

**ARCHEOLOGY AND PHOTOGRAMMETRY:
THE SITE OF LAODICEIA AD LYCUM (TURKEY)**

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ABSTRACT

The Laboratory of Photogrammetry of the Centro Interdipartimentale di Rilievo Cartografia e Elaborazione has been commissioned two years ago by the Dipartimento di Scienze Storico-Archeologiche e Orientalistiche to survey the archeological site of Laodiceia on the left bank of the Lycum river, next to the modern city of Denizli (Turkey).

The site of the city of Laodiceia is a heap of stones with no enclosure, totally abandoned on a hilly area large 150 hectares.

The city reveals many ruins (an aceduct, a gymnasium, a stadium, two theaters, ...) which have been explored very superficially.

The Istituto di Archeologia of the Università di Venezia has set in motion an extended program for a deeper knowledge of the city.

The program contemplates a detailed survey of this huge archeological site forseeing two main issues:

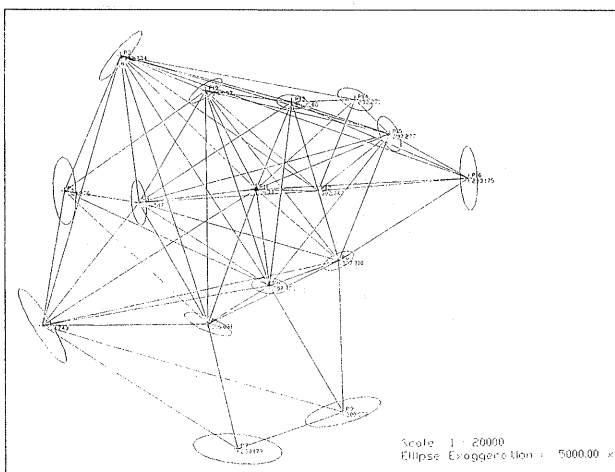
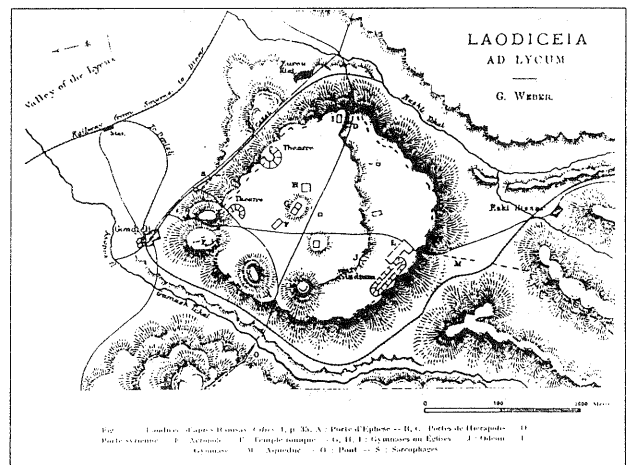
- a comprehensive analysis of the territory through a detailed D.T.M. for a correct location of the main buildings and the remains still underground;
- the measured drawing of some of the most significant architectural elements for the purpose of dating the various historical layers corresponding to the vaste range of archeological stratification.

The Photogrammetrical Section of the Centro Interdipartimentale di Rilievo, Cartografia ed Elaborazione dati (CIRCE), has cooperated since 1994 with the Università degli Studi di Ca' Foscari in Venice for the survey of the archeological site of the ancient city of Laodiceia.

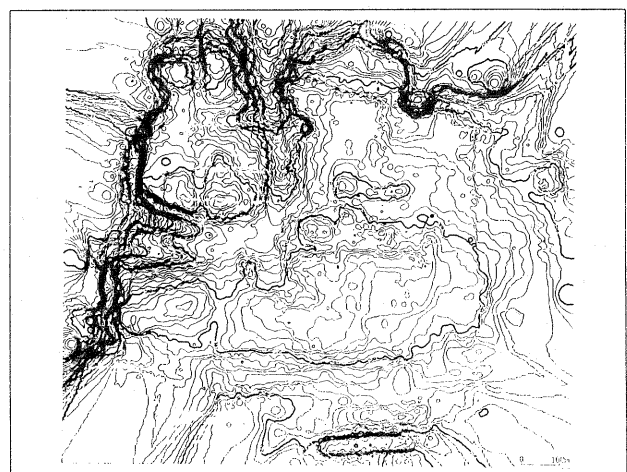
Funded by a Seleucidae king (probably Antiochus II) between 261 and 253 B.C., the city of Laodiceia in ancient times was of great importance and its most prosperous period was probably in Roman times in the second century A.D.; there is large written evidence as emperor Hadrian visited the city, Cicero was its governor, Strabo mentioned the quality of its wool production and Saint John quoted the city in the Apocalypse.

Severely damaged by earthquakes, this city has never been studied.

In the period 1961-1963 an expedition of the Laval University of Quebec, Canada, has undertaken an excavation campaign of a



Network with 95% error ellipses.



Contour map (contour interval 1 m).

Ninphaion which was brought to light and examined.

Studies have been re-engaged in 1993 by the Università di Venezia under the direction of prof. Gustavo Traversari. Till today the effort has been dedicated to a survey aimed to identify and to catalogue all the distinctive elements.

The photogrammetrical section of the CIRCE is in charge of the measured survey of the city, of individual buildings and of specific architectural details (capitels, mouldings, ...).

The city has very consistent ruins clearly identifiable and explored very superficially: two theaters (conventionally called the "roman theater" and the "greek theater"), parts of an acqueduct, a gymnasium, a stadium, the bouleterion, a necropolis, the city gates, the remains of a bridge, traces of temples and thermal baths. One of the main problems encountered during the recognition of the site is the absence of any cartographical support on which the distinctive emerging elements can be located.

The lack of cartography creates problems at the various levels of the general survey at the urban scale, at the architectural scale as well as the scale of details.

The photogrammetrical survey of the archeological site of Laodiceia has three main purposes:

- . the survey of the urban area,
- . the survey of some architecturally significant buildings,
- . the setting up of a "container" to catalogue the various distinctive elements at any different scale.

The entire survey work is referred to the system defined by the major topographical net.

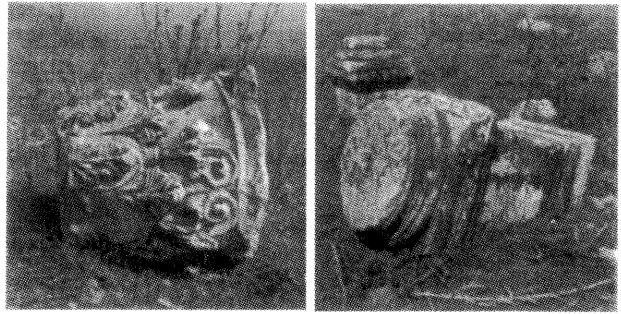
For the survey of the urban area a special flight has been commissioned: the entire archeological area has been stereoscopically covered with films at the average scale 1:2500. The photogrammetrical restitution will map the territory at the scale 1:500. A grid (5x5 m) will be produced for a Digital Terrain Model (DTM).

The DTM has the purpose of:

- . representing the morphology of the site through contour lines or axonometric views,
- . creating the model of the heights to produce a orthophotograph at the scale 1:2000.

For the measured survey of the architectural remains two different operational procedures have been used:

- . overlapping pairs to be analytically restituted of the façades where details are still recognizable,
- . converging photographs to be restituted with monoscopic systems; in some case to overlap and complete the stereoscopic pairs in some others when stereoscopic restitution is particularly



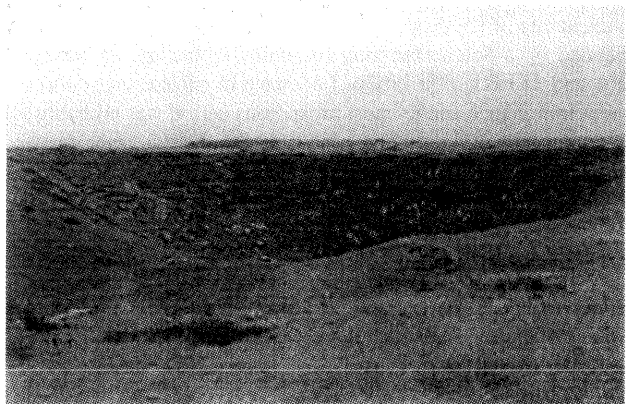
Capitel and base from Laodiceia

difficult (the case of completely ruined buildings). This option is consequent as in a archeological measured survey are very often missing those "geometrical references" that generally guide the architectural restitution: vertical lines, horizontal lines, interpolating planes parallel to the average course of a façade. There are so many problems that sometimes it is even difficult to choose a significant plan of representation. Non-stereoscopic photographs allow more "freedom": there is not the necessity to identify previously the restitution plane.

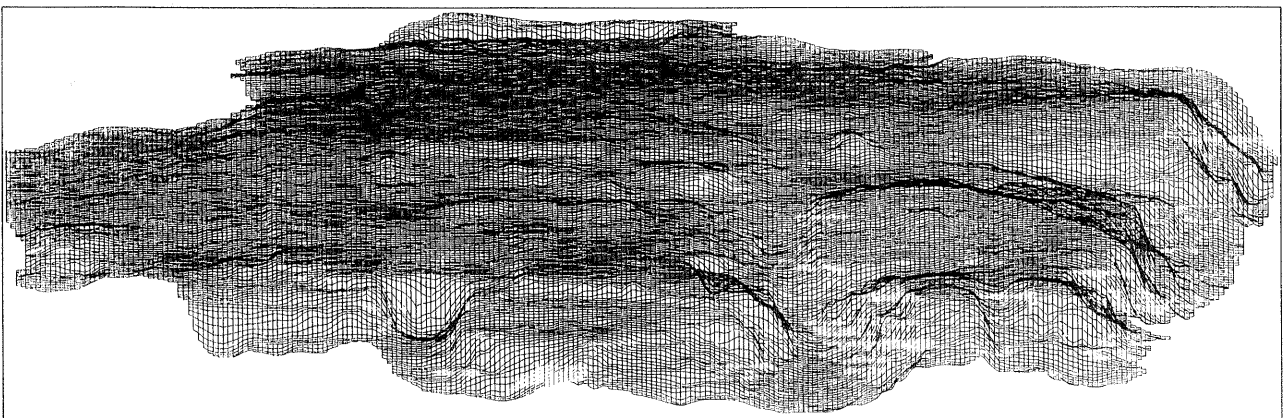
The photogrammetrical survey is not exclusively aimed to produce measured drawings: the overlapping pairs and the topographical control points constitute an archive of the formal character (dimensional and geometrical) of the architectural findings that can be questioned and used in any convenient moment.

Up to now the survey has involved:

- . the bouleterion,
- . the Ephesia gate,



The "greek theater"



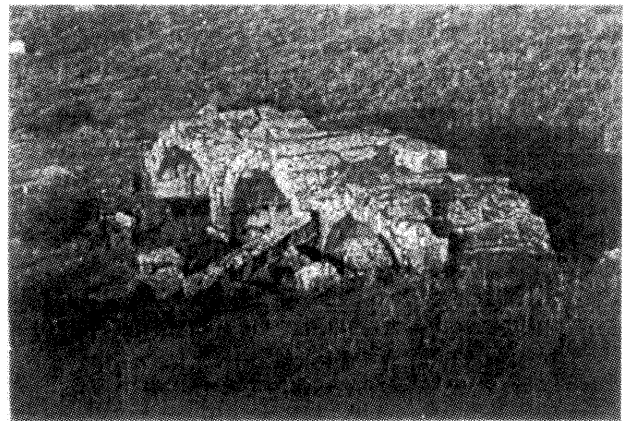
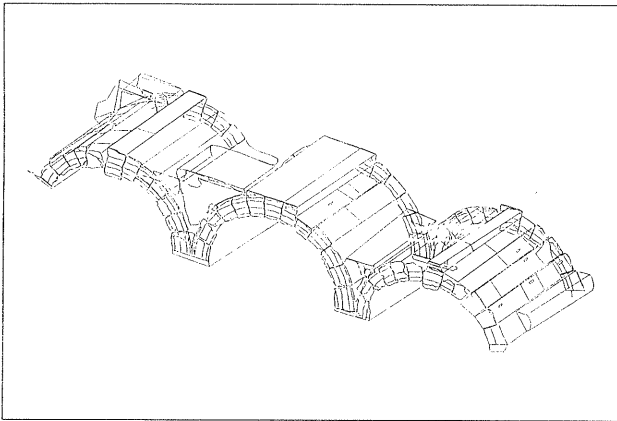
DTM of the archeological site (grid 5x5m.)

. the roman bridge,
 . the greek theater;
 only the first and the second have been partially restituted.
 For the catalogue of the emerging distinctive elements the DTM grid will be used as spatial reference: this uniform system of rectilinear lines is superimposed on the entire site. Therefore sketches, drawings, topographical measurements, general informations and specific notes are all referred to this "global" grid system.
 To make the identification and the location of details easier inside

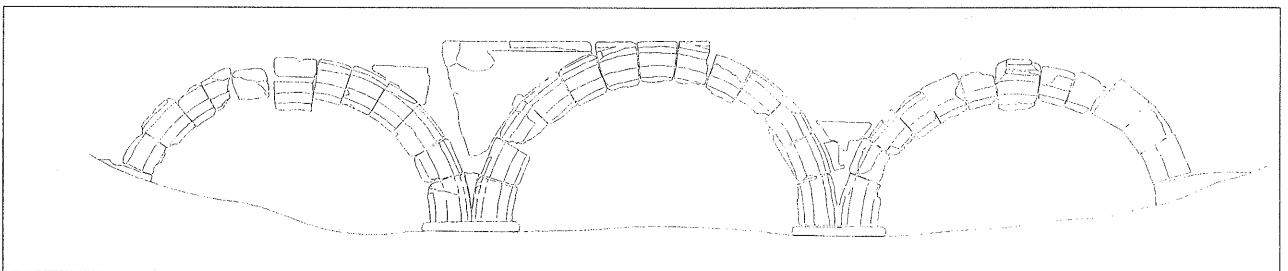
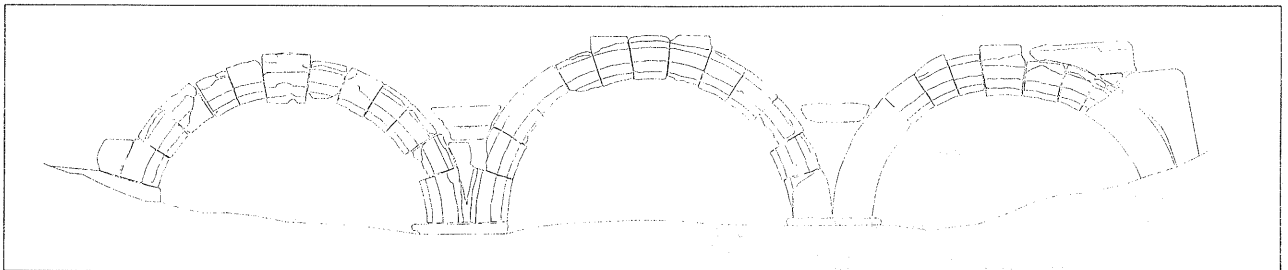
the reference grid, photogrammetrical pictures have been taken to be superimposed on the DTM perspective views; the parameters of the perspective will be the same as the parameters of the interior and exterior orientation of the photographs.

In the future the program foresees to continue the campaign with the measured survey of other architectural remains. When the excavation will come into being the interaction with photogrammetry will be planned more specifically as it is an irreplaceable instrument for archeological information.

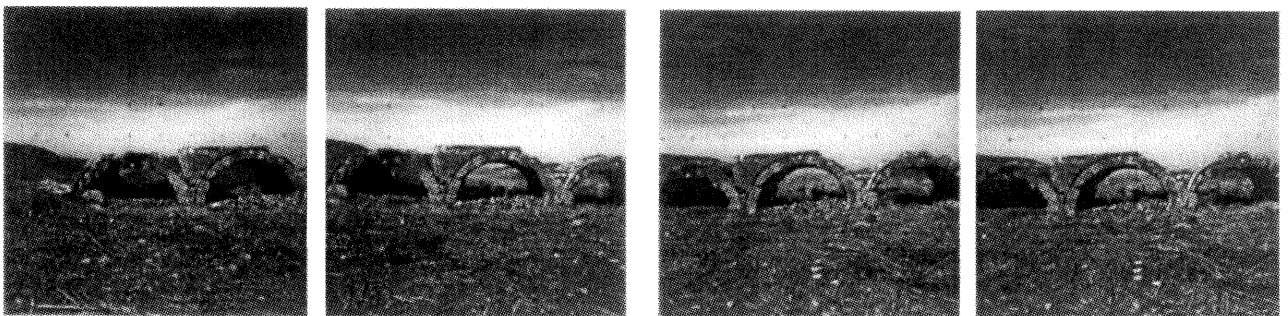
THE EPHESIA GATE



Axonometric view and photograph (restitutions, Silvia Magro)

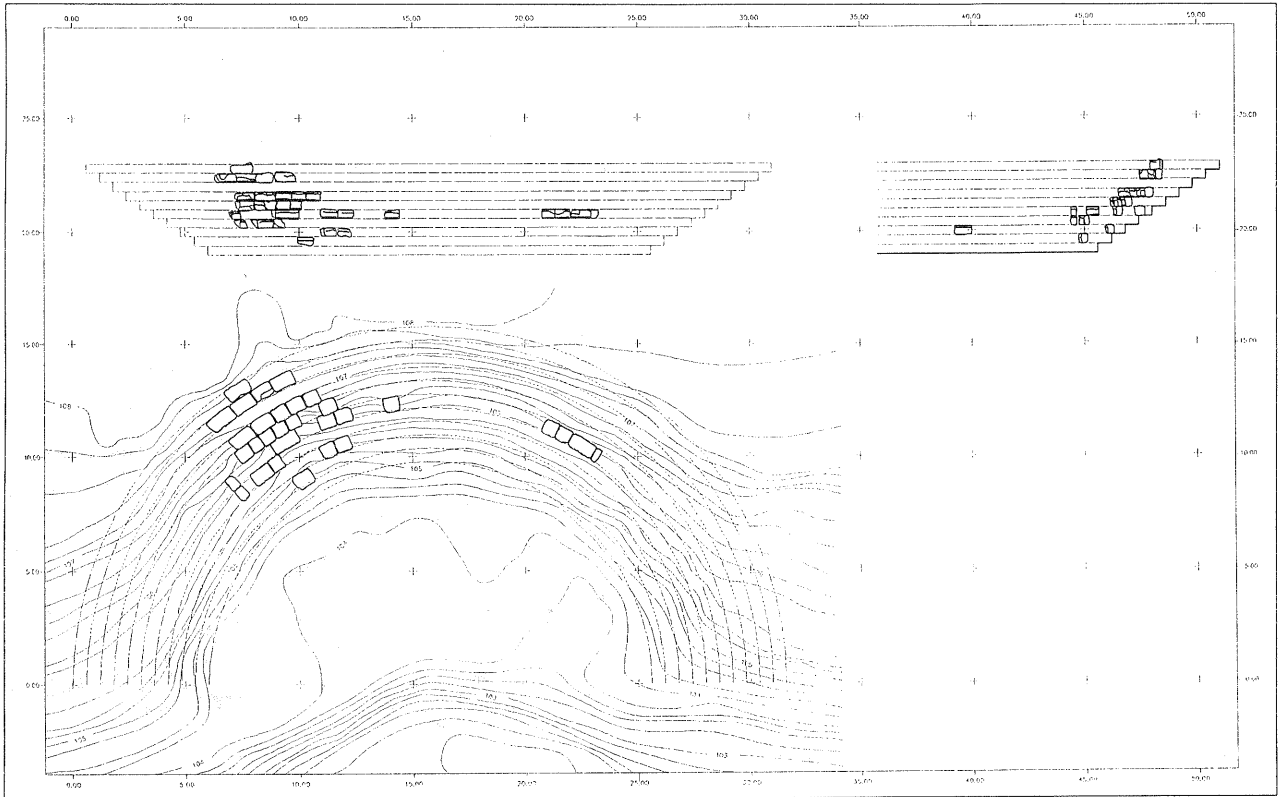


East and west front (scale 1:100)

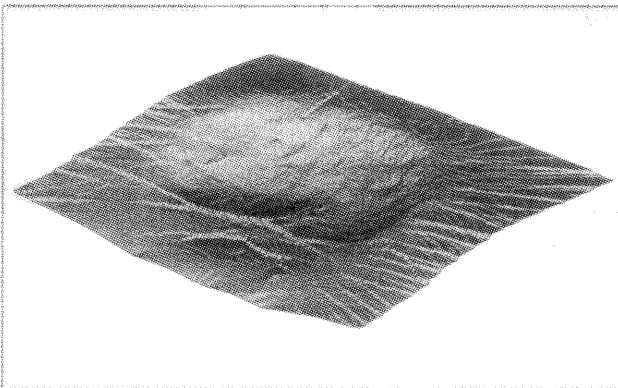


Stereometric pairs for analytical restitution

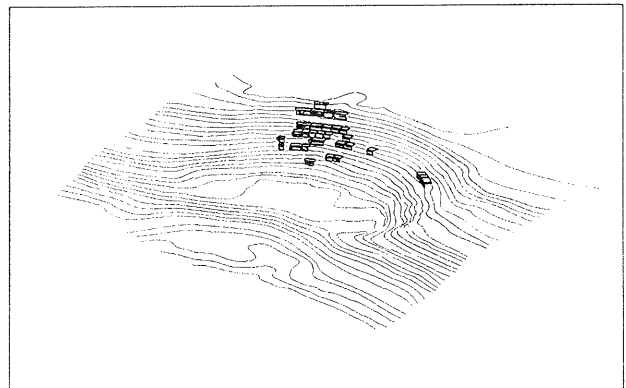
THE BOULEUTERION



Plan and elevation of the Bouleuterion (scale 1:333)



DTM in axonometric view



Contour lines in axonometric view (contour interval 0.20 cm).



Photographs of the cavea