THE PHOTOGRAMMETRIC SURVEY OF THE "RES GESTAE" IN ANKARA

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ABSTRACT

In Ankara, Turkey, there is a very important Latin inscription, which is very much in danger. That is the so-called, Res-Gestae, "the queen of the inscriptions", as it has been defined by Momsen, a great Latin historian. The photogrammetric survey of the monument has been carried out. If a case exists where photogrammetry should be applied, for sure this is the case. In fact this particular survey must be fast, complete, accurate, do not have alter the monument. The photogrammetry keeps untouched the memory of the monument. It fixes in the time the geometry of the surveyed object. Photogrammetry makes possible the surveyed object to be recomposed in its three dimensions. Obviously this capacity doesn't guarantee the conservation of the monument, but at least it records the spatial dimensions. From this point of view the really important operation is the photogrammetric taking. Photogrammetry could be defined as a virtual cast. The survey and the results are shown and described.

1. INTRODUCTION

The present work is the first phase of a large project undertaken in Ankara, the capital of Turkey. The Trieste University approved and financed a research programme, called "Ankyra Project" from the ancient name of Ankara.
Since many years M. Ekrem Akurgal, (1,1993) the famous turkish archaeologist, expressed his alarm and deep concern for the state of preservation of the inscription defined by Theodor Mommsen, (5,1865) the greatest roman historian, as "the queen of the inscriptions": the RES GESTAE.
The inscription is placed in the roman temple just in the inner part of Ankara; it contains the testament of August, the first Roman emperor.
The inscription, written in Latin and Greek, is about to vanish. The pathology of the marble is very dramatic mainly for the inscription. Therefore Trieste University decided to undertake this project having the photogrammetric record as the main target (Botteri, 3,1997).
The reasons for the photogrammetric survey were the necessity to be fast, complete, accurate. Furthermore has the advantage to be a technique of non-contact and then not to be aggressive or intrusive towards the surveyed object. There is also the irreplaceable advantage of stereo interpretation.

2. THE PHOTOGRAMMETRIC SURVEY

The photogrammetric survey has been carried out in two successive missions in Ankara, one in June 1997 and the other in September. The first mission was aimed to get a photographic documentation and to design the real survey that indeed has been done during the second mission. It has been carried out with a semi-metric camera Rollei 6006 with 40mm lens. Any image has been taken two times in two different ways:

- with grazing light of lateral flash;
- with natural light.

The light of grazing flash was intended to enhance the grooves of the incisions. Nevertheless from the examination of the developed photograms we didn't notice any remarkable difference between the two types of illumination.
In the scheme in figure 1 the three zones are shown with the collocation of the epigraphs:

- Western Latin A
- Eastern Latin B
- Greek C

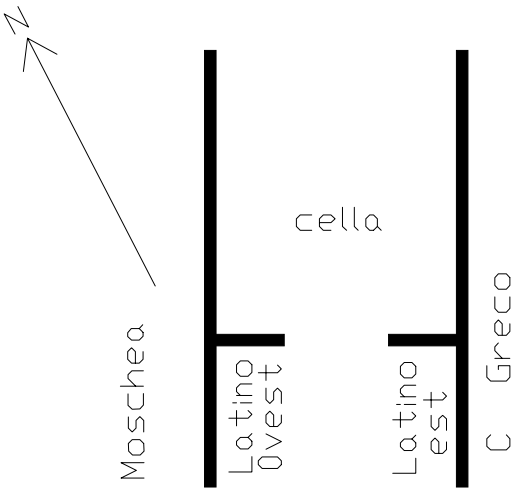

Figure 1 – Plan of the roman temple

The two Latin inscriptions have dimensions almost identical : 3.80 x 2.50 m^2 and are placed in the inner part of the walls before the door of the temple. The Greek inscription is located on the external wall of the temple, its dimensions are 21.3 x 1.2 m^2. Both geodetic and photogrammetric surveys have been carried out from the scaffoldings near to the wall.
The photogrammetric stereo coverage of the two Latin inscriptions have been realised with four parallel horizontal strips each of them composed by twelve photograms.
The Greek inscription has been covered by two stereoscopic parallel horizontal strips any of them made by 54 photograms. The medium taking distance, the

distance from the camera to the wall, was about 70-80 cm; the taking base was always around 40 cm. The coverage of any photogram is then 90 cm about.
The photographic scale is then about 1/20.

Figure 2 shows control network for Latin inscriptions and figure 3 for Greek inscriptions.
We didn't use target control point, because the critical status of the surface and therefore only natural control point have been chosen, thus reducing the achievable accuracy in the order of 1-2 mm.

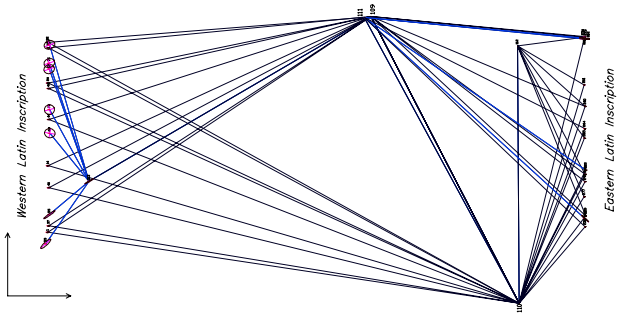

Figure 2 - Plan of the Control Network for the Latin inscriptions composed by five theodolite stations

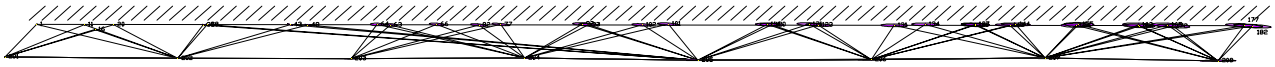

Figure 3 - Control Network of the Greek inscription composed by eight theodolite stations.

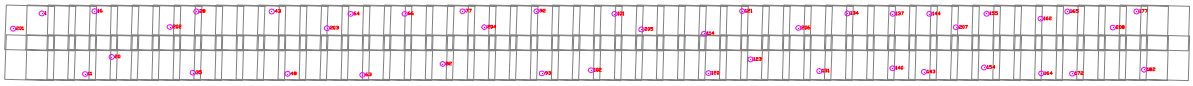

Figure 6 – The Greek Photogrammetric block with the Control Points

The whole work is synthesised in table 1.

	a	b	c	d	e	f	g	h	i
A	3.90	2.54	9.91	4	12	48	16	54	1/20
B	3.90	2.51	9.79	4	12	48	15	68	1/20
C	21.3	1.20	26.2	2	54	108	35	228	1/20

A = Latin western epigraph
B = Latin eastern epigraph
C = Greek epigraph
a = lenght (m)
b = height (m)
c = surface (m^2)
d = number of the strips
e = number of the photograms per strip
f = total number of the photograms
g = number of the control points
h = number of the pass points
i = medium scale of the photograms

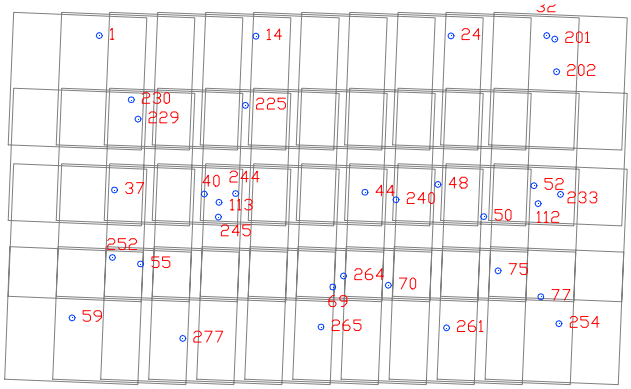

Figure 4 – The western Latin block with the Control Points

Figure 4, 5 and 6 show respectively the two latin Photogrammetric block, western and eastern, and the Greek bloc with the control points[1]. In total have been observed 38 points in the Greek inscription and 31 points in the two Latin inscriptions. In total 5+8=13 theodolite stations have set-up.

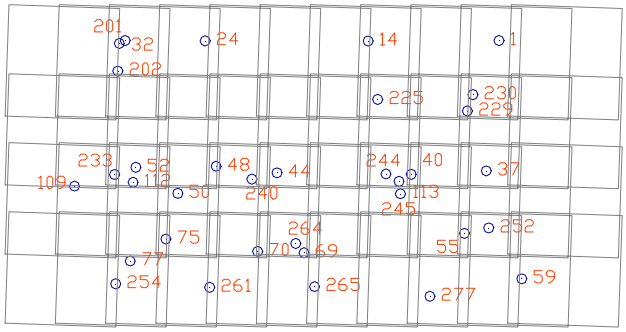

Figure 5 - The eastern Latin block with the control points

3. THE AERIALTRIANGULATION

The observations of the metric photograms Rollei were carried out with an analytical stereoplotter Kern DSR11 of the University of Ancona. The aerial triangulation adjustment with Independent Models have been performed with an expressly made aerial triangulation adjustment program.
The achieved accuracy for the pass points is almost the same get by direct geodetic measure (in the order of one-two millimetres). Figure 7 shows the graphs of the western Latin photogrammetric block, with remarked the control points, the pass points, the overlay of the 40 photogrammetric models and the observation residuals.

[1] The control network has been laid down by surveyor Giovanni Meng.

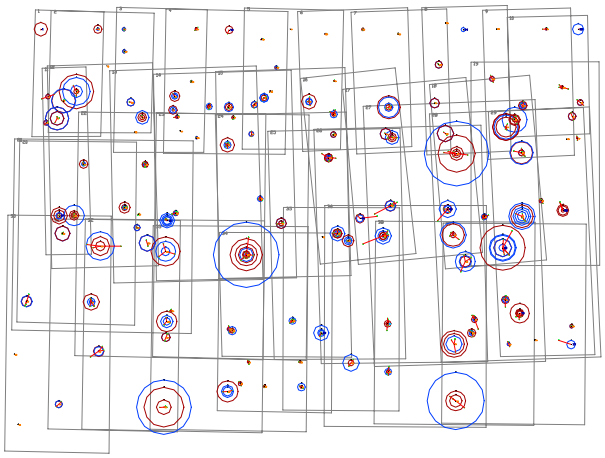

Figure 7 - Western side . Results of the aerial triangulation and photogrammetric models. Distribution of the control points, of the pass points, of the planimetric and altimetric observation residuals. The rectangular polygons bound the photogrammetric models.

4. PLOTTING

The plotting has been made both in vectorial and in raster mode. The vectorial contains the information relative to the punctual and mono-dimensional elements such as lines and points. On the contrary the raster plotting contains the information concerning the two-dimensional elements (surfaces). We think in such a way to optimise the peculiarity of each type of archive from a point of view of the economy and of completeness of the information.
The photogrammetric line plotting has been given to a private company[2]. For the moment the two Latin blocks have been evaluated (figure 8).
On the contrary with the results of the aerial triangulation we formed two rectified photomosaic of the Latin blocks.

4.1 Orthophotomosaic

All the images have been scanned at a resolution of 600 dpi with a non-calibrated desktop scanner obtaining a pixel size on the ground of about 0.8mm.
A preprocessing step has been performed to remove the noise from all the images. Then they have been rectified with MSR commercial program using the results of the line plotting obtaining the final photomosaic[3]. Although the whole wall is not flat, because of the large holes, made in the past to recuperate the copper ties, linking the marble blocks, the written part of the inscription is quite regular and there the rectification is valid.
Finally the line plotting has been superimposed to the photomosaic (figure 11).

4.1.1 Radiometric corrections. The acquired images present a very strong non-homogeneous illumination causing a no-acceptable quality of the final mosaic (figure 9). In order to eliminate the radiometric problem a correction has been applied making use of the Wallis filter (Baltzavias et al.2, 1990).

This algorithm impose for all the images the same mean grey value and the same contrast selected by the operator. Furthermore it subdivided the image in rectangular meshes, choose by operator; for each of them the same mean and contrast values applied. The border lines are treated with a bilinear interpolation to eliminate any radiometric difference between adjacent meshes.
The new pixel value is calcoleted using the following expression:

$$x'(m,n) = [x(m,n) - x^*].c.s_f /(c. s_g + s_f/c)+b.x^{**}+(1-b) .x^*$$

where:
x^* : mean grey value of the mesh belonging the pixel (m,n);
x^{**}: mean grey value impose to all the images;
s_f : mean contrast value of the meshes belonging to the pixel (m,n);
s_g : contrast value impose to all the images;
c: costant coefficient (set to 1);
b: gain coefficient (set to 1).

Figure 10 shows the photomosaic after the radiometric correction by Wallis.

5. CONCLUSION

While in the 1936 M. Schede D. Krencker (5,1936) spent about half a year in Ankara to make the cast on the inscription, shown now in the Berliner Bodenmuseum, it took one week only for us today to carry out the photogrammetric survey in Ankara. Furthermore today the real cast could not be possible because the worst condition of the marble walls.
Photogrammetry could be defined as a virtual cast.

6. REFERENCE

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[2] StudioA by Fratelli Alinary, Florence.
[3] The rectifications have been executed by Eng. R. Brasili and Eng. C. Laganà for their graduation thesis.

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Fig. 8 – Line plotting of the westrn latin block

Figure 9 - The photogrammetric orthomosaic without radiometri correction

Next page, fig. 10 – The photomosaic after the application of the Wallis filter

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Figure 11 – The line plotting superimposed to the rectified photomosaic

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