

PHOTOGRAMMETRY AND PHOTOINTERPRETATION ON THE
STUDY AND PRESERVATION OF THE CULTURAL INHERITANCE

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G R E E C E

ABSTRACT

Photointerpretation and photogrammetric studies of monuments and historical centers of Greece are presented in this paper. The presentation mainly concerns the methods (analogical, analytical-photographic) that are being used. Analysis and comments are being done. The particularities, the use and generally the possibility of the contribution of the methods to form photogrammetric archives of monuments and historical centers, are being emphasized. Several cases are mentioned (historical centers, general face, external face, internal areas, plane and curved surfaces, statues etc.). The examples mainly concern the historical centers at Mystra, Delphi, Olympia and the islands of the Aegean Sea.

INTRODUCTION

The importance - necessity of studying monuments and historical centers of every country has multiply evaluated.

For this reason, beyond others, photogrammetric and photointerpretation methods are particularly significant.

Several scientific centers, commissions of international congresses, universal organizations etc. face systematically the relative subjects-problems.

Airphotographs and terrestrial takings as well various photographic and photointerpretation methods are used, suitably combined. It is realistic and useful to have seriously in mind the local factors and particularities relevant to the in general existing substructure and the amount of work.

During the last years we made a relevant effort on this purpose, concerning photogrammetric and photointerpretation study of monuments and historic centers in Greece.

A classified presentation of the above activities with concise relevant remarks may be considered useful.

Our activity, till now, mainly concerns the following directions.

PHOTOINTERPRETATIVE AND PHOTOGRAMMETRIC STUDIES OF MONUMENTS AND HISTORIC CENTERS.

1. Recognition Based On Photointerpretation.

The study of monuments and historic centers is a subject with problems often different from those of the usual photogrammetric works.

While the multiple information about the object is considered given

to the architect-archaeologist, for the photogrammetrist this must be obtained.

Even if any photogrammetric methodology is going to be used, a basic knowledge of the monument and historic center is essential for the photogrammetrist, not only for the quicker and qualitatively better restitution, but also for avoiding various errors, which many times are serious.

The variety of the physiognomy of the monuments and historic centers, especially in Greece, makes the above demand stronger and more necessary. At this phase, photointerpretation is very important. Serious bibliographic informing and next thorough stereoscopic study, make the object progressively familiar, secure the ability of analysis at its architectural parts and offer secure for every kind of photogrammetric work to follow.

The above aspects are satisfied at the studies that are mentioned below.

1.1. Photointerpretation based on airphotographs of scale 1:15000 and 1:20000 of the historical centers of Akropolis in Mycenae, Minoic city of Gournia, Gortyna and the Castle of Monembasia. (17).

The photointerpretation study offers an amount of information, which vary, according to the case, for the wide area of the historic center, urban or not (relief, uses of land etc.), for the kind of monuments (extension, volume, grade of ruining etc.), for the general city planning at the case in which the historical center is a whole town, for subjects of placing (old-new), for subjects of attendance and help at the various stages of doing excavation etc.

1.2. Photointerpretation study of archaeological areas which include Basilics presenting special interest for the Christian Archaeology (Basilics of Philipi, Anhiolos, Kos). (5)

Possibilities and restrictions at the study of airphotographs of various scales (1:20000,1:15000,1:8000,1:4000) are being examined at the study of characteristic parts of the surrounding but also of the monument itself.

1.3. Photointerpretation study of Delos island and especially of its historic center. (11)

General photointerpretation of the whole island is given with the help of airphotographs in scale 1:40000 taken in 1973. Characteristic monuments of the historic center and the places from which the terrestrial takings were done, are located. Photointerpretation of the area of the historical center is also done based on old airphotographs in scale 1:6000 taken in 1936. The importance of the photogrammetric exploitation of old airphotographs is multiply interesting. The terrestrial takings, beyond the qualitative and metric possibility of their exploitation, can offer the necessary information for the metric exploitation of the old air photograph.

1.4. Photointerpretation study of Thyra island and especially of An-

cient Thyra. (13)

General photointerpretation for the whole island based on airphotographs of scale 1:40000 and more detailed photointerpretation for the area of Ancient Thyra based on pair of airphotographs in scale 1:10000.

Strong internal factors in combination with external ones have given particular characteristics to the morphology of the island. We realize the particularity of the forms of the steep coasts, of drainage net, of steps, of inhabited areas and of placing the ancient areas at the surrounding.

2. Total Consideration Of Wide Areas.

The great number of monuments and historical centers in Greece causes in many cases general interest for wide areas because many monuments are gathered in these.

Having in mind that the monument must not be considered isolated from the wide surrounding, it is useful to do in the beginning photointerpretation for the whole area in these cases.

The use of such a consideration is multiple and it also concerns general developing interests.

This aspect was searched through at the case of Athos Peninsula.(7)

Airphotographs in scale 1:60000 are being used and a controlled photomosaic is formed based on the method of radial aerotriangulation.

The crests of the mountains, the drainage net, the roads, the monasteries, the places of different smoothness of coasts etc. are being marked.

Possibilities of stereoscopic observation with mirror stereoscope Wild ST4 without magnifying dioptres and with magnification X3 are being examined.

We emphasize the importance of this general photointerpretation of Athos Peninsula, which presents unice historical and cultural interest, as basic preliminar stage for further photogrammetric works.

More detailed study of the area of a monastery from airphotographs in scale 1:20000 is indicatively presented.

3. Photogrammetric And Photointerpretation Studies On Attendance During The Time Of The Wide Area Of Historic Centers.

This direction is very interesting for monuments of exceptional glitter.

At this case the evolutions of every kind (natural, by man) in the surrounding must be systematically attended. This can be satisfactorily served, except from others, by photogrammetric and photointerpretation methods.

The case of the possibilities of orthophotograph as basic photographic metric document has been examined in combination with photointerpretation attendance during the time.

The case concerns the Asklipeio of Kos Island, near which the Management of Hipokrateous Foundation (International center of Medicine) continue to be built. (4)

4. Study Of Castles.

Various works of fortification (castles, towers etc.) constitute a particularly interesting case of monuments. A great amount of such monuments of different times, extensions, form, grade of ruining, exists at various places (plain, highland, coasts) in Greece.

Besides these fortresses are possible to be connected with civil or not surrounding. Both these cases were examined for medieval fortresses of Kos island (city of Kos, Antimahia) based on stereoscopic study of airphotographs, orthophotograph (in scale 1:2000 and 1:5000 correspondingly) and on local control (3). Terrestrial photogrammetric takings are also necessary to complete the study.

5. Photointerpretation And Photogrammetric Study On Monuments And Historic Centers Of Urban Areas.

This is a case of increasing interest which we often meet in Greek cities. For this case, except from other photogrammetric documents, the use of orthophotograph, which in combination with stereoscopic observation offers a wealth of photographic details combined with metric abilities, is considered particularly useful.

Simultaneous study, with the help of field controls, of Land Uses - Space Uses of the wide urban areas of the historic centers and suitable mapping of these uses, increases the usefulness of the whole work on the document. Several scales of orthophotograph 1:2000 (1), 1:5000 (2), 1:10000 each time offer other possibilities.

6. Preparation Of A General Atlas.

The collection, the classification and the study of all monuments and historical centers under a form of an atlas is considered particularly useful.

The basic parts which this could include for every monument and historic center are:

Stereoscopic pair orientated for observation with stereoscope of lens and general metric restitution, preferably graphic. Airphotographs of various scales and time taking as well concised explanations are considered particularly useful.

In this way, collection, classification and qualitative and quantitative evaluation of the data are being done and we have all the necessary information for further planning of work, in order to form photogrammetric archives of monuments and historical centers.

A relevant study concerns the case of Akropolis in Athens (6). Stereoscopic pairs are being used, orientated for observation with stereoscope of lens, from airphotographs in scale 1:6000 taken in 1953 and in scale 1:8000 taken in 1979, as well a general photogrammetric restitution in scale 1:2500, which was done and included basic alignment and

altitude data.

7. Graphical Restitutions Of Airphotographs In Small Scales.

Possibilities of airphotographs in relatively small scales are presented for graphical photogrammetric restitution of areas of historical center.

The relevant study concerns the historic center of Mystra (airphotographs in scale 1:15000, restitution in 1:1000) and of Phestos (airphotographs in scale 1:8000 and restitution in 1:500). (8).

General rules exist, securing better accuracy at the restitution for the bearings of scales of airphotographs-map.

However, the scale of restitution was further increased with suitable exploitation of the abilities of the instruments.

Therefore, it is possible to use airphotographs in relatively small scales, which as a rule are provided for all the Greek area and they can be the material for getting graphic photogrammetric documents of limited accuracy, without the need of planning special photogrammetric flights - takings for the totality of monuments and historic centers.

8. DTM On The Study Of Monuments And Historic Centers.

Various evolutions of methods at the photogrammetric applications are specially evaluated on the study of monuments and historic centers.

From this aspect the considerations for DTMs present great interest in many cases.

An application of DTMs was done by terrestrial photogrammetric takings for the case of a semi-cylindrical surface in the inside of the Cathedral at historic center of Mystra which presented faults and deformations (use of square grid, drawing of contours etc). At the same church, the method of orthophotograph was applied for another semi - cylindrical surface which was covered by paintings. (15).

An application of the DTMs was also done with airphotographs on the study of an area of monasteries at Athos Peninsula, in order to have a data bank for several geomorphologic, hydraulic etc. studies (triangular net of sampling points, drawing of contours, sections etc.).(16).

It seems that remarkable results can be taken for both these cases for which suitable software was developed.

9. Methodology Of Taking Multiple Data For Monuments.

Every one of the photogrammetric methods (analogic-numeric-photographic), presents particular advantages. We studied the possibilities of taking multiple elements at the single photogrammetric procedure.

The relevant paper concerns Ancient Olympia. (12). According to this methodology, with the same instrument and orientation of the models, the following are taken:

Graphic data with all the desirable detail and which is allowed by the scale. Numeric data for architectural parts that especially interest. Numeric data at a square grid for automatic production of orthophotograph.

Especially the work included the following:

A photointerpretation study based on airphotographs of scale 1:20000 with mirror stereoscope equipped with magnifying dioptries X8 was considered intentional for first information.

Photogrammetric restitution at map scale 1:5000 followed, based on the same airphotographs (scale 1:20000) with the analogic instrument Autograph Wild A7 combined with the recorder Wild E K8. This work included:

Taking of digitals with which the preparation of digitally controlled orthophotography could be at first possible.

Graphic restitution of monuments, and taking of digitals which concern monuments.

Correspondent works were done with the same instruments (Wild A7, E K8) based on airphotographs in scale 1:4000. Digitals were taken in order to prepare digitally controlled orthophotograph.

Graphic restitution was indicatively done for a monument and digitals were taken for its architectural parts.

Except from graphic data, numeric data is particularly useful because it can be the basis of a catalog for filing and attending historic centers.

Numeric data for the production of orthophotograph can be used in the future for new orthophotographs without additional measurements.

At this methodology we get multiple information with sensible decrease of cost-time because these products may be received without repeating the basic works of orientation etc.

The methodology can be applied for both airphotographs and terrestrial takings.

10. Terrestrial Photogrammetric Takings.

We studied the possible great amount of cases concerning external takings of totality, external takings of isolated monuments and taking of inside areas.

From the aspect of photogrammetric methods, analogic, numeric and photographic ones, suitably formed to face better the problem each time, were being used.

10.1 Analogic methods were being used at the case of external face of Saint Theodori at the historic center of Mystra (9). Problems of choice of the stations were faced to make possible the use of the takings

with the existing equipment.

The dead angles, which remain, must be faced with suitable bases.

10.2. Analytic methods were being used at the following cases.

10.2.1. External general face of the Castle of Mystras. (9).

The case had serious difficulties because of the relief, which did not allow to use the usual methods (normal case, axis parallel inclined to the base).

The study drove to general solution of the problem with suitable calculation of matrices of rotation and analytic finding of the section of the corresponding radius. Such a general solution secures liberty in choosing stations in order to include in the taking the desirable part of the whole.

During the restitution the coordinates of any points can be found as for example the coordinates of points determining dimensions of various architectural parts of the monuments, points determining crevices, inclinations etc. were calculated.

10.2.2. Study of statues (14).

This study concerns the statue of Heniochos, a work of art of extreme importance which belongs at the Museum of Delphi.

Terrestrial photogrammetric taking with Stereocamera Wild C40 were done during the night, under the light of a projector, which projected suitable net of points, discriminated at the photographs (orthogonal grid) at the statue.

The measurements were made at Stereocomparator Wild STK1 with the grid of points as a guide.

Analytic determination, at the system of the camera of the coordinates of different points-dots which cover the head of the statue was done and next for better supervision, conversion of the coordinates at suitable system relative to the object, followed.

The analytic solution allowed further multiple use as calculation of dimensions, drawing of contours and sections, perspectives etc., in combination with various automatisms.

10.3. Photographic methods.

We studied the possibilities of rectification at special cases.

10.3.1. External faces with plane elements at different depth. Case of neoclassic Villa Alatini (10). Our methodology provided rectification at successive phases for every level and also at single sensitive paper. Every time the not projected area remained covered.

Local measurements offered the necessary data for the rectification and also for controls. Particular difficulty, that was faced, concer-

ned the success of a similar continuous appearance of all the face from geometric as well from photographic-tonal aspect.

In this way we can face usual cases of faces and we can take documents which present combined the advantages of a photograph and map.

10.3.2. Plane architectural parts included in the historic center.

In many cases significant level parts may be included in photogrammetric takings of the whole of historic center. At these cases, except from any other photogrammetric exploitation graphic or numeric for the whole, it is possible and useful to get photographic documents for the level parts. We will need only some additional measurements for the rectification.

This case was faced for the Palaces at Mystra (11) at the same time with the takings which concern the whole of the historic center.

10.3.3. Plane surfaces of inside areas.

The takings concern the internal area of Perivleptos at Mystra. (11)

The surface is covered by paintings with different grade of destruction and it includes structure elements which slightly stand out.

For this case the taking with Stereocamera was considered intentional. One of the photographs of the pair was used for the rectification. Measurements can be made at the pair for the small standings out, if it is desirable.

10.3.4. Surfaces with level and curved parts of small curve.

Case of the face of the Evangelistria Church of Mystra. (9).

The rectification was done based on suitable points on the level surface to which the result was more accurate.

CONCLUSIONS

In this paper we attempt a grouping of the photointerpretation and photogrammetric methods to face the study of monuments and historic centers, with special references in Greece, based on our up today experience.

In this way we can evaluate the relevant problems, realize the amount of work and assess the propriety of the methods.

Possibilities and inabilities are also realized, directions that must be faced are located and a useful substructure is formed, which combined with other relevant efforts may significantly serve the continuation of the effort to form archives of monuments and historic centers.

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