tool for the specialist. When the path that leads to the final reconstruction of the building is thoroughly documented, it generates a vast amount of new data otherwise never encountered.

The theoretical ambition of this project is to (re-)define this set of concepts and to test their validity by bringing into play a specific and rich set of data, namely the houses and roofs of Acquarossa.

3. Reconstructing the landscape of Acquarossa

The reconstruction of the townscape of Acquarossa cannot be done without the landscape surrounding it. In collaboration with the Geo-staff of the British School in Rome, we have made a 3D landscape reconstruction of the site. We use a variety of techniques and equipment, among others Structure from Motion (aerial images), Terrestrial Laser Scanning (Leica P30) and Structured Light Scanning (HDI advanced), for the digital 3D documentations of tombs, waterworks and quarries in the deep creeks and ravines around the plateau.

Today, no precise inventory exist of the many archaeological features around the site. We plan to make a detailed map in 3D of the site, which of course was not possible at the time, but is now accessible with modern techniques. We also will do a geophysical survey of the area of Pian del Sale, a small plateau, W from the main plateau with the clusters of houses and the monumental area, with ground-penetrating radar and magnetometers (Fig. 1) to investigate this unexcavated area. The results of this survey are included into a GIS that serves as an intermediary between the 3D reconstruction and the database. The model of the landscape is then exported to the 3D modelling program Cinema4D to test the constructional methods of the built walls and roofing systems (Opgenhaffen, Sepers 2015). Recently resistivity analysis was carried out, but this revealed not enough traces of what is actually underground. The geophysical radar instruments will certainly reveal remains of building at Pian del Sale, and a field survey already found indications for workshop and building activities. We hope to find the industrial area where the architectural terracottas were produced. However, we will investigate the area in an entirely non-destructive way: that is through modern techniques and survey.

4. Reconstructing the houses

We will concentrate first on the reconstruction of Zone B, where a relatively complete set of three houses had been excavated in the 1970s. Reconstruction of roof-building is indispensable when one studies architectural terracottas. This project aims to create an innovative interdisciplinary approach to source and reconstruct roof production, focusing on the distribution of moulds, as well as roof construction techniques, in order to study the later phase in the production process (the actual roof decoration), production tools (matrix or mould), and building techniques, using as a case study the workshops manufacturing architectural terracottas in Acquarossa between 680 and 530 BC (Wikander 1981, 1986, 1988; Winter 2009, 513-514).

We will focus on the reconstruction of the cluster of houses from Zone B, attributed to at least two different phases (Winter 2009, 14-16 and 60-62). Many reconstructions of these houses have been suggested, but they remain preliminary. The roofing systems proved to be valuable for the study of the exterior and supporting system. In Zone B, two different roof systems were used, dated from 620-610 and 560-530 BC (Wikander 1988, 33-34; Winter 2009, Roofs 1-15 and 2-12, 14-16, 60-62, reconstructions: 17 and 61). In the final 3D model different hypotheses are visualized as variations, leaving the actual remains and other data intact and accessible. The bird-eye view of the area shows how Zone B was constructed (Fig. 2).

Simulation of the construction sequence of built structures provides insights into the social organisation of workshops and dynamics of craft

Fig. 2 – Bird-eye view of the Zone B complex in 3D. Author: M.H. Sepers, 4D Researchlab.

communities. Through comparison of the workshops, the origin, transfer and introduction of new technologies can be traced. This social context of domestic architecture and roofs can be understood when the physical aspect of materiality is involved, by examining the construction sequence or the *chaîne opératoire* of these monuments. Digital 4D modelling has been used as an innovative method to simulate the construction sequence (Hermon, Nikodem 2008; Lulof, Opgenhaffen, Sepers 2013).

The model of Zone B will be published in an annotated system (Fig. 3). The 4D Research Lab of the University of Amsterdam already has an initial system in place for storing built heritage information digitally (Noordegraaf, Opgenhaffen, Bakker 2016). An interactive website is activated with access to other media. The models are completely accessible and dealt with as a scientific publication (Ryan 2001; Huvila 2012). The final model can then be used to build actual houses, but based on proper research and publications, not phantasy or misinformation. Zone B has been thoroughly analyzed and prepared for an annotated model, which will serve the architect in building the holiday homes at the first place, but of course primarily serve the scientific community to analyse building structures from the Etruscan period and *chaîne opératoire* in the past (Fig. 4).

First and foremost, our research group will work on the vast data collection needed for a refereed virtual model. Although some work has been done

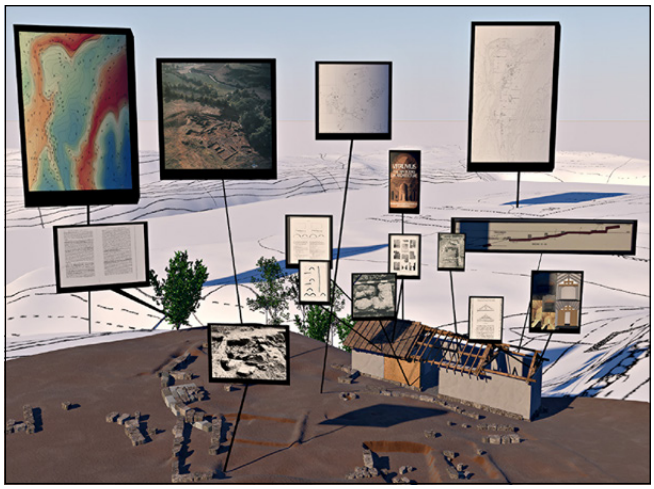

Fig. 3 – 3D Model of House B in Zone B with annotation system. Author: M.H. Sepers, 4D Researchlab.

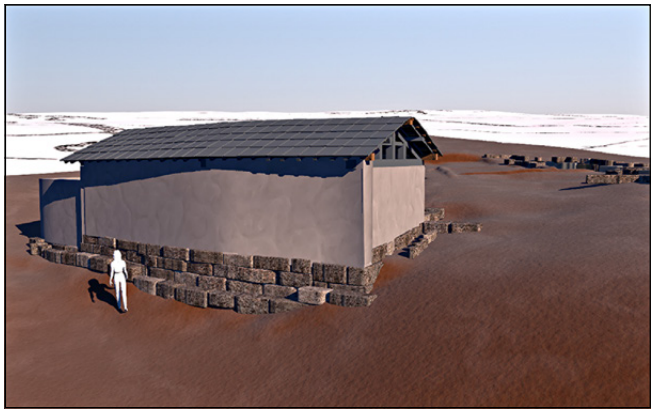

Fig. 4 – 3D Model of House B in Zone B, backside. Author: M.H. Sepers, 4D Researchlab.

on the conceptual aspects of this process (the so-called London Charter), it remains up to today fundamental in 3D modeling to create a new publication format that enables us to follow each step and argument, as well as annotate them, for reconstructing built heritage from Antiquity.

Moulds are rare archaeological objects and yet essential to understanding production methods. 3D scans of roof elements (such as antefixes) will be

Fig. 5 – Scanning the roof and acroterion of House B in the Viterbo Museum. Author: P.S. Lulof.

used for the reconstruction of moulds. Terracotta roofs need a sophisticated and solid sub-construction, like the timber truss. Digital 4D modelling will be used as an innovative research tool to simulate construction sequence. Focusing on the accurate construction of the houses (and their roofs) at the site, we made a set of 3D scans in the museum in Viterbo (Fig. 5). The cut-out acroterion belonged to houses of Zone B (Rystedt 1983, 22-23; Winter 2009, 113). With the 3D scan we can create a negative, a mould, which in its form can be printed and then re-used to create the terracotta roof elements. In total we have now the material to build three different roofs, in an accurate manner. We deliver the materials, and the architects and commissioner can work with them.

The scanning is done with the HDI scanner which has the ability to create models with extreme precision. Moulds need to be very precise in order to produce exact materials. It is for the very first time that moulds for roof elements are created in modern times. Moulds are essential for studying *chaîne opératoire*.

The study of the roofs will take two different approaches: first, the reconstruction of moulds and second, the reconstruction of the wooden roof-supporting system. Both topics, aside from thorough desktop research and study of material objects, will be addressed with the indispensable research tool of 3D scanning and modelling. Moulds were important craftsman's tools, used to reproduce hundreds of roof elements of the same quality, in a short time, as

well as enabling distribution over a vast region. Moulds are rarely preserved in archaeological contexts and yet essential to understanding production methods (Winter 2009, 513-514). Today it is possible to reconstruct (and print) these moulds, by making a negative model of a terracotta roof element. The moulds used in Acquarossa will be reconstructed through the 3D scanning of separate terracotta roof elements (antefixes, relief plaques). These "recreated" moulds are of extreme importance for the proposed research, as they can be used for comparison between several find groups, explain repeated usage and show networks between workshops hired to decorate the houses. Light and low structures of perishable materials, like the mudbrick of domestic houses with terracotta roofs, need a solid roof-supporting system, like the much-disputed timber truss (Hopkins 2016). The timber roof truss consists of two rafters joined at their lower ends to the tie-beam, so as to form a triangle. This will retain its shape and is therefore very stable and distributes the weight vertically. However, it is also possible that the post and lintel system or hybrid forms were more appropriate. Representations of technical detail of roofs in contemporary tombs are important datasets for thinking about roof systems (Prayon 1975).

5. Future research questions

Investigating craft communities, workshop organizations and networks has never been thoroughly undertaken for this period and region, nor for this exceptionally rich category of materials, or for the craftspeople producing the architectural terracottas. The socio-economic dynamics of craft production in sacred areas and networks between sanctuaries have only recently been addressed in a wider context; connections have been made with the phenomenon of the urbanization of the region. With the exception of a project on the petrography of architectural terracottas from the earliest phase, technical, science-based research and computer-based methods, like petrography, x-ray imaging, and 3D GIS or 4D modelling (4D includes changes over time), have not yet been used for this material group. A synthesis is therefore needed to fully understand and clarify roof production and roof construction in this period, to reveal relationships between main production centres, and to study the possible influences of craftspeople on society.

This research project, combining innovative interdisciplinary methodologies with traditional approaches, is a unique opportunity that will result in insights in chronologies, production, and consumption of Etruscan architecture and its terracotta decoration between circa 700 and 550 BC.

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ABSTRACT

Digital techniques and cultural heritage connect, in an innovative way, new and old within the Humanities. In this new project, an Etruscan townscape will be recreated; modelled results created by the 4D Research Lab will be integrated in an Archaeological Park and Museum in such a way that international scholars and visitors can acknowledge and study 3D reconstructions of a series of Etruscan houses within their successive phases of creation, function, reception, destruction, and reconstruction. Acquarossa is an Etruscan town near Viterbo, Italy. Excavations carried out by the Swedish Institute in Rome revealed a series of Etruscan houses, inhabited from the 8th century BC until the middle of the 6th century BC, when the town was suddenly and inexplicably abandoned. The houses were left to crumble and the remains of the foundations, the walls and the decorated roofs, as well as the thousands of household utensils, were all found *in situ*. It is one of the very few examples of an intact Etruscan townscape, with a unique set of family dwellings from the past. The remnants of the houses were partially reconstructed in the 1980s and covered with soil, but others were left to be destroyed by weather conditions. The site was left to vanish completely. Since 2014, the 4D Research Lab of the Faculty of Humanities of the University of Amsterdam has been involved in an interdisciplinary research project, in collaboration with the private partner Azienda Agrituristica Raffaele Rocchi, the proprietor of the site, which focuses on the reconstruction of a set of houses in annotated 3D models. The 3D models will be used to build "actual" guesthouses at the site itself, for which permission from the Soprintendenza per i Beni archeologici del Lazio e dell'Etruria Meridionale has been granted. The project aims to analyse the house architecture, roof decoration and building processes through 3D modelling and scanning.