RECORDING OF HISTORICAL MONUMENTS FOR MONO-DIFFERENTIAL RESTITUTION

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ABSTRACT

The graphic representation of historical monuments is traditionally performed with the assistance of tape measure. Whit this purpose, all the necessary elements for its representation are measured, "in loco". This traditional technique, used in most of the works carried out in Brazil, is based on direct measurements on the monument. This measurements are time consuming dependent on the conservation state of the monument. They can even damage the monument. After the Second World War, the conservation of monuments was motivated, leading, in 1964, to elaboration of the International Charter about conservation and restoration of monuments, known as Charter of Venice. Since then, several countries, including Brazil, began to establish programs for maintenance of their historical monuments. The International Council of Monuments and Sites – ICOMOS recommended that each country should constitute a photogrammetric record of its monuments and sites, since photogrammetry is considered the main and more advanced method for surveying. This paper shows the photogrammetric survey made in the "Solar of Rosário", a monument placed in the historical center of Curitiba – Paraná – Brazil. The survey was done with a Rolleiflex 6006 camera and the recording was performed by the method of mono-differential restitution, which presupposes the solution of the problem (representation of an object) with observations in a single frame photography. The work was divided in three stages: First, the recognition of the monument and photogrammetric survey; second, the topographic survey of the control points; and third, the mono-differential restitution. The mono-differential restitution was made through the "Monorestituidor Digital" program, that is associated with a PC based CAD-MicroStation system and its module for image processing IRAS-C. The mono-differential restitution was performed according to the following steps: a) interior orientation; b) approximate space orientation; c) external orientation; d) vectorial digitising of the elements of interest and, finally, e) the transformation between the referential of the image space and referential object space and the adopted projection system.

1 INTRODUCTION

The majority of Countries have shown its preoccupation respect to the its culture preservation, what presupposes, among other factors, the conservation, restoration and consequent heritage classification of the architectural monuments and archaeological sites. The conciliation between the preservation of the historical heritage with the regional development has continually been, object of study, redirecting and revitalizing the activities of use of the constructions that represent historical monuments of the city or of the culture immigration.

Several works related to the monuments conservation and restoration, be them architectural, archaeological or historical character, have shown the importance and the applicable of the photogrammetry for this aim.

Programs of maintenance of historical monuments were developed over all the world. In Brazil the subject began to be discussed in 1920, nevertheless there are few works that used the photogrammetry for data acquisition. With the

Figure 1. Solar of Rosário

commemoration of 500 years of the Brazil discovery, a Global Plan of Action was structured. The Program of Heritage Preservation is one the several programs which constitute this Global Plan.

The present paper shows the experience that it is being developed in the "Solar of Rosário" monument located in the Curitiba historical center. The front facade of this construction measure nearly 10 meters of height and 10 meters of width.

2 PHOTOGRAMMETRIC RECORDING

The photographic survey was recorded by a Rolleiflex réseau 6006 camera. The front facade of the construction was photographed starting from 6 stations, as shown in the figure 2.

In this case, the photos can be scanned and digitally stored in a further step. The Vexcel scanner, model ZX 3000 was used and the dimensions of the pixel are nearly of 0.01 millimeters, in files of 5700 x 5700 pixels (approximately 14 Mbytes).
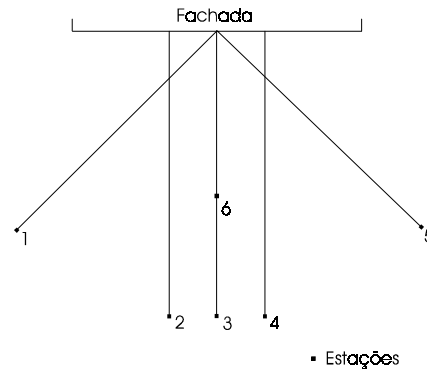

Figure 2. Station Configuration

3 CONTROL POINTS

The topographical survey to obtain the control points was accomplished with a Leica Total Station TC 2002, from 3 observation stations. In each one of the stations were observed 12 points, distributed on the whole of facade, according to configuration shown in the figure 3. After the adjustment of the survey measurements, the coordinates of these 12 points have been determined with a rms. values of 1,5 mm, in a Local Cartesian System (three-dimensional). The table 1 shows the adjusted coordinates of the control points by the least squares method.
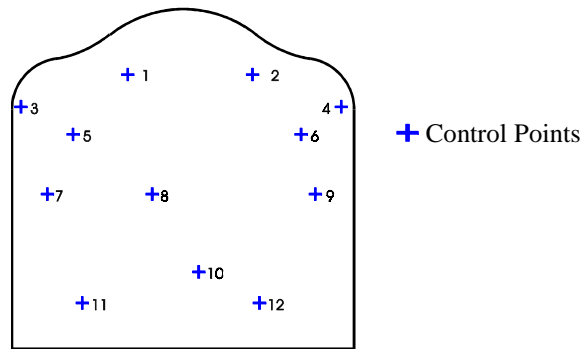

Figure 3. Configuration of Control Points in the facade

Point	X (m)	Y (m)	Z (m)
1	-0,618	16,950	6,787
2	4,290	17,043	6,776
3	7,138	17,062	5,782
4	-3,538	16,862	5,794
5	-0,705	16,221	4,845
6	4,404	16,325	4,827
7	6,606	17,102	2,552
8	1,066	16,997	2,549
9	-3,575	16,848	2,723
10	-1,842	16,865	-0,707
11	3,985	17,006	-0,711
12	2,612	16,998	0,782

Table 1. Coordinates of the control points

4 PHOTOGRAMMETRIC RESTITUTION

The photogrammetric restitution is defined as the obtaining process to graphic or numeric representation of a surface or a photographed object. The process is realized with oriented photos, from it are extracted the interest features. The restitution product is denominated of photogrammetric original, and it is obtained through stereo or mono-differential methods. This work presents the use of the mono-differential restitution for the architectural monuments representation.

The digital mono-differential was accomplished with the "*Monorestituidor Digital*" system, which is associated with a PC based CAD-MicroStation system and its module for image processing IRAS-C. The restitution was performed according to the following steps: a) interior orientation; b) approximate space orientation; c) external orientation; d) vectorial digitising of the elements of interest and, finally, e) the transformation between the referential of the image space and referential object space and the adopted projection system.

The photo-coordinates of the interest points in the restitution are determined through parameters that allow the correction of the systematic error in the photos. These parameters are determined during the orientation, which needs the knowledge of some parameters provided by the camera calibration certificate.

The approximate space orientation models mathematically the relationship among the photogrammetric and topographical referentials. It needs the reading of photogrammetric points whose coordinates of the topographical referential are known. In this step are also verified the existence of gross error in the control points. The external orientation determines the rotation and translation parameters of each picture.

The transformation between the image space referential and the object space referential has as purpose to rectify the file graphic. The vectorial digitising of the elements, together with its edition were made in the CAD-MicroStation system.

5 CONCLUSIONS

The progress of the computer science, allowing that a common user has access to computers with great storage capacity and high-speed of data processing, has making possible the use of several techniques not used until now, the mono-differential restitution, for example.

For the presented photogrammetric recording, the mono-differential restitution have been shown useful, because the surface of the monument "Solar of Rosário" is approximately planes. In other surfaces, it is necessary more investigations to evaluate the final product as function on the photographed object shape.

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