

3 X 3 RULES FOR SIMPLE PHOTOGRAMMETRIC DOCUMENTATION OF ARCHITECTURE

Peter Waldhäusl¹ and Cliff Ogleby²

1. University of Technology, Vienna, Austria. 2. University of Melbourne, Australia

Invited paper, Commission V, Working Group 4

KEY WORDS: Architectural Photogrammetry, Non-metric Cameras, Rules for Photography, Stereophotogrammetry, CIPA, Test, Karlsplatz, Convention of The Hague 1954, UNESCO.

ABSTRACT:

The CIPA Test "Karlsplatz, Vienna" shall prove that

- non-metric cameras may also be used for photogrammetric recording, and that
- the participating centers are able to do the restitution therefrom as well as to train others in their region.

CIPA will recommend the participating centers to ICOMOS and UNESCO as expert centers for general photogrammetry, including non-metric image technology.

CIPA and especially this symposium, are challenged to recommend also "non-metric" cameras as a means for fast and world-wide documentation of valuable architecture as a consequence of the UNESCO-Convention of The Hague 1954. 3x3-rules are presented again which are to be followed using non-metric photography.

KURZFASSUNG:

Der CIPA-Test "Karlsplatz, Wien" soll nachweisen, daß

- auch Nicht-Meßkameras ("Amateurkameras") zur photogrammetrischen Dokumentation verwendet werden können und daß
- die am Test teilnehmenden Zentren in der Lage sind, solche Bilder selbst auszuwerten sowie andere Zentren in der Region dafür auszubilden.

Das CIPA wird die teilnehmenden Zentren der UNESCO und dem ICOMOS als Fachzentren für allgemeine Photogrammetrie, insbesondere auch Amateurbild-Technologie, empfehlen.

Das CIPA, und speziell dieses Symposium, werden hiermit aufgefordert, auch die Verwendung von Nicht-Meßkameras für beschleunigte und weltweit anzuwendende Dokumentation wertvoller Architektur zu empfehlen; eine Konsequenz der Haager Konvention der UNESCO von 1954. Die dabei zu beachtenden Regeln ("3x3-Rules") sind detailliert angeführt.

1. MOTIVATION

The practical use of non-metric cameras for architectural photogrammetry is no utopia any more. Today it may be considered a reality or, at least, a realistic possibility in emergency cases. Considering that but a little percentage of the world's valuable architecture has been recorded with metric cameras during the first hundred years of photogrammetry, the additional use of non-metric cameras seems rather an unavoidable necessity. It is true, of course, that the professional use of metric, i.e. calibrated cameras is more exact and for sure also more economic, especially whenever it is known in advance that photogrammetric restitutions are required immediately. But in the case of photogrammetric recording of the mass of architecture the contrary is known in advance: Only a minority of photographs will be used for photogrammetric restitution after such bad events as fire disaster, storm, earthquake, war, decay. But such events are numerous enough - unfortunately - to justify accelerated and systematic recording of the total of the valuable architectural heritage. Therefore it should be considered earnestly to make use of the immense and generally available capacity of amateur photography.

2. THE VIENNA KARLSPLATZ TEST

During the last years, I often got the impression that even professional photogrammetrists did not believe in this possibility. In 1991, CIPA started therefore the VIENNA KARLSPLATZ TEST. The first and preliminary results have been presented by the heads of the pilot centers, by Petros Patias from Thessaloniki, Greece, for the numerical results, and by Antonio Almagro, Granada, Spain, for the graphical results of the test on the occasion of the CIPA-Symposium in Sinaia, Romania in 1993.

Important is the preliminary summary of the numerical results: Except for four gross errors, all 96 testblock adjustments showed that medium as well as small format, metric as well as non-metric, photography blocks allow for reconstruction of the 25x 20 m test building within an accuracy of only 2 to 3 cm.

On the other hand, it was surprising that several bundle adjustment software systems could deal only with control points, not with more simple control information as distances and plumb-lines.

What was the purpose of this initiative? A small, but important building of Art Nouveau, built by Otto Wagner in 1898/99, has been photographed with four different cameras, small and medium format, and each metric and non-metric. Other test photography has been added later on by the cooperating 23 or more centers which showed interest in the proposal made in Delphi in 1991. These centers are now witnesses of the fact that records with amateur cameras are restitutable, and 16 centers have already proved that they can really do such restitutions. Thus CIPA will recommend these institutes and institutions to ICOMOS and UNESCO as potential regional centers for consultations and restitutions in the special fields of amateur photogrammetric recording. And these centers should now cooperate in the further development of the methodology with the major aims

- to do such recording with amateur cameras,
- to do it faster,
- to finish it within one generation, and
- to enable proper updating of the records.

The last point seems to me very important: Up to now the photogrammetric records have been archived, but practically never repeated, updated, not even after major changes of the buildings.

3. RECOMMENDATIONS

The task of the last CIPA conference was to discuss, and to decide about the consequences by preparing and adopting internationally a respective resolution. This resolution*¹ reads as follows:

The Symposium,

considering:

the slow progress of the recording of the architectural and archaeological heritage of the world,

recommends:

the world-wide use of photogrammetric recording using either metric or non-metric cameras as appropriate,

and, in order to ensure a high professional standard of results, the use and promotion of a set of simple and proper rules that will guarantee satisfactory restitutions and rectifications.

A further recommendation may be added saying that:

Non-metric photography should be used with priority

- wherever and whenever metric cameras are not available,
- in all emergency cases,

*¹) Modified by Cliff Ogleby, Australia, Chairman of Working Group V/4 of ISPRS on Architectural Photogrammetry, and adopted in the closing session of the Symposium in Sinaia, 25.9.1993. The resolution has been accepted also by an ad-hoc-group of experts of ICOMOS and UNESCO in Paris, 8.10.1993.

- for rather simple and small objects,
- for supplementary recording of details,
- for updating after renovations etc.,
- for the mass of valuable architecture as a reserve for emergency.

Whereas the professional metric photogrammetrists should be employed to their full capacity with priority

- for the first order world heritage,
- for huge complicated and important buildings, as for example for domes, castles and monasteries, and
- for projects, where restitutions are required immediately.

4. PRACTICAL RULES

Simple rules which are to be observed for photography with non-metric cameras have been written, tested and published already on the occasion of the CIPA-Symposium in Sofia in 1988. It was a first edition of such rules, and possibly some amendments are necessary. Therefore you and the CIPA-committee should test and discuss these rules thoroughly, and decide about their general application. I called these rules for my students the "3x3-Rules", because they are structured in three items, with three sub-items each. There are

- 3 geometric,
- 3 photographic, and
- 3 organizational

matters treated. In detail, the rules read as follows:

4.1 The 3 geometrical rules

4.1.1 Prepare control information: (Fig.1)

- Some long distance between well defined points, eventually targets.
- some plumb-lines,
 - o Defined ("This is a plumb-line"), or
 - o Made by plumbing down e.g. a roof corner and by targetting of the foot.
 - o Do that on several sides of the building for control.

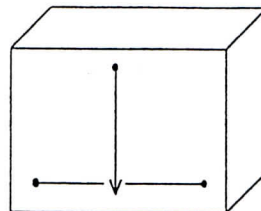


Figure 1: Minimum metric information

- one distance
- one plumb-line

4.1.2 Multiple photographic all-around coverage: (Fig. 2)

- Take a "ring" of pictures all around the object, overlapping each other more than 50 %.
- Take shots from half the object's height, if possible.

- Include parts of the neighbourhood.
- Add diagonal shots combining two sides of the object.
- Add traversing shots combining the neighbouring photographs.
- Include also the roof, if of interest.
- Check multiple coverage carefully.
- Add orthogonal full façade shots for overview and rectification.

4.1.3 Take stereopartners for stereo-restitution: (Fig. 2)

- Stereopartners are taken as
 - o normal case (base-distance-ratio 1:4 to 1:15), or
 - o convergent case (base-distance-ratio 1:10 to 1:15).
- Avoid divergent case.
- Add close-up stereopairs for valuable details and measure additional control distances for them or add a rod to the object.
- Check stereo-coverage carefully.
- In case of doubt, add more shots and measure "by hand" whatever remains invisible.

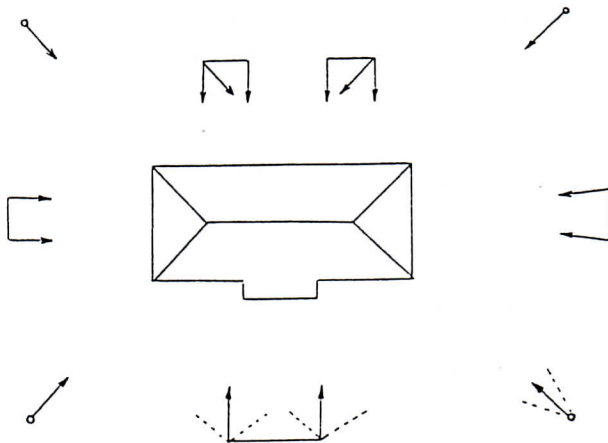


Figure 2: Ground plan of a stable bundle block arrangement all around a building

4.2 The 3 photographic rules

4.2.1 The inner geometry of the camera has to be kept constant:

- No zooming! Use end position, or avoid zoom optics at all, or fix focus of optics by adhesive tape.
- No shift optics.
- No distance changes. Fix to indefinite, or mean distance by adhesive tape, but use only
 - o one distance for "ring"-photography,
 - o one distance for the close-ups.
- Image format frame of camera must be sharply visible on the images with good contrast.
- Don't cut into format when cutting the original film (=document!).
- The true documents are the original negatives. Treat and keep them carefully.

4.2.2 Select homogenous illumination:

- Plan the best time of day.
- Use tripod and cable release for sharp images.
- Any film may be used. Black-and-white is sufficient, colour provides advantages for interpretation and documents also the colours. From slides it is more costly to make enlargements.

4.2.3 Select most stable and largest format camera available:

- Wide angle is better than narrow angle for all-around photography.
- Medium format is better than small format.
- Calibrated (or metric) cameras are better than non-metric.
- Film sucked flat, or kept flat behind a reseau glass plate, is better than film with varying bending as in normal cameras.

4.3 The 3 organizational rules

4.3.1 Make proper sketches:

- Ground plan and
- Elevation of each side (1:100-1:500).
- Note object, owner, address.
- Mark north direction and
- Photo standpoints (with film and negative number) and photo directions.
- Mark single photo coverages and stereo coverages.
- Show control distances and plumb-lines.

4.3.2 Write proper protocols:

- Object, owner, address.
- Date.
- Camera, optics, focus and distance settings.
- Calibration report, if available.
- Description of place, object, history.
- Bibliography.
- Specials, artists, architects, permissions, obligations, etc.

4.3.3 Don't forget the final check:

- Write down everything immediately.
- Check completeness and correctness before leaving the site.
- Conclude the reports while you remember all details.
- Check the results at home together with an authority for monuments and sites.
- Plan next project bearing in mind any mistake made previously. Learn.

These 3x3-Rules should be included in a simple textbook of applied photogrammetry, simple enough to be explained to everybody. And exactly this will be done in the near future according to a decision made by the CIPA committee. I invite all of you (especially all National Delegates to CIPA) to make further proposals and contributions to this problem of a more general use of the immense capacity of amateur photographic recording.

5. SOME FINAL WORDS OF THANKS

In the name of CIPA I thank herewith all centers/institutes/institutions which have shown immediate interest in the subject; thanks to its heads and collaborators:

- Antonio Almagro, Escuela de Estudios Arabes (CSIC) Granada, Spain, for co-development of the idea, for his restitutions and for being head of the pilot center for graphical presentations;
- Petros Patias and his collaborators, The Aristotle University of Thessaloniki, Greece, for being head of pilot center for numerical results and for his restitutions;
- Jozef Jachimski, The Stanislaw Staszig University of Mining and Metallurgy, Cracow, Poland, for his critical partnership in discussion and for his institute's restitutions and own contributions;
- Sergio Dequal and Fulvio Rinaudo, Politecnico di Torino, Italy, for the formation of an Italian group "Karlsplatz" and for restitutions and own contributions together with
- Clemente di Thiene, Laboratorio di Fotogrammetria San Polo, Venezia, Italy;
- Giorgio Folloni, Istituto di Topografia, Bologna;
- Fabio Crosilla, Istituto di Urbanistica, Udine;
- Paolo Centanni, GEOTOP, Ancona;
- Carlo Monti, Politecnico di Milano,
- Margherita Fiani, Università di Roma "La Sapienza", and for their work and own contributions.

Further I thank all the centers which took over at least part of the work or who contributed or still contribute with their own methodology:

- Armin Grün and André Streilein, Eidgenössische Technische Hochschule Zürich, Switzerland;
- Günter Chesi and Klaus Hanke, Universität Innsbruck, Austria;
- Victor Gregor, Pavel Bartos and Michaela Ragalova, Slovakian Polytechnical University Bratislava, Slovakia;
- Zbynek Marsik and Vlastimil Hanzl, Polytechnical University Brno, Czechia;
- Jozef Smidrkal and Karel Pavelka, Polytechnical University Prague, Czechia;
- Pierre Grussenmeyer, Ecole Nationale Supérieure des Arts et Industries de Strasbourg, France;
- Günter Hell, Fachhochschule Karlsruhe, Germany;
- Franz Josef Heimes, Fachhochschule Bochum, Germany;
- Dieter Fritsch, Universität Stuttgart, Germany;
- Evangelos Vozikis and Andreas Georgopoulos, INFO-TOP Ltd. and National Technical University Athens, Greece;
- Ernst Bacher and Gottfried Klummer, Bundesdenkmalamt (Federal Office of Historical Documents), Wien, Austria;
- John Fryer, University of Newcastle, NSW, Australia;
- Teodor Fiedler and Lidija Semak, Technical University Zagreb, Croatia;
- M. Holdorf, Rollei Fototechnik, Braunschweig, Germany.

I herewith invite also further centers to take part in the Karlsplatz Test. The final report is planned for 1995.

Bibliography:

Waldhäusl, P., Brunner, M., 1988. Architectural photogrammetry world-wide and by anybody with non-metric cameras? In: Hadjiev, G. (Editor), 1989. Contributions of modern photogrammetry, remote sensing and image processing methods to the architectural and urban heritage. XIth International Symposium of CIPA, Sofia, pp. 35-49.

Waldhäusl, P., 1991. A test object for architectural photogrammetry: Otto Wagner's underground station Karlsplatz in Vienna. Paper presented at the XIVth International Symposium of CIPA, Delphi, 1991.

Waldhäusl, P., 1992. Defining the future of architectural photogrammetry. In: International Archives of Photogrammetry and Remote Sensing, Washington, Vol. XXIX, Part B5, pp. 767-770.

Kager, H., Waldhäusl, P., 1991. ORIENT. A Universal photogrammetric adjustment system. Product information of the Institute of Photogrammetry and Remote Sensing, Vienna University of Technology.

Address of the Author:

Prof. Dr. Peter Waldhäusl
Institute for Photogrammetry and Remote Sensing
Gusshausstraße 27-29/122
A-1040 Wien, Austria
Tel. +431 58801 3814
Fax +431 5056268
e-mail:pwaldh@fbgeo1.tuwien.ac.at

Cliff Ogleby
Department of Geomatics
The University of Melbourne
Parkville, 3052
Australia.
Tel +61 3 344 6806
Fax +61 3 347 2916
email: Cliff_Ogleby@mac.unimelb.edu.au