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The photogrammetric survey of Tomb II in Agios Athanasios, Thessaloniki

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Abstract - This study is a collaboration between the, Eforia Extraurban of Thessaloniki and the departments of Sciences of the Cultural Heritage of the University of Salerno. The paper describes the survey of Tomb II of Agios Athanasios, Thessaloniki, carried out with the technique of the uncalibrated terrestrial photogrammetry. The final purpose is the realization of a georeferenced digital model.

The results show that the acquisition techniques, although characterized by further margins of error, show the advantage of acquisition's speed and secure overlap between the frames, allowing to monitor the cultural heritage with an extreme ease of operation.

I THE TOMB II, STRUCTURAL AND TECHNICAL ANALYSIS

The Tomb II is located on the south east end of the modern municipality of Agios Athanasios, southern to the road leading to Salonicco, where the academics believe once rose the ancient settlement of Chalastra (STRAB. *Geografia,* VII. 8.20.). (Fig 1)

Fig.1 Satellite view of Agyos Athanasios, ancient Chalastra.

The tomb was discovered in the sixties but, due to the setup the reconstruction of the ancient dromos has been compromised [3][8].

The burial belongs to the chamber tomb with vault typology dominated by an imposing mound. It is built in alluvial matrix stone blocks and presents an external facade (4.40 x 3.70 m.) in ionic type, originally entirely plastered, and nowadays mostly well preserved. The tomb stands as a unicum among the burials of Agios Athanasios[7]. (Fig. 2)

Fig.2 Ionic facade of the tomb II.

In the upper part of the facade, a denticular frame is recognizable above the trabeation, apparently devoid of any decoration however, as the fronton, covered by plaster [3].

The facade presents four semi-columns coming up to the wall, crowned by capitals with volutes. The central columns are slightly inclined towards the center emphasizing the opening of the entrance door. The semi-columns are built as well in alluvial matrix stone single blocks, channeled and covered by a light plaster.

The entrance with two-leave door (1.35 x 2.75 m.) was probably made out of wood with application in bronze, of which only few wooden traces remain and fragmentary pieces of metal inserts. At the time of the discovery, the gate was obstructed by stone slabs [5].

The Tomb II presents parts which were originally plastered both externally and internally.

The internal structure (3 x 3 x 3.40 m) is made out of a masonry *pseudo isodoma* and preserves traces of plaster on two bands. The lower one is lightly colored and it was probably originally white. The upper band is thinner and red colored. It is possible that even the vault was once entirely plastered [3].

The paving is formed by stone slabs [3].

Based on the confront with Tomb III and on their similarities, it has been possible to date Tomb II to the last quarter of the IV century b.C.[3].

II DATA ACQUISITION

The equipment chosen for this specific work consisted in a Reflex camera Nikon D 5300, with Nikkor lens 18x105 mm, regulated on 18 mm.

Moreover, as a support a Manfrotto tripod was used, together with a Nikon remote control in order to minimize the vibrations.

The captured image have a quality of 24,2 megapixel and have been saved in file RAW and JPEG. The wi fi use allowed to connect the camera directly to a smart device to verify immediately the quality avoiding the camera's removal.

The Camera's GPS provided the pictures with the information about the exact location to be inserted in the GIS.

A distance of 1,5 m for the indoor and 2 m for the facade filming has been kept. For practical reasons, two different field survey were carried out: one for the facade and the other for the internal. 281 images for the facade and 308 for the internal room were produced, with over the 60% of overlapping.

III PROCESSING DATA

The data processing was carried out with the AgiSoft software (1.4.1 version), using a laptop Toshiba Satellite, processor Intel Core i7-3630QM Dual Core 2.40 GHz RAM 4.00 GB Graphics Card RADEON Graphics AMD.

The post-development of the data starts from a first selection of the photograms, excluding blurred images or ripetitive ones in order to ease the processing.

The following passages, which are alignment, Dense Cloud drawing up, Mesh and Texturing; will be done by the software itself. These phases are important to develop the 3D model [2].(Fig.3a,b,c,d)

Fig.3a Alignment Photo, first step.

Fig.3b Building the Dense Cloud, second step.

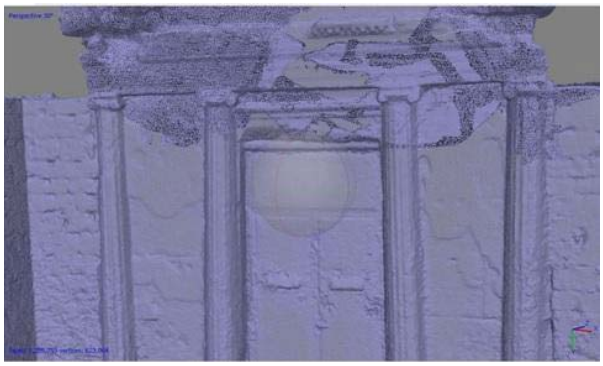

Fig.3c Building the Mesh, third step.

Fig.3d Model with Texture, the last step.

These were the fundamental passages to produce the 3D model [1][6].

Once finalised the model, it has been possible to put the Key Points more precisely, that is to say some Markers of the areas we already know the measures to give scales to the model. (Fig.4)

Fig.4 Model with Marker on the door.

The same process has been developed similarly to rebuild 3D model also the internal area of the structure.

The last step sees the alignment of the two chunk (models) with the recogniseable of the markers located on the door of the building and recognizable in both of the models [1].

In 226 photos, a total of 239.179 points were identified. (Fig.5)

Fig.5 Final Model.

From the whole model it has been possible to develop some sections which carry to the conduction of the analysis of the deterioration agents in the building, mainly linked to the presence of water [4].(Fig.6a,b,c,d)

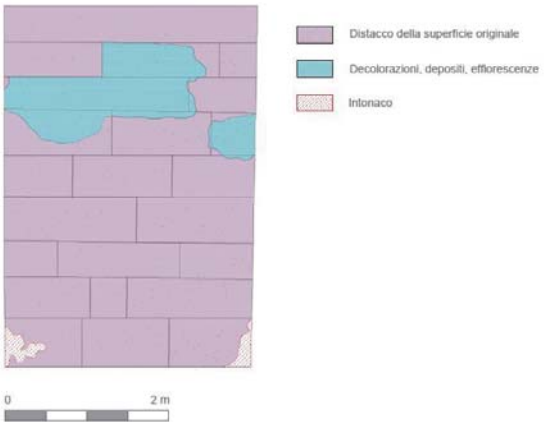

Fig.6a north side of the tomb II, deterioration agents analysis.

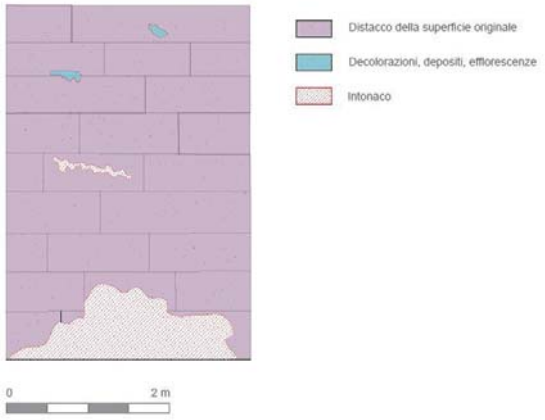

Fig.6b south side of the tomb II, deterioration agents analysis.

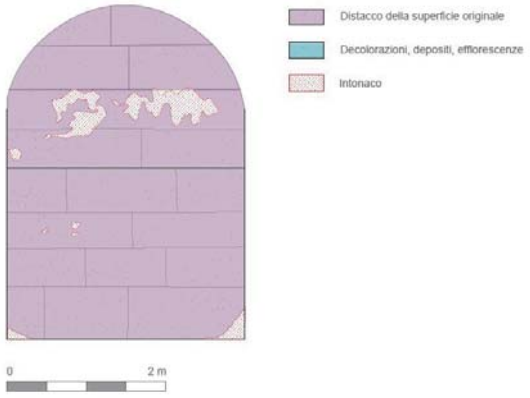

Fig6.Owest side of the tomb II deterioration agents analysis.

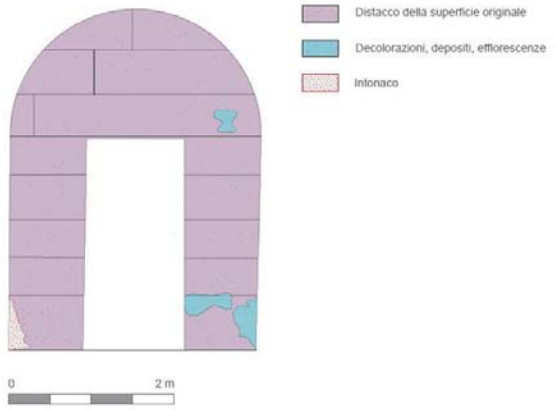

Fig. 6d East side of the tomb II deterioration agents analysis.

From the analysis carried out on the digital model, the capillary resurgence of the waters results as the major cause of degradation, which lead to the separation of the surface through the formation of saline crystals which pressured between the wall and the plaster layer causing the progressive fall for the upper part of the wall, while it provoked the formation of efflorescences in the lower parts of the wall. (Fig.7a,b)

Fig.7a The capillary resurgence, efflorescences.

Fig.7b The capillary resurgence, efflorescences.

IV DISCUSSION

The tombs of Agios Athanasios are one of the major proofs of the relevant painting occurred between the 4th and the 3rd century b.C in Macedonian territory, yet not enhanced properly.

The use of terrestrial photogrammetry combined with the live relief it has proved to be a valid choice for the study of this monument, carrying us a lot of advantages.

Among these advantages, first of all, there is the digital restitution reflecting reality. Therefore, the product is full of geometric and material information, its digital features will remain unaltered and from it is possible to carry out numerous analysis. The survey serves as a support to the traditional documentation.

V CONCLUSIONS

The realization of a 3D model for the Tomb II is useful to demonstrate the artifact's potential, facilitation its divulgation.

The model helped to define the deterioration level of the structure and it has been possible thanks to the high quality of the 3D which makes us achieve such results.

The use of the digital model as a valuable support to the archaelogical research has loads of advantages as it provides us technical and constructive information. Moreover, it is possible to detect with subtle accuracy some details that can be overlooked by a naked eye. Furthermore, on the digital model is possible to rebuild missing parts through appropriate softwares, and those can be considered as hypothetical restored elements.

Thus, with this model an alternative method is proposed to study and access the structure with more facility.

The digital restitution should be considered as a key for a better diffusion, provided that it is a temporary solution until a valorisation plan is developed, in order to render the site accessible to the visitors.

The final aim is to guarantee new instruments useful to study the monuments, to estimate the degradation and valorize contexts in critical areas. It is, in summary, a developed documentation technique to be taken into consideration especially for the rapid application carried out on excavations or, on wider scale, on the archaeological heritage.

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