ARCHITECTURAL REPRESENTATION THROUGH DIGITAL PHOTOGRAMMETRY OF THE SOUTH FACADE OF "LA LOGGIA" PALACE IN BRESCIA (ITALY)

Roberto Cantoni [a], Giorgio Vassena [a], Carlo Lanzi [a]

[a] Brescia University, Civil Engineering Dep.
Via Branze, 38 25123 Brescia Italy Tel. +39.030.3715516 Fax. +39.030.3715503
E-mail: cantoni@bsing.ing.unibs.it vassena@bsing.ing.unibs.it lanzi@bsing.ing.unibs.it

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ABSTRACT:

Even though the coming of the laser-scanning technology opens wide to the architectural survey new applicatory ambits and allows to obtain unthinkable representations with traditional survey methodologies, the digital photogrammetry preserves a series of characteristics which favour her in many applications.
The choice about the survey of the south facade of the La Loggia palace in Brescia, borns from the will to show the potentialities of a survey technique known and tested for decades in the topographic world, but doesn't still come into the common usual procedures of the architectural survey. Potentialities in terms of precision and completeness of particulars that the close range digital photogrammetry is able to reach through the most recent hardware/software instrumentation.
This application is not limited to the study about the new instrumentations and application ambits, but it also tried to define some restitution methodologies of the survey results, so to build architectural table richest as possible of informations, but at the same time easy and clear to read also by users without the knowledges necessary to the interpretation of a traditional architectural table.
This project born inside an advanced didactic activity in Brescia University, where from some years the topographic group coordinated from Professor Vassena, mobilise the new generation to look after the cultural heritage in the feature through the architectural photogrammetric documentation.

1. INTRODUCTION

The first difficulties that are present in the approach to the survey of an architecture, are essentially connected to the choice of an investigation method adequate to the architectural reality of the building. The South façade of the La Loggia palace in Brescia, is characterized for an articulate overlap of architectural stone elements (arcs, pilaster strip, balustrades, busts, etc) that require a hight detail level so to consider unthinkable the application of a classical survey made by traditional instrumentation.

2. PHOTOGRAMMETRIC SURVEY

2.1 Photographic survey

Film based photography requires photographic processing including the developing, printing and replication of diapositives followed by an ispection of the results.
The photographic survey in this case was led using the innovative semimetric camera D7 Metric developed by Rollei, which combines in an excellent way use easiness and image quality. The image resolution of Rollei D7 is 1240 x 1024 pixels. The use of a digital camera, allowed the images transfer directly from the memory card to the PC where the elaboration software was installed. That avoided the phases of development and print of the film, let alone the scanning of the positive one, which would have increased the deformations and then the metrical inaccuracy of the image.

Figure 1. Camera D7 Metric by Rollei

The facade overlooks on a narrow road which limits the deep distance for the photographic images at about ten meters, imposing, to complete the photographic covering of the whole façade (about 47 meters length and 24 meters height), to take the photograms through the numerous windows of the overlooking palace. That imposes a high number of photographic pictures, equal to 65, used during the graphic-numerical elaboration.

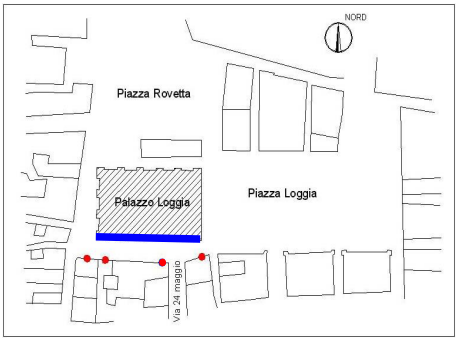

Figure 2. Sketch with the positions where the photographs were taken

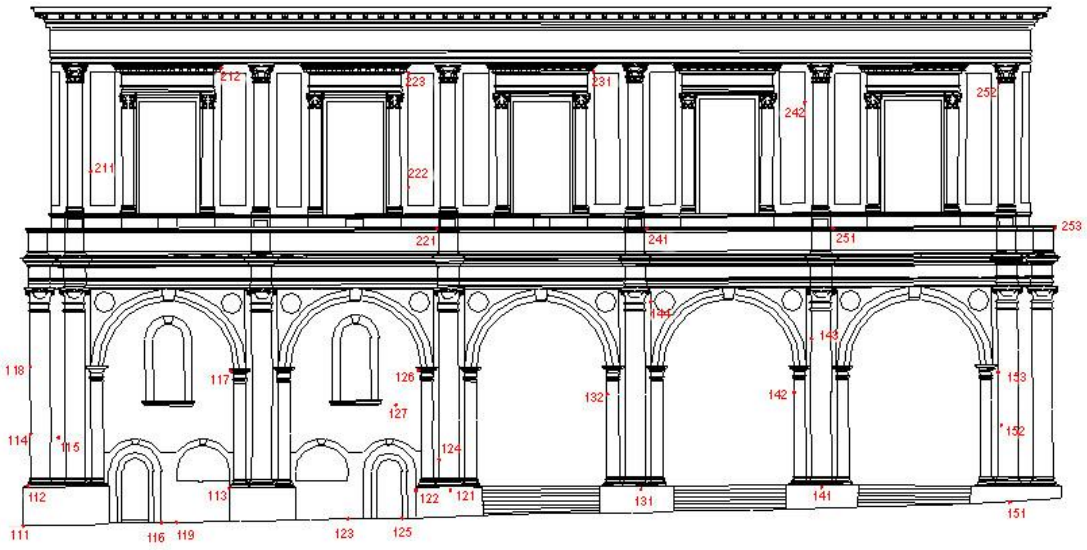

Figure 3. Distribution of used control points

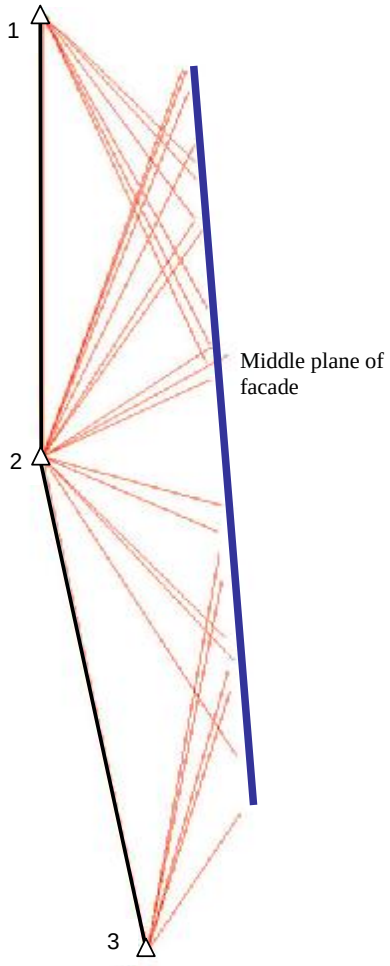

Figure 4. Topographic survey

Control point	Net vertex	X [m]	Y [m]	Z [m]
111	1	103,159	107,625	100,324
112	2	103,493	107,833	102,168
113	2	112,706	108,292	102,085
114	2	103,499	107,999	104,523
115	2	104,767	108,187	104,373
116	1	109,134	108,551	100,474
117	1	112,751	108,581	107,442
118	2	103,495	107,991	107,611
119	1	110,237	108,652	100,489
121	1	122,900	109,085	101,956
122	1	121,271	109,151	101,954
123	1	118,103	109,221	100,645
124	1	122,341	109,414	103,373
125	1	120,617	109,406	100,684
126	1	121,382	109,226	107,481
127	2	120,337	109,387	105,849
131	2	131,678	109,747	102,016
132	2	130,107	110,060	106,372
141	3	140,046	110,385	102,049
142	2	138,701	110,706	106,480
143	2	139,524	110,705	108,899
144	2	132,119	110,206	110,616
151	3	148,709	111,024	101,390
152	3	148,313	111,361	104,944
153	3	148,084	111,392	107,401
211	2	106,177	109,267	116,598
212	2	112,175	109,653	121,171
221	2	122,253	109,282	113,976
222	2	120,838	110,340	115,848
223	3	121,068	110,294	121,532
231	3	129,416	110,937	121,204
241	3	131,920	109,967	113,947
242	2	139,205	111,727	119,827
251	3	140,544	110,608	113,955
252	2	148,211	112,284	120,737

Table1. Control points coordinates

2.2 Topographic survey

Topographic survey of a target network was made by a classical topographical instrumentation composed from a *Leica* total station TPS 1103. During this phase the coordinates of 36 control points were measured from a net composed by 3 vertexes. The Figure 3. shows the distribution of these control points, necessary for the photograms orientation. Table 1. reports the coordinates obtained after the three-dimensional least square adjustment approach.

3. DATA PROCESSING

Once a target network has been established and photography has been taken the remainig work is perfomed off-site. The software used during this phase was *Rollei CDW plus* 750 (Rolleimetric, Braunschweig). This is a digital monoscopic photogrammetric software that allows the acquisition of images taken from any position, doesn't need the stereoscopic couple.
Rollei CDW is a well established close range software package. It is based on developments by Wester-Ebbinghaus [1978, 1981], Fellbaum [1984] and others [e.g. Dold & Suilmann 1993] and is the successor of the Rolleimetric MR2, which was a pioneer in the distribution of analytical photogrammetry to customers outside the photogrammetric society.
The choice to use this software instead other stereoscopic software is because:

- Is very easy to use
- Doesn't need a particular hardware interface
- It has a complete restitution system, including measurement tools
- Good blunder detection

So this software is the right one to show to the students the representative power of the photogrammetric methodology without using powerfull photogrammetric workstation. Figure 5. shows the workflow follow during data processing operations.

4. RESTITUTION

A survey with these features allows to collects many elements and informations from which several disciplines can reach. Assume primary importance to this purpose the levels, or so-called layer, which allow to make the work flexible and organize it according to categories or informtions groups.
This application is not limited to the study about the new instrumentations and application ambits, but it also tried to define some restitution methodologies of the survey results, so to build architectural table richest as possible of informations, but at the same time easy and clear to read also by users without the knowledges necessary to the interpretation of a traditional architectural table.
Is explained in this way the realization of a result in which the minute lapidee façade decorations, are represented in full particulars not more by the stroke necessarily schematic of the operator, but directly from the photographic image preventively straightened. Therefore are entrust to the completeness of the image the representation of particulars, which lose the essence itself in the approximate rebuilding of geometries through points and lines.
An architectural survey which collects the constructive details with the approximation of about 2 cm is explained with the will to realize a kind of metrical virtual model of the facade which get metric-descriptive information. A model that is tridimensional.

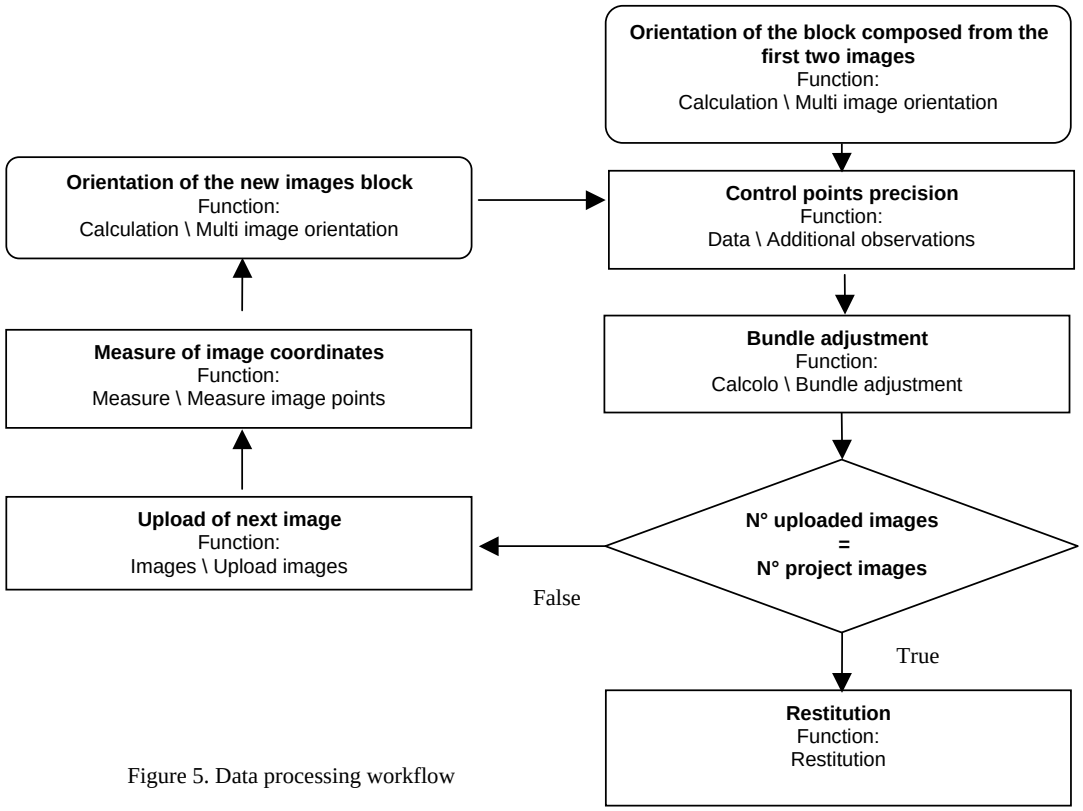

Figure 5. Data processing workflow

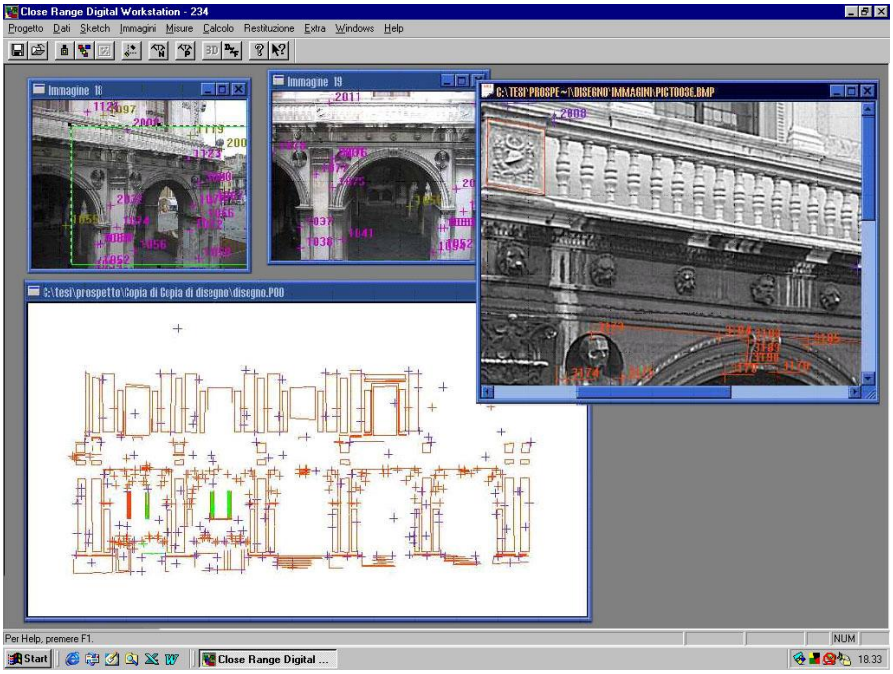

Figure 6. Screenshot of Rollei CDW

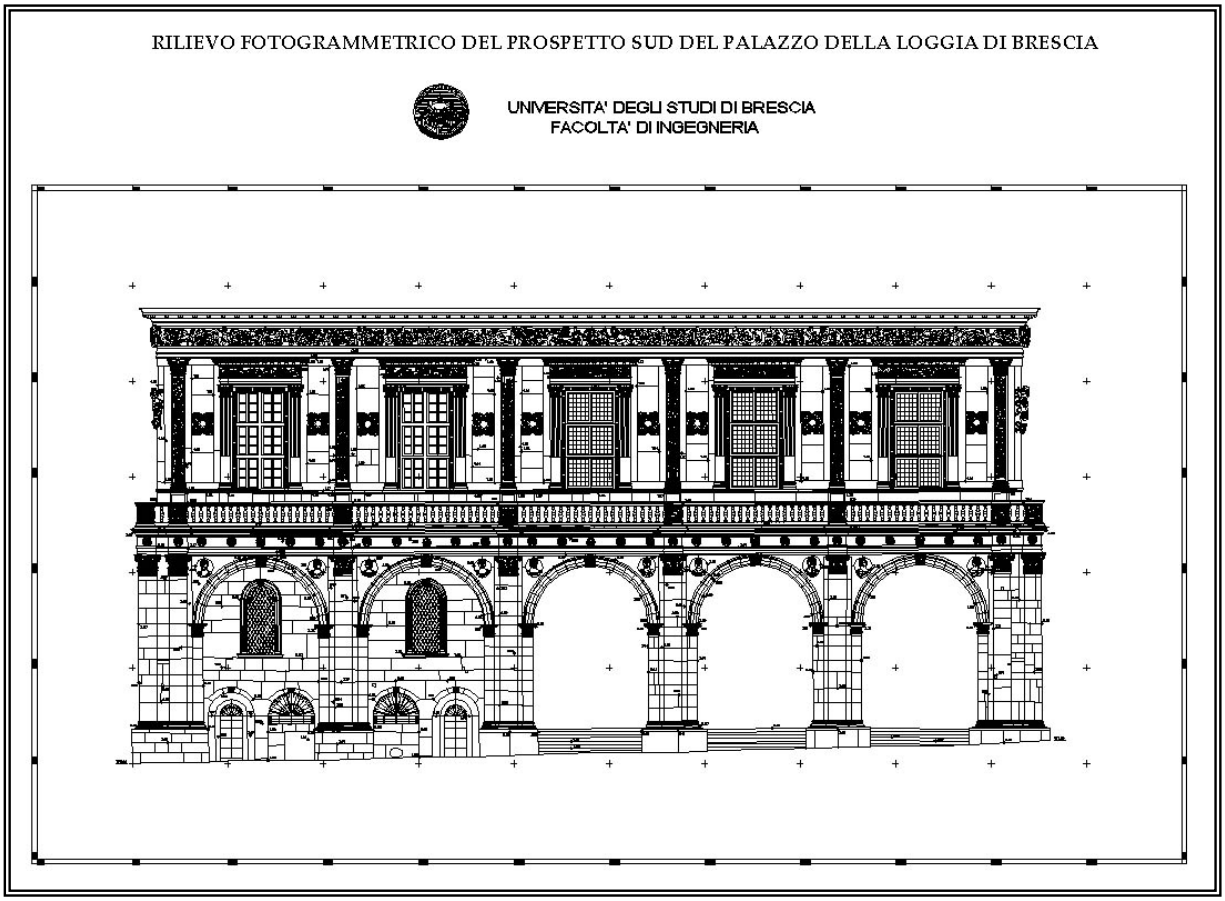

Figure 7. Table that represent the orthogonal projection of the façade with the elevation of some points respect to the middle plane

Therefore rebuilding the detail is not a useless waste of resources. If for example the survey had been exclusively made on the basis of the necessity of the recent study about the static investigations, conducted on the palace by the same department of Civil Engineering of Brescia, the result would have reduced himself to a meagre representation of the essential structural elements geometries.
This would however represent a useless tool in the purposes of many other research ambits for which proceeding to a new survey according to specific criteria would be necessary.
Is clear so that the planning of a survey that allows a faithful reproduction of the building, within the limits of the representation scale approximations, constitutes an interesting analysis phase for the management of the resources for the study and conservation of the architectural heritage.

5. CONCLUSIONS

This didactis experience pointed out as achieving valuable representative results through not expensive instrumentations in the context of the cultural heritage is possible.
Is important to underline as the present investigation work was led as integration to the available iconographic information about the palace of La Loggia, in order to the realization of a little information system.
A result as this can become an important support tool also for the purposes of the creation of an informtic archive, inside which the data provided by the survey, the ones inferred by texts and other historical sources or other research fields, can be integrated and offer to the collectivity a real cognitive support tool.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

Faig W.,1989. Non-Metric and Semi-Metric Cameras: Data Reduction. In H.M. Karara (Ed.): Non-Topographic Photogrammetry, ASPRS, Second Edition, pp. 61-80.

Fellbaum M., 1992. Low Cost Surveying Systems in Architectural Photogrammetry. IAPRS XXIX, Part B5, pp. 771-777.

Jacobsen K., 1982. Attempt at optaining the best possible accuracy in bundle block adjustment. Photogrammetria, p.219.

Marten, W., Mauelshagen, L. Pallaske, R. 1994. Digital orthoimage-system for architecture representation. ISPRS *Journal of Photogrammetry and Remote Sensing*, 49(5), pp. 16-22.

Schewe H., 1995. A PC Based System for Digital Close Range Photogrammetry. First Turkish-German Joint Geodetic Days, Istanbul pp.255-261.

Wiedemann A., 2000 Hemmleb, M. & Albertz, J.: Reconstruction of historical buildings basedon images from the Meydenbauer archives. IAPRS, Vol. XXXIII, Amsterdam B5/2, pp. 887-893.

Wiedemann A., Moré J., Suthau T., Theodoropoulou I., Weferling U., Ergün B., 2001. Comparison of bundle block adjustments for close range applications, Fourth Turkish-German Joint Geodetic Days, Berlin.