INTERDISCIPLINARY INVESTIGATIONS AIMED AT THE PRESERVATION OF A FUNERARY ROMAN MONUMENT NAMED “TORRE ROSSA” IN Fiumefreddo di Sicilia

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ABSTRACT

This study is the result of an interdisciplinary cooperation – among specialists and academics – aimed at the knowledge and the conservation of the funerary roman monument named “Torre Rossa”, located in Fiumefreddo di Sicilia (CT).

Probably dated back to the 2nd century AD, the Torre Rossa arises inside a vigorous citrus trees garden, in a typically Mediterranean landscape. The monument is shaped like a high parallelepiped (about 8 mt); its core is in concrete made of lava stones and lime and its wall surface is made of brick elements (late Hellenistic period tiles). The monument’s interior is a partially hypogean room with a squared shape. It has rectangular niches on three perimeter walls and a barrel vault covers it.

The experts team headed by the architect Buda and the archaeologist Privitera of the Cultural Heritage Office of Catania together with researchers from University of Catania and freelancer consultants, have analyzed the monument, strongly degraded from an environmental and structural point of view, and they have planned the works to make it stronger and safer.

The cognitive approach has provided a wide range of investigations (historic and iconographic investigations; archaeological investigations; geometric-morphologic surveys realized with digital photogrammetry and 3d laser scanning; diagnostic; simulation) and, after they have been interrelated, they have been the grid used to plan the conservation project of the monument.

Keywords: Roman monument, 3D laser scanning, Structural analysis

1. INTRODUCTION

The conservation project for Torre Rossa, a sepulchral monument situated in and belonging to the town of Fiumefreddo, has been carried out by the Cultural Heritage Office of Catania. Although the construction is small, it appears highly complex, at the same time, for its deterioration as well as for its intrinsic archaeological value [1, 2]. Such characteristics gave the opportunity of working in a team by involving various professions, that is, archaeologists, architects, chemists and engineers, with the use of the most recent tools for survey and diagnosis.

The primary aim was to make the monument secure and to avoid further collapses, which have become quite frequent over the last few years. During the planning phase, the research team realised that an accurate survey and specific chemical and physical tests were essential in order to understand the geometry of the construction and the dynamics of its deterioration. Thus, the following actions

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were preliminarily planned: a campaign of survey with a 3D laser scanner (by profiting from the skills of the researchers of the University of Catania) and a series of diagnostic tests entrusted to the company LAPIS. The data obtained from the tests were interpreted by the research team in order to give an answer to the hypotheses previously formulated.

The aim was to verify: whether the detachments had also been affected by movements of the construction as a whole, that is, if it had undergone collapses, fractures or rotations; whether the hypogeum and the part above ground, including the stairway, had been built during the same phase; whether or not the summit wall complex contained the chamber which Jean Houel had assumed in the description of the monument appearing in his late eighteenth century publication. More than two centuries after the visit of the learned French traveller, who, besides describing the Torre Rossa, also drew it, the monument partly lost its mushroom-shaped outline due to the stripping of the brick wall surface of the lower part. In all likelihood, in the early twentieth century, the Roman sepulchre was used as a warehouse and a shelter for animals; the inside floor level was raised to the height of the ground level; solid retaining brickwork was added to prop up the east and south corners.

![Fig. 1-2 Torre Rossa. Gouache made by Jean Houel in 1782 (on the left); 1993 photo (on the right)](image)

2. **THE ROMAN TOMB KNOWN AS TORRE ROSSA: ARCHAEOLOGICAL OBSERVATIONS**

Not far from the town of Fiumefreddo di Sicilia, in a rural landscape still partly well preserved, rises an old ruin which over the last few centuries has been called Torre Rossa after the colour of the bricks covering it. The name passed on to the small rural centre which grew around it, now almost uninhabited.

It was the French traveller and painter Jean Houel who first described the ruins and correctly identified them as a multi-storey Roman tomb, even though he believed he would find it in the Greek city of Naxos [3]. Houel gives a beautiful and precise image of the monument by drawing also the section and the map of the place, in which he indicates the remains of other old constructions [Buda, s. below]. By looking at the print and at the watercolour it is possible to notice that the construction was in the same condition in which it would remain until 1993, when some of the brickwork of the southern side collapsed: the whole of the lower part had been chiselled and stripped of its brick covering, undoubtedly used by the local peasant for their houses.

The structure of the monument is, indeed, that of most Roman constructions of the Imperial Age: a brickwork nucleus of stones and mortar, covered with a brick surface. In this case, though, the covering is made up, only in small part, of bricks and, mostly, of chips of Greek-Hellenic imbrices, probably made in a local workshop and perhaps recycled from another construction. One of them is stamped with the Greek letters which have been found on other tiles in the territory, in contexts dating back to the 3rd-2nd century B.C.

The territory of Taormina was an area under the influence of Greek culture. In this territory, where during the 1st century B.C. as well as during the following centuries the language spoken was Greek, the Romans founded a colony in 36 B.C. The monument was certainly built after this date.
The type of tomb is, indeed, distinctly Roman. It is a quadrangular structure raised above the ground (max. height m. 7), with a funeral chamber inside. The presence of a three-step podium is due to the Greek influence. Basically, the monument falls within the type of chamber tombs or house tombs which were widespread in Lazio and Campania, above all, from the 1st century to the 3rd century A.D. In the urban necropolises they were usually built facing actual roads, in the very same way as the houses, whereas, in the territory outside the urban centre and in the countryside, they are often isolated, near the villae of the rich Romans. The funeral chamber can either be on ground level or partly underground. In the Torre Rossa it is of the latter type. The chamber has a barrel vaulted ceiling and there are two pairs of niches on three walls, which originally contained cinerary urns. The practice of incineration in the Roman world began to decrease and to be replaced by inhumation in sarcophagi around the mid-2nd century A.D., and this provides us with another certain date before which the tomb was built.

Fig. 3 Torre Rossa. Survey notes by Jean Houel (1782) (1782)

To go down into the sepulchral chamber there was a stairway, of which some traces still exist, along the south-western wall, near the western corner. This leads us to think that the entrance door was in this place, where before the restoration there was the largest missing part in the brickwork. The opening existing on the eastern side is, in fact, modern. Then, the stairway continued by going up inside the southern and eastern walls, until it opened onto the summit. In the past, this certainly favoured the idea that the construction was a tower. In fact, Roman sepulchres of this multi-storey type are rare, except in the East (tower tombs). In the existing sepulchres in Rome and in the surrounding territory the most important funerary chamber is generally on the upper floor and has a slightly different structure, sometimes with outside stairways. In Taormina there are eleven, more or less well-preserved, examples of house tombs with niches, but none of them has a second floor [4]. If there was a second chamber in Torre Rossa, it was not inside the brickwork, as Houel assumed, but would probably have been by the existing summit. If that were the case, however, it must have been demolished without leaving a trace, and this appears to be somewhat difficult. It could be hypothesised that there was only a terrace – which exists in some examples in Rome and was used for funerary ceremonies – but this is also to be verified.

Outside the Torre archaeological tests have been made in order to find the plan for its use as well as retracing the phases of its life. As a result, on the northern side, an area probably intended for the funerary rites was found, with numerous small ceramic jugs, either unbroken or in pieces, which must have been used to make libations for the dead. Moreover, on the western side, a layer with ceramic fragments probably coming from the inside of the funerary chamber when it was abandoned, was found. There are many pieces of lamps – which, of course, were used to light the inside when entering it – of Roman type dating back to the 1st and 2nd centuries A.D. They were probably placed in small, still existing recesses at the top, next to the niches for the urns.

The various data, thus, confirm that the Torre Rossa is a monument tomb of a not very common type in Sicily, that it is connected to the presence of the Romans and that it was built between the end of the 1st century and the mid-2nd century A.D.
The existence of a *villa* in whose land the tomb was situated is very likely. And the remains of a small thermal bath construction with mosaics which were discovered a few tens of metres south-east of the tomb, in the courtyard of an old country house, would demonstrate it.

3. GEOMETRICAL SURVEY BY MEANS OF 3D LASER SCANNER

3.1. Data acquisition and processing

The architectural characteristics of the *Torre Rossa* and its state of preservation have made necessary the use of the laser scanning survey technique [5,6], which is able to provide, in one digital model, detailed documentation (dimension, material, state of deterioration of the structure and of its materials) necessary for the project for making it secure and its restoration. A Leica Geosystem HDS 3000 TOF (Time of Flight) 3D laser scanner from the Laboratory of Architectural Photogrammetry and Survey 'Luigi Andreozzi' of the Department of Architecture of the University of Catania was used.

![Survey drawings](image)

**Fig. 4 Torre Rossa.** Survey drawings

The drafting of the survey project took into account the requests of both the Cultural Heritage Office and the professionals responsible for the project. The survey of the chamber entailed the creation of 4 station points. For the survey of the outside lower part a closed polygonation made up of 8 station points by the axes and the diagonals of the quadrangle at the base was planned; also, four additional station points were planned. The survey of the roof entailed 5 station points: 4 by the corners and 1 by the stairway landing in the covering. The scans were carried out at a height of 9 m by using a special basket lift firmly fixed to the ground.
During the phase of acquisition the definition of the resolution of the clouds of points took into account the level of required detail (1:20) so as to document the wall surface, the missing parts, the consistency of the cement nucleus and possible lesions in a comprehensive manner. The 21 scans were assembled in one frame of reference, for a total of 61 million points, through the identification of homologous points between contiguous scans. The average initial maximum error of alignment equal to about 1.3 cm was reduced to 4 mm by optimizing the parameters of calculation (subsampling percentage; maximum number of interactions).

3.2. From the cloud of points to the textured model

The 2D and 3D technical drawings (plans, elevations, sections), useful for the geometrical, spatial and material-stylistic knowledge of the construction as well as essential to the drafting of the restoration project, were obtained by the 3D model. Being able to use a digital copy of the monument on the computer contributed to a more dynamic approach to the project since it was possible to draw, at any time, new information to compare with the hypotheses as they were being formulated. This was true especially for the study of the static behaviour of the construction: for each side of the tower five section-profiles were drawn in order to understand the out of plumb walls, the alignments and all other information useful to the designers responsible for the structural consolidation. Also the choice of the heights at which the plans were to be made was agreed on by the work team according to the process of knowledge of Torre Rossa. Seven plans were made: at 0.70 m from the floor of the chamber (documentation of the underground chamber); at the heights at which two core drillings were made; at the impost of the vault of the chamber, at the height of the roof and at another two intermediate heights. The aim of the final part was the documentation of the monument through the creation of a 3D photographic model. For this purpose the following steps were taken: pre-processing of the clouds (noise filtering, calculation of width and angular discontinuities, calculation of the confidence interval and of the slopes); photographic mapping; creation of high definition meshes; clustering of the meshes in one textured model.

![Fig. 5-6 Torre Rossa. Flat visualization (on the left) and textured visualization (on the right) of the 3D model](image)

The next phase of texture mapping made possible the projection of the images on the mesh model as well as the radiometric correction of the images, filmed in various light conditions. The overall textured model was reduced by 25% and exported in wmr format so that it could be visualised and explored with 3D viewers (e.g. Cortona).

3.3. Some observations on the interpretation of the data of the survey

The severe state of deterioration of the ruin made particularly complex the comprehension of the typological characteristics of the construction. The reading of the survey graphs raised some questions on the drawings of the Torre Rossa passed down by Jean Houel. In particular, the iconographic documentation provided by Houel is an
expression of the time in which it was produced; in fact, in some of its parts, it depicts accurate conjectural reconstructions of the monument, which present some incongruity when compared with the data of the current survey: the existing height difference between the ground level and the floor of the chamber; the height of the semi-underground funerary chamber; the number and the arrangement of the steps of the stairway which leads to the roof. Such observations need further analysis through typological comparisons with Roman funerary monuments of the same period.

4. THE DIAGNOSTIC SURVEY

To investigate the masonry texture in form of constituent materials, construction method and decay processes, and also, to recognize the stratigraphic evolution of the monument some in situ test and laboratory analysis were performed by LAPIS (Laboratory for Petrographic Analysis and Instrumental Investigations).

Characterization analysis has been able to define the compositional homogeneity of mortars used in masonry and also the use of aggregates of local provenance, mainly composed by volcanic fragments and sands of metamorphic nature. Small amounts of crushed bricks *cocciopesto* have been recognized, without reaction rims of hydraulic activity.

![Image](image.png)

**Fig. 7-8** Thin section microphotography of mortar sample made of quick lime and coarse sand of volcanic origin, added with small amounts of quartz grains and metamorphic fragments of river provenance

Thin section modal analysis by point counting has been also helpful to define the mix proportion we have to adopting formulation of restoration mortars. Petrographic analysis of mortars and bricks also confirmed the compositional homogeneity of all samples so suggested that the monument, as conserved, was probably built up in a single stage without any appreciable time interruption.

![Image](image.png)

**Fig. 9-10** Stratigraphic representations

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Diffractometric and spectrophotometric analysis carried out on bricks and mortars sampled at different height of the masonry have underlined the presence of relatively high amount of Gypsum and Nitrate. An important feature that has been considered in deciding use of restoration material. Masonry texture investigation was carried out by means of cutting and cutting hole video-endoscopy. This kind of investigations have been used to verify the existence of a inner room inside the monument core and to define the thickness of wall and wall facing and also the capability of injection of masonry during consolidation works, if used.

The picture below show two section of monument taken at an elevation that corresponds to cutting position. The stratigraphic representations, made using cutting and video endoscopy data, show the presence of a 1-1.5 meters thick core wall made by decimetric unshaped blocks, followed by 50 cm thick caementum wall and an external facing of brick, 20 cm thick. The lack of any cavity in the core of monument has also been determined.

5. THE CONSERVATION PROJECT

Through the accurate geometrical survey and the endoscopic analysis some incongruities emerged in the iconographic documentation and in the description of the monument produced by Houel (s. 3.3 and 4 below). In particular, the endoscopic analysis verified the absence of an additional, not accessible funerary chamber inside the massive wall block. Moreover, the homogeneity of the composition of the lime mortar samples taken from both the inside and the outside of the brickworks dispelled possible doubts and confirmed that the tomb was built in one phase, even though it must be assumed that because of the presence of the stairway it should have had a higher elevation (s. 2 below).

Having verified that the overall structural solidity of the monument, also thanks to the high quality of the mortar and of the bricks, goes back to the time of its construction, and, not having observed structural movements, it was clear that the deterioration progressed only because of the phenomenon of imbibition and that of the wall surface consequently becoming heavier, caused by the vegetation growing on the construction taking root. The microclimate created by the surrounding irrigated citrus cultivation over the last century also favoured and accelerated the phenomenon.

The reduction in number of the orange trees around the monument as well as the accurate both handmade and chemical weeding with the elimination of what were actual shrubs growing on the summit, which was carried out without uprooting them, but killing off the roots, were necessary in order to observe, photograph and survey the monument. It was, however, the first problem to be taken care of per se. Such an operation should take place regularly in the maintenance of the archaeological remains especially if they are situated in the countryside, as it would also make more invasive and costly actions unnecessary.

Over the last decades the increasing weight of the parts of the wall surface not propped up and kept together only by the adhesion of the mortar to the nucleus has caused the Torre Rossa many losses and the impoverishment of its outline, especially in the western corner where the walls were thinner due to the presence of the stairway and probably also to that of the entrance. The wall surface, built according to the opus testaceum technique [7] which, except for the stripped parts, covers all of the construction and characterises it, was made with cut tiles with the thin part exposed in alternate rows. The use of the tiles will have contributed, without any doubt, to the solidity of the construction. Because of their form and negligible thickness the tiles, indeed, have made the wall surface more ‘tied’ to the inside brickwork: in this case the friction force which counters the ‘slipping off’ of the pieces toothed one into the other is far stronger compared to other techniques.

In spite of every good intention to carry out the ‘smallest’ effective action, the reconstruction of the south-western corner was made necessary in order to prevent the collapse of this side which had been temporarily propped up. Knowing that it was inevitable to forsake the romantic image passed down by Houel – which is, in fact, lost by now – an action of ‘repair’ was opted for, aiming to integrate the original brickworks, also with the retrieval of the structural scheme. It was, thus, decided to render something more similar to what the tomb should have been in the past, that is, a parallelepiped, unique for the presence of a stairway built inside the walls, whose small vaulted roof joined the outside wall to the central block lying on the vault. The partial reconstruction would not have had a reversible character since the new parts had to be necessarily toothed to the old brickworks and the repair work should be visible, but, at the same time, it should integrate itself with the existing elements.

After various hypotheses for the reconstruction of the missing parts, the technique most similar to the original opus latericium was chosen, but using bricks which, in order to retain the texture of the
curtain wall, would render the same exposed thickness. For this reason, we looked for a brick-kiln in the area using clay and a backing method which could make bricks similar as for tones and material to those used for the Torre Rossa. With the same technique and by using only the thinnest bricks we restored the small vaults covering the stairways in order to recreate the original structural behaviour of the various parts of the construction.

![Fig. 11-12 Torre Rossa. The small vault covering the stairway before and after the repairs](image)

6. THE STRUCTURAL CONSOLIDATION

The Roman building named Torre Rossa, dates back to the 2nd century AD. It is a parallelepiped shape structure with square floor plan of about 5.3 m side and 7 m height of the present building remains. The opus testaceum building rises from a three orders podium having steps with riser and tread of about 25 cm. The opus testaceum is a brick faced masonry (with medium thickness of face bricks of about 20 cm) built with pieces of rocks and brick rubble. The masonry is faced with alternate brick layers thick 5.5 and 3 cm having longitudinal length between 25 and 40 cm. The mortar and bricks masonry facade are largely missing from the base to a height of about 3 meters. In other parts of the building, there is conspicuous internal masonry missing. Beyond the brickwork, with a thickness of about 20 cm, rock, brick and mortar are also missing from the center of the wall.

![Fig. 13-14 Torre Rossa. The northern corner before and after the conservation work](image)

The hypogeal room is covered by a concrete barrel vault. The top covering vault, set back about 150 cm didn't have any more compensation to the lateral thrust because of the collapse of the corresponding perimeter walls and small vaults that covered the stairs.
Following instructions of the work directors (archeologist Francesco Privitera and architect Giovanna Buda), with eng. Mario Santagati, we proceeded integrating the brick facade masonry using new handmade bricks, with alternate layer thickness of 3 and 5.5 cm. Between new bricks facade and previous masonry we built progressive mortar layers with embedded pieces of rocks and brick rubble, as roman used to build.

The new brick facade masonry is connected to previous remains by stainless steel AISI 304  φ 8 cable placed in the facade mortar layer. The mortar is composed of natural hydraulic lime mixed with pozzuolana cement and additives to decrease mortar set contraction caused by maintaining previous high layer thickness (1.6 cm) between bricks. The 25 cm appearing length of new bricks facade, contradistinguishes, even if coplanar, the new masonry from the previous one.

CREDITS

Despite the joint nature of the research work carried out, the editorial responsibility for the paragraphs is attributed to: 1. Giovanna Buda; 2. Francesco Privitera; 3. Mariateresa Galizia & Cettina Santagati; 4. Antonio Lo Presti; 5. Giovanna Buda; 6. Gaetano Randazzo.

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