DETAIL SURVEYS WITH CLOSE-RANGE PHOTOGRAMMETRY IN ARCHAEOLOGICAL SITES

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ABSTRACT

The necessity of surveying the monuments in the archaeological sites is obvious. As a matter of fact scientists with a variety of specialization are involved in that field and all of them are trying to develop better methods for surveying. According to the above mentioned the classic method of surveying applied by architects is modernized and automated with less people and time needed for similar or sometimes better results. New techniques are developed that give various methods for the survey and editing of the final plans. Evenmore when we need detail surveys in large scale we need better accuracy in measuring thus we apply special surveying methods.

After a brief review on the setting out of this problem an example is given for the survey in large scale of the "Tholos" in Delphi, Greece. The survey has been worked out during the summers in 1995 and 1996. The project was under the University of Kumamoto, with the collaboration of Asia Air Survey and the support of University of Thessaloniki. All methods used are analyzed and the results are compared between.

1. THE NECESSITY OF SURVEYING

During the last decades we have seen many monuments, all over the world, that have been destroyed from several reasons. Therefore, and also because of the great interest of all people nowadays for the cultural heritage, we need detailed plans and registration for every monument if possible. As a result of the above many scientists are involved in surveying monuments. Their specialization varies widely and a common language is needed but more over is needed their close collaboration. So the archaeologist, the architect, the conservatist, the engineer, the phogrammetrist, the surveyor, and others are requested to work together as a team. And generally, I believe that, we are leaded in a new century of team work, because of the huge and very fast development of technology.

Registration for a monument is needed each time we want to deal with it. For example whenever we have to study or to repair or to reconstruct or to conserve a monument its plan is necessary. There is no possibility to do anything on a monument or archaeological site without drawing its present accurate situation on a plan. Also in some cases we have to survey the monuments just for registration purposes only, because there are monuments which are invaluable and we own to register them at least in detailed archives. This becomes more obvious for all classical ancient monuments all over the world.

2. MODERN TECHNIQUES IN SURVEYING

A common method in use for surveying monuments is the one applied mostly by architects with topometric measurements. When this method is combined with surveying measurements using total stations, it leads to very good results concerning the details and the accuracy. But new techniques have been developed for surveying monuments during the last years. There are at least four reasons which cause this fact:

a. The development of instrumentation in surveying
b. the development of computers which automated most of the work
c. the development of photogrammetric instrumentation from analog plotters to the digital plotters
d. the remarkable acceptance of archaeologists for the new technology

In a way these reasons lead to the close collaboration of several specializations for a better result in surveying monuments. Because it is impossible for a single person to learn and manipulate all the necessary volume of instrumentation and knowledge in order to obtain the needed result.

The new techniques depended upon the size of the monument, the scale of surveying and the required accuracy. Most of the new techniques are based on photogrammetry, even though surveyors have yet the responsibility for target control points establishment. Photogrammetric surveys depended on the accuracy of control points which observed with classic surveying methods using total stations or with GPS. The density of control points depends upon the scale. The accuracy of the control points depends on the method of their determination and the accuracy of measuring instruments. Another applied classification deals with the type of the used camera which could be metric, semi-metric or non metric and also CCD digital camera. The number of required control points depends also on the type of the camera and the method of solution for extracting the final results.

Apart from all of the above we use many types of platforms to take the proper shots, such as kites,

balloons, grains, model helicopters etc. in order to carry the camera at the appropriate distance from the object we want to survey (Y. Miyatsuka, 1996). After that we have the choice to manipulate the images in many different ways with several programs in order to obtain the final results. The conclusion is that more easily with less hours and less people we can have valuable results which have much accurate information.

3. DETAIL SURVEYS

Whenever a detailed plan is needed in great scales we have to apply different methods in surveying. If we choose the photogrammetric one, we need better accuracy in control points. Another factor we have to face is that we need very high resolution in shots, therefor we use large format cameras. Usually we use control points for the survey which are permanent marked on its surface in a way that they can easily be used for further densificasion of the details in future surveys. In this way we succeed to have higher accuracy and connectivity of the measurements between different measuring epochs.

In Delphi many methods were applied for the survey of three buildings. The major goal of the effort was to have plans very accurate and very detailed. This goal has been set up by the researchers of Kumamoto University and as we can see from the results that follow they have succeed their goal.

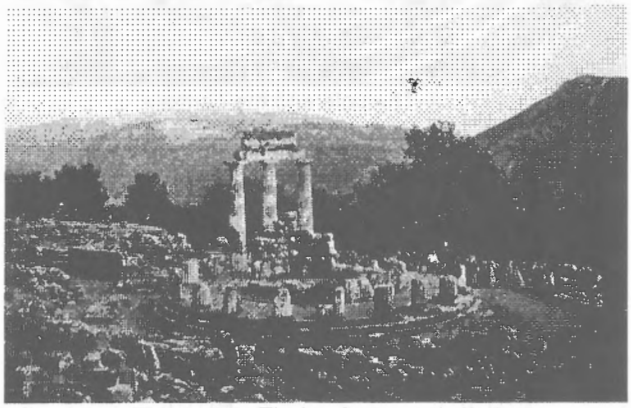

Fig. 1 The Tholos from northwest

4. THE THOLOS IN DELPHI

The Tholos is the most widely-known building at Delphi. This magnificent piece of architecture was built in late forth century BC It has twenty peristylar columns supporting the roof and entablature decorated with sculptured reliefs along with a circular nave wall and ten proto-corinthian half-columns. Some of the carved decoration remains in the marble at the base of the temple. Other pieces and blocks are arranged around the building as if to suggest that further restoration will be happening in the future. The exact purpose of the building is not known, but its shape and decoration suggest one of importance.

A part of the building was reconstructed in 1938, this part has three of the twenty peristylar columns and a part of the cella wall at the southeast side. The column drums are destroyed and only the bottom drums are placed on the stylobate. The orthostate of the western half of the cella wall is preserved in situ. On the eastern part it was reconstructed up to a height of 3 m by the French School. Inside of the cella the western part of the floor is preserved and it seems to have been concentric and stepped (Juko Ito, 1997).

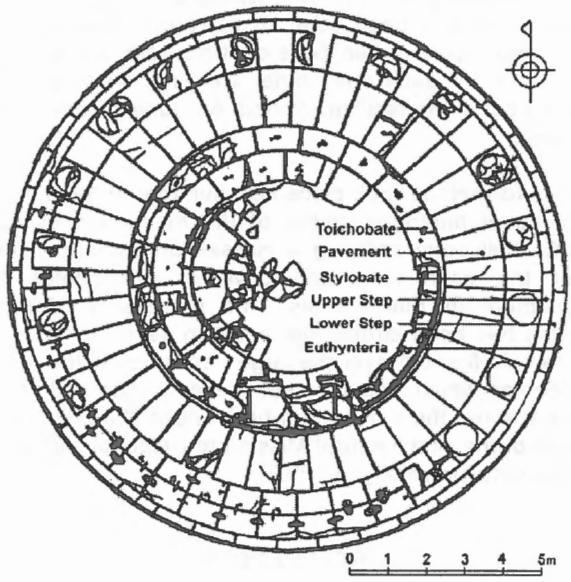

Fig. 2 Floor plan of Tholos

5. SURVEY OF THOLOS

In the summer of 1995 was surveyed the present situation of Tholos and a floor plan of the building was made (fig. 2). There was an existing such plan drawn by Goulob of the French School which was published in 1925. The purpose of the new survey was to determine exactly the dimensions of each element of the monument, especially the diameters, because they are basic elements of this round building. For this measurement the photogrammetric method was applied. This method has been chosen because it was fast enough and it could provide us with the necessary information and details for the dimensions of the building. Three different photogrammetric methods have been used for having the final plans, which have been checked out and completed with topometric measurements by the architects.

In the first method we used a metal pole consisted of four aluminum pipes joined one-another, 2m-long each one, fitted on a steel plate based on the ground. On the top of the pole there is a hanger which holds the camera via a measuring tape so the height of the camera can be measured easily. The pole could moved by ropes in all directions (fig. 4), and shifted over certain points for the shots to be taken. All the system was maneuvered by several people and the camera was at a height of 6 m. In this way the scale of the negative can be managed. The camera was a Hasselblad (6x6 cm format) with special lens and they have been taken about one hundred photos for the survey. In figure 6 we can see one of the results of this effort.

By the second method we want to survey two frieze blocks from the entablature. The purpose was to draw all the details of those rounded heavy stones. A metal frame was placed around the two stones on which 6 control points were attached in such a way so they were visible from both sides of the frame (fig. 6). It has been used a heavy aerial metric camera (18x18 cm format) in order to obtain accuracy of 1-2 mm. Because of its large weight a small grain has been used to carry the camera. They have been taken stereo pairs of shots from both sides of the frame for each one stone. The final drawings were carried out in the facilities of Asia Air Survey Company in Japan.

The third method took place next summer of 1996 and it was aerial photogrammetry of the monument using a model helicopter carrying a Hasselblad camera. It flew over the entire site and covered with photos the monument in many shots. The processing of those photos has been carried out again in Japan by Asia Air Survey. In figure 1 over the large tree is visible the model helicopter which you can see better in figure 3. More details about the survey can be found in the preliminary report of the Architectural Mission to Delphi published by Kumamoto University in 1997.

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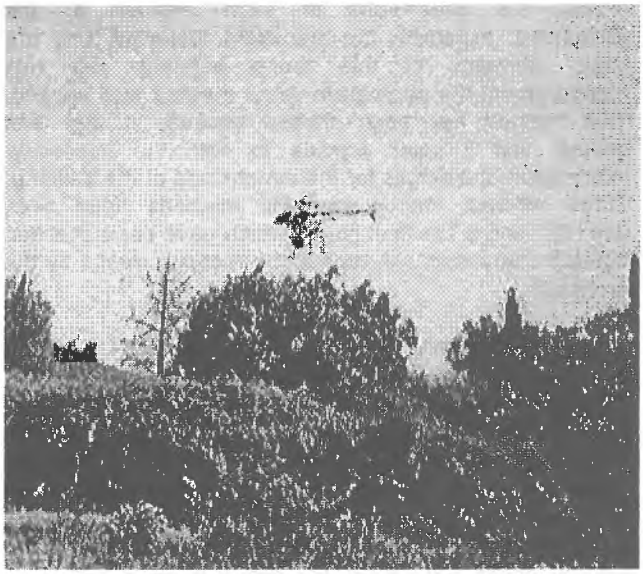

Fig. 3 The model helicopter with the camera

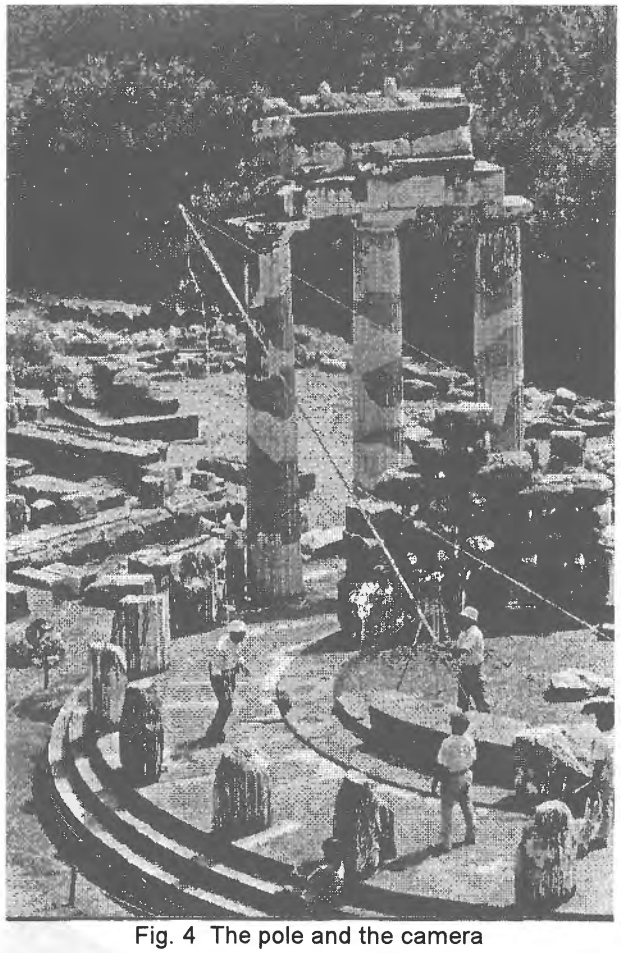

Fig. 4 The pole and the camera

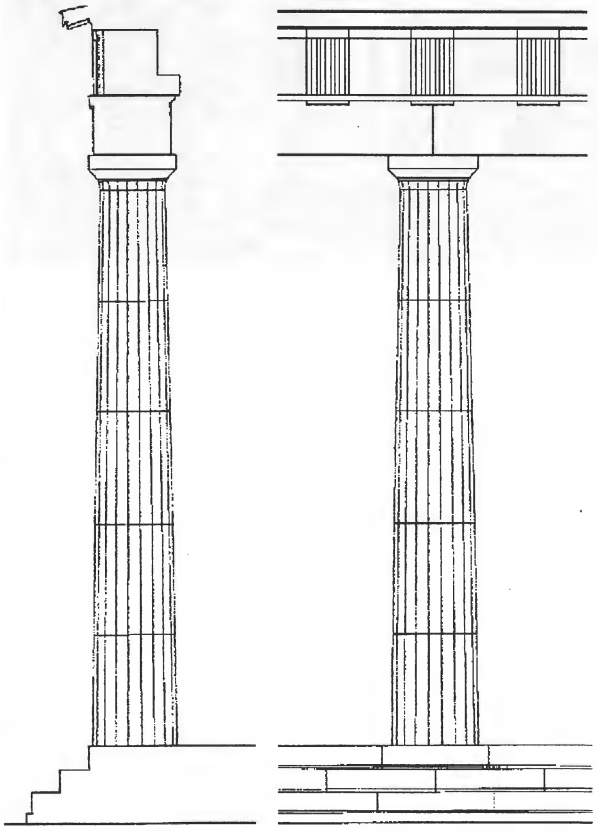

Fig. 5 Restored section and elevation (1:50), 1995

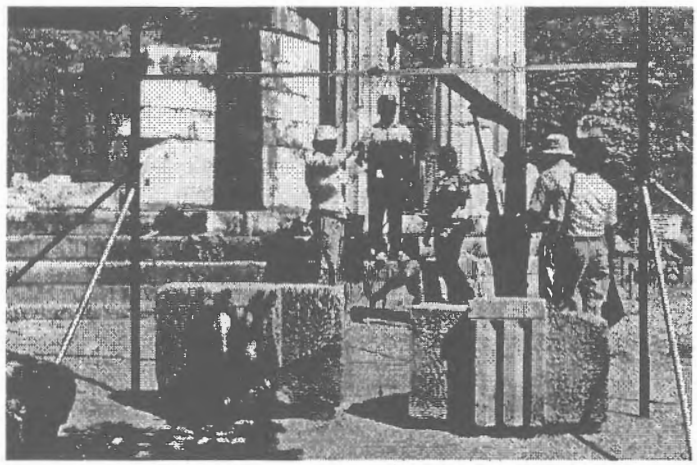

Fig. 6 The survey of the two stones

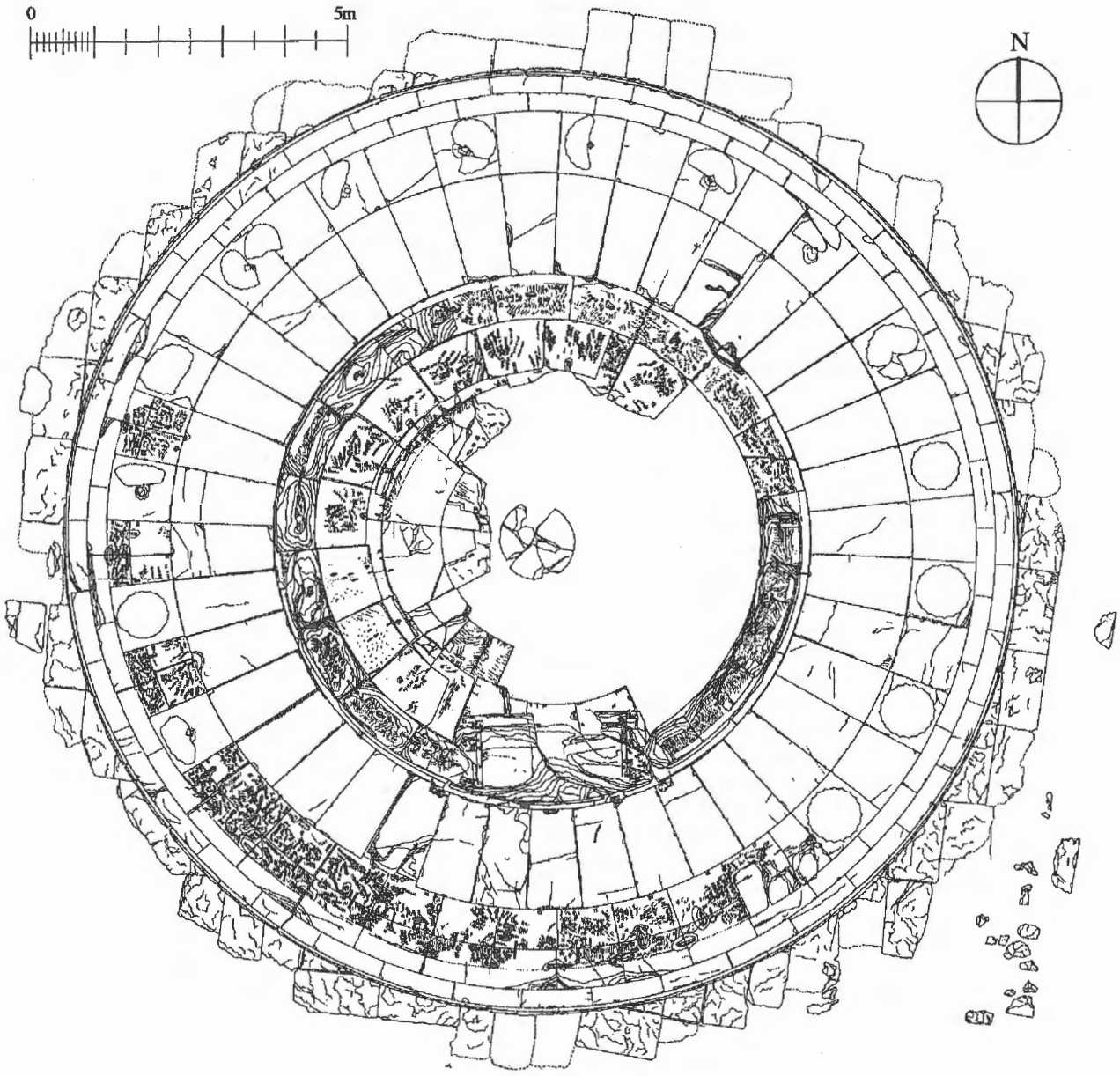

Fig. 7 Plan of Tholos, 1995