Integrating traditional methods with new technologies

Architectural study of the large theatre at Gortyn

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Abstract— Various archeological evidence suggest the significance of the ancient city of Gortyn, capital of the Roman province of Crete since 67 AD till the end of the supremacy of the Roman Empire, around the VII century. Still a number of monumental buildings, of which archaeological remains are less majestic, have to be well studied and understood. Among others, it is the large Roman theatre built on the South-East slope of the acropolis. The area is currently inspected through archaeological excavations, under the Ephorate of Prehistoric and Classical Antiquities of the Municipality of Herakleion. The visible remains of the theatre are still quite few but information about it is available thanks to many different sources: plans, descriptions and geophysical surveys. A careful analysis of these documents allow us to make various hypotheses about the original structure of the theatre that will be shown through the 3D reconstruction of the monument. With the help of the visualization tool it will be possible to identify which hypothesis represents better the original aspect of the theatre . The aim of this paper is to manifest the way that meaningful results can be drawn through the combination of traditional instruments with new technologies and methods, and to underline the power of visualization for the comprehension of archaeological context.

Key words: new technologies - 3D model - visualization

I. INTRODUCTION

Gortyn is a municipality located in the Messara plain, in the south part of the Greek island of Crete.

The first settlement in the territory, that later on had been occupied by the city of Gortyn, has to be probably dated to the Neolithic age. This area had a very long history and a flourishing life that went on till 673 (year of the arrival of the Ottomans), as its various monuments prove. Large part of these monuments belong to the Roman time, when the town played a leading role in the island of Crete, after it was designated as capital of the Roman province in 67 AD. The Italian School of Archaeology in Athens has the merit to have been the first one which has carried out archaeological excavations in Gortyn following a scientific approach, since the end of the XIX century. Until that moment, just some ruins were visible to the numerous European travellers who, during their journey to the East, wrote descriptions of what they could easily observe in the surrounding landscape.

Nowadays, several monuments crowd into the archaeological site of Gortyn, but some of them are still below the surface. Among others, it is the large Roman theatre on the South-East slope of the ancient acropolis that is currently under excavations by the Ephorate of Prehistoric and Classical Antiquity of the Municipality of Herakleion. At present, some rows of seats of the cavea have been revealed, together with few architectonic elements such as columns and capitals. According to old texts, drawings and more recent researches, there are good possibilities that the archaeological excavations will give interesting results in the near future.

Indeed, the theatre has been well documented in the past. It has been mentioned for the first time, at the end of the XVI century, in a letter, written by Onorio Belli, a physician from Vicenza, who explored Crete for a long time [1]. Besides a brief description of the *scaenae frons*, Belli added a plan of the theatre (Fig. 1). This drawing gives a very good depiction of the original status of the monument. At the end of 1500, Belli had the chance to see more remains than everyone else after him but it is possible that he completed the plan as he considered more worthwhile, adding elements which were actually not visible. Considering that Belli raised in the entourage of Palladio, it is likely that the rules of classical architecture, given by Vitruvius, influenced him in the production of his plan.

Three hundred years later, a British traveller, Captain Spratt, affirmed in his travel journal that he could recognize the shape of the theatre and he managed to take the measurement of its diameter, but very few remains were still visible [2].

The architect Edward Falkener, studied the plan of Belli and he re-elaborated the drawing, making some modifications in its dimensions, in the number of rows of seats, and the number of columns, and adding some elements as stepladders in the cavea and entrances to the cavea (Fig. 2) [3]. He modified the plan probably on the basis of his own experience, without going to inspect the site.

At the beginning of the XX century, an archaeologist, Antonio Taramelli, examined the area of the theatre and he made a section of it and a plan, trying to combine his data, gained by his measurements, with the information and the measures given by Belli and Falkener (Fig. 3)[4].

The archaeologist Ian Sanders visited the area of the theatre in the second half of the last century. He gave a quite detailed description of the visible remains at that time and he completed some measures such as the perimeter of the cavea, its internal and external diameters, the thickness of the *analemmata*, the width of the upper portico and that one of the *praecinctio*, the length of the stage building and that one of the *scaenae frons* [5].

Another archaeologist, in more recent years, Paolo Barresi, examined the theatre and gave a new interpretation that sees the cavea formed by three orders of seats instead of two as indicated by the other scholars, and he supposes the existence of a high podium around the orchestra that does not appear in the older plans [6].

One of the last research on the theatre was carried out by GeoSat ReSeArchLab of IMS-FORTH through the use of new technologies such as geophysical prospection. The results obtained by the lab are very interesting, even if in a fragmentary state, many archaeological features have been identified: *cunei*, *porticus* and *praecinctio*, *scalae*, north side of the *analemmata*, possible internal delimitation of the cavea, pillars, and structures belonging to the scene building (Fig. 4) [7].

The documents above refer to different categories of sources:

- old plans and old descriptions made by non archaeologists;
- reports of archaeological surveys;
- results of new methods applied to archaeology.

Each one of them has pros and cons regarding the interpretation of archaeological data. In the first case we are dealing with drawings which are not so accurate and, even if the scholars were very keen about ancient remains, they probably did not have the "eye" of the archaeologist, able to get fundamental elements of the structure that allows to understand history and meaning of the monument. In the second case, archaeological surveys started at the very beginning of the last century, when large part of the structure was already destroyed, or not visible on the surface. The geophysical prospection has been useful to visualize what is still below the surface today, but without seeing the structures, sometimes it is possible only supposing its real function or history.

The only way to make a reconstruction, as close as possible to the reality, is the combined use of sources and the integrated use of traditional methods and new technologies.

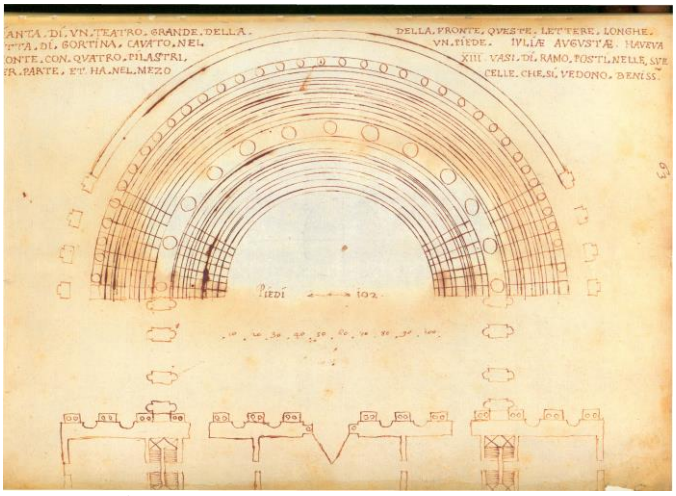

Fig. 1. Plan of the Large Theatre at Gortin by Onorio Belli. From Beschi L., *Onorio Belli a Creta*, 1999.

Plans and descriptions of the scholars together with the results of the geophysical prospection are the instruments to make various interpretations. 3D models represent the different hypotheses and are used to verify their accuracy.

II. METHOD AND GOALS

The first step of the project was to import the three plans in a 2D CAD software (Autodesk AutoCad 2014), scale them and take the correct measures of each one of them. The result is that the dimensions of the theatre and of its architectural elements, often, do not correspond with the different plans and descriptions, as it was predictable (TABLE I).

Being no conformity among the measures given, a careful analysis of each document is essential to find out the possible correct ones. The analysis has to be based on the historical and cultural context of the scholars who produced the documents and on the comparisons with other Roman theatres. Geophysical prospection are useful to locate the correct position of some of the structure of the theatre, to verify the real area occupied by the monument, and to ascertain the actual presence of some architectural elements previously described by the scholars. Furthermore, the rules given by Vitruvius are taken into account, above all to reconstruct the elevated structures that formed the theatre.

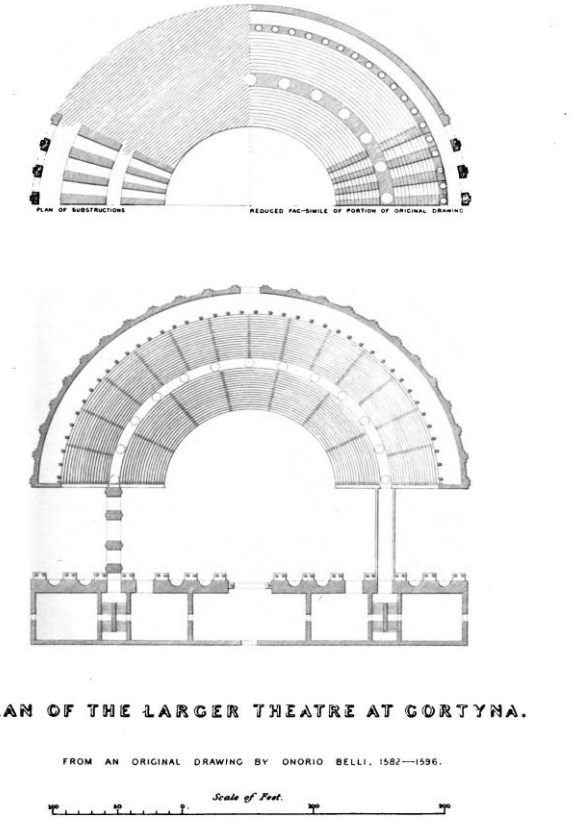

Fig. 2. Plan of the Large Theatre at Gortin by Edward Falkener. From Falkener E., *A description of some important theatresin Crete, from a ms. History of Candia by Onorio Belli in 1586*, 1854.

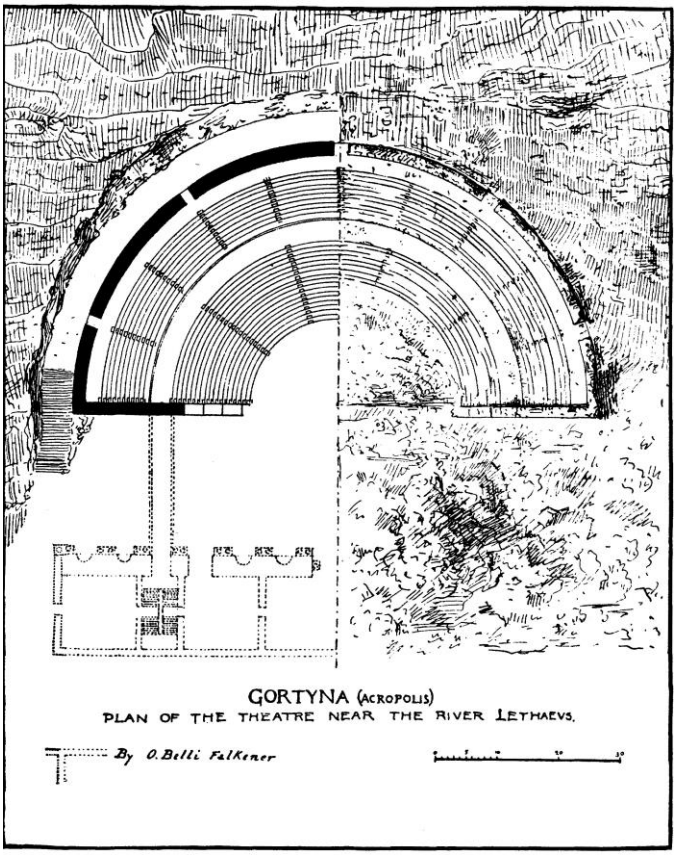

Fig. 3. Plan of the Large Theatre at Gortin by Antonio Taramelli. From Taramelli A., *Cretan Expedition,* in *American Journal of Archaeology 6, 2*, 1902.

It is hard to ascertain, for each plan, which parts of the structure of the theatre are represented correctly and which parts instead are the results of conjectures or may be the result of wrong measurements. Our goal is to take advantage of various visualization techniques in order to solve these issues. Visualization is generally used to show results of researches to the general public or to verify the hypothesis represented by 3D models, to evaluate if they are reliable or not. But, it would be more advantageous if visualization could be used as a tool also during the process of interpretation, not just at the end. Visualization can provide us with a better understanding of the monument, but it can also facilitate the development of that reasoning and of those ideas which produce the final result.

Three 3D models have been already created to reproduce the plan of Belli, the plan of Falkener and that one of Taramelli, elaborated following the information that is possible to get from them and from the respective descriptions. We already get some interesting results from the reconstructed models: 1. first the caveas have been modelled, respecting the number and the width of rows of seats represented in the plans, attributing to them the standard height of 40 cm., plus the porticos up the caveas. Then, the *scaenae frons* have been reconstructed, applying the Virtuvian rules to the information given by the plans and it has been possible supposing the number of storeys, taking into

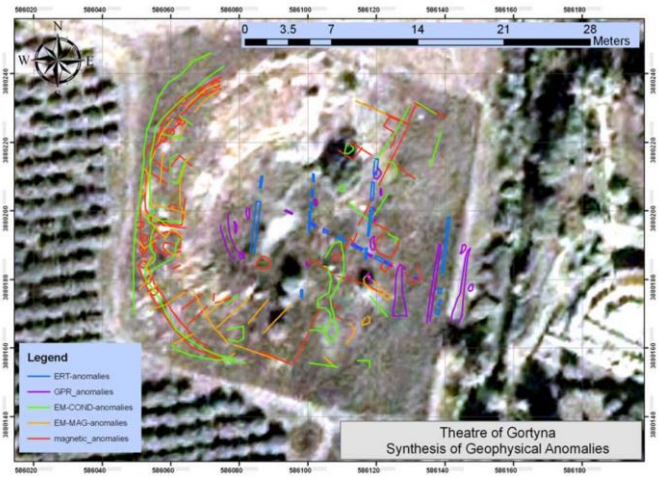

Fig. 4. Synthesis of geophysical anomalies at the Large Theatre at Gortin. From Sarris A. – Papadopoulos N., *Τεχνικη εκθεση της γεωφυσικης ερευνας & χαρτογραφησης του χωρου του αρχαιου θεατρου της Γορτυνας*, 2009.

account that the height of the cavea should be the same as that one of the *scaenae frons.* So we have two storeys in the models obtained from the plans of Belli and Falkener and one storey from the plan of Taramelli. These hypothesis also show the falseness of the affirmation of Belli who said the storeys were five. 2. The plans do not give any information about the stage. We can suppose the length of the stage considering that the side doors gave access to the stage and that it had to be placed within the area delimited by the *parodoi*. From the assumed length we calculated the width trough the Vitruvian rule. The result we obtained, for each model, is that the stage arrive exactly till the way that is supposed to be where the spectators passed to get their seats.

Combining architectural elements belonging to the different 3D models (as for example the cavea made by Belli and the *scaenae frons* made by Falkener), more hypothesis are going to be represented. Overlapping each one of these hypothesis on a picture of the satellite Quickbird (took from Google Earth), representing the area of the theatre, where the results of the geophysical surveys have been already marked by GeoSat ReSeArchLab of IMS-FORTH, it is going to be possible visualize which one of the reconstructions fits better in the area, according to the remains of the monument and to the geophysical results. Contour lines [8] of different colours drawn around the 3D elements are useful to make possible a recognition of which plan they belong, without interfering too much with the realistic texture.

Finally a new 3D model, representing the optimal combination of the architectural elements will be elaborated. Also in the final model, contour lines of different colours will draw the outline of the architectural elements belonging to different groups (for example: columns of the portico, columns of the *scaenae frons*, seats, corridors etc.) in order to indicate which source is the basis of each reconstruction. Furthermore, a diverse level of transparency of the contour lines [9] will specify the authenticity of the reconstructed elements.

The final result of this project will be an example of virtual archaeology that follows many of the principles of the Seville's

TABLE I. Known dimensions of the large theatre at Gortyn.

	Belli	**Falkener**	**Spratt**	**Taramelli**	**Sanders**	**Barresi**
Diameter cavea	85 m.	98 m.	63 m.	81 m.	88 m.	94 m.
Diameter orchestra	34 m.	39 m.		28 m.	40 m.	
Width *praecinctio*	3 m.	2.30 m.		3.60 m.	3.60 m.	
Width portico	3 m.	5.20 m.		2 m.	2 m.	
Thickness *analemmata*		1.10 m.		2.20 m.	2.2 m.	
Number of entrances		1		5	5	
Width central entrance		4.30 m.		1.85 m.		
Width side entrances				1.50 m.		
Rows *ima* cavea	12	18		18	18	
Rows *summa* cavea	12	19		11	11	
***Cunei ima* cavea**		7		5		
***Cunei summa* cavea**		14		10		
Length scene building	88 m.	100 m.			120 m.	
Length *scaenae frons*	52 m.	59 m.			70 m.	
Number columns portico	36	42				
Diameter columns portico	0,55 m.	0,85 m.				

Charter, such as “purpose”, “complementarity”, “authenticity”, “historical rigour” and “scientific transparency”.

III. CONCLUSION

The aim of this paper is to highlight the added value offered through a balanced convergence of traditional with new methods (geophysics, 3D modelling and visualization tools) in archaeological interpretation. The task of these new tools is to help old instruments to get data and results that before were very hard or impossible to obtain. Nevertheless the new technologies should not replace the physical contact with the archaeological structures. Centuries of studies have allowed the development of a discipline such as the archaeology and during these centuries something that always has been part of archaeology is the excavation. Examination of objects, buildings, structures and stratigraphy is the first step that enables archaeologists to understand the meaning of the studied monuments. Now, through 3D modelling and virtual visualization, observation has become also the key of the procedure, with the possibility to elaborate, verify and modify the interpretations.

To obtain a valuable result that will improve archaeological knowledge it is important to follow the principles of Seville’s Charter which gives a guidance on how to work in the world of the virtual archaeology.

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