# SMALL-FORMAT AERIAL AND CLOSE-RANGE SURVEY OF ARCHAEOLOGICAL AND HISTORIC SITES AND BUILDINGS

Francisco Ursúa Cocke
Coordinator, Sub-Committee on Applied Photogrammetry,
Mexican National Committee for ICOMOS

ABSTRACT

Recent research and applications from the author's experience is presented for archaeological and historic sites and buildings, painting, stained-glass and sculpture. Commentary is offered regarding *linearity* and expression; and the contention is made that the operator, and educated viewers and users of line drawings as well, will better appreciate, from these drawings, the difficulties and the merit of the original's execution, as well as its meaning. A programmable procedure for three-dimensional plotting in the drafting room is described, based on the use of utility and micro-light fixed-wing aircraft, specially-prepared or commercial color slides, amateur cameras and in-house rectification on simple proprietary equipment. Observations are made regarding corrections in the drafting room.

KEY WORDS: Small-format, sites and buildings, painting, stained-glass and sculpture, line drawings.

## INTRODUCTION

We shall be dealing in this paper with traditional architectural surveys: elevations mostly but also painting, stained-glass, and sculpture. Artists have often (discreetly) used the camera oscura and photography, its legitimate heir, for support; we document here, from personal experience, the equivalent use of non-metric 35mm equipment and specially-prepared or commercial, aerial or terrestrial color slides, to produce on short notice, at reasonable cost, good drawings to reasonable tolerances.

## Theory

The following question arises immediately for painting - and for stained-glass as a derivation: is it useful to render as a line drawing, such a non-linear presentation; and for sculpture, is it useful to render as a line drawing, bodies, the folds of garments, and the expression in faces? Regarding painting, we quickly resolved, in a difficult moment, an encouraging test-case from a commercial slide. Villard's marvelous plates are encouragement also for sculpture - herewith our testimonial. So it appears already at this point in our discusssion, that some certain combination of traditional free-hand drawing with modern methods, including photography and photogrammetry, is recommended.

There remains the thorny question of accuracy; or, more to the point, of a reasonable relationship between price, time of execution, and accuracy. It appears to us, that the *a priori* demands of the scientific method; or the eventual neeed for precise reconstruction of works that might be lost, must be compared to the benefits of a less cumbersome procedure more useful perhaps, in actual practice, to

conservators. Dare we present here, from personal observation, this connecting inquiry: how much of a concern is a controllable error, duly announced by the operator, if no one can see it? We speak in this connection of certain drawings deliberately prepared in our office with a distortion of 4%, that specialist viewers were unable to distinguish, face to face, from the original. How much time and money and effort is one willing or able to expend on a particular project? We therefore suggest that in certain situations, larger tolerances be allowed in the trade, to favor expediency.

**Applications**

In sketching-out this combination of traditional and contemporary procedures, we write for ordinary talent in actual drafting-room practice; and especially for rapid execution and exact proportion. We are thinking also of the young, and of a healthy balance between craft and machine. When using stereoplotters, Corinthian capitals have been rendered ocasionally in the form of artichokes! Adequate training in the survey by hand of historic buildings is the only way, in our experience, of preventing such unexpected results, including for stereoplotter operators, whose usefulness (and astounding accuracy) is not in question.

From surveys done by hand, the draftsperson as well as the alert user obtain important results: a more direct reading of the work owing to *the line's integrity* (Ingres); an appreciation of the difficulties involved in the execution of the original; the perception of intimate reality - troubling at times and hidden ordinarily by the medium and by convention. Psychological connotations less readable in the original owing at times to placement and lighting also become clear. In summary, our feeling is that a photo shows all, while a line drawing shows more! Well yes, a line drawing is already an interpretation; and a teachable one at that, in actual drafting-room practice (please see below).

A few practical applications of this procedure are obvious: restoration and conservation projects, inventories, publication (line drawings are much easier to reproduces than continuous or even half-tones). Others must be explored in connection with conservation groups and the young. To be sure, our method depends on a large pool of readily-available, semi-skilled draftspersons, which is the case in Mexico; and sufficient numbers (well, one-third . . . ) of new applicants, from recent experience, can master the few simple rules involved, in one short trainig session.

**Corrections**

Herewith our observations which will serve to calculate percentage errors ($\partial$, Table I, Fig. 1) with regard to 2R (diameter of an advancing object) for three different telephoto lenses (R=1, d=1):

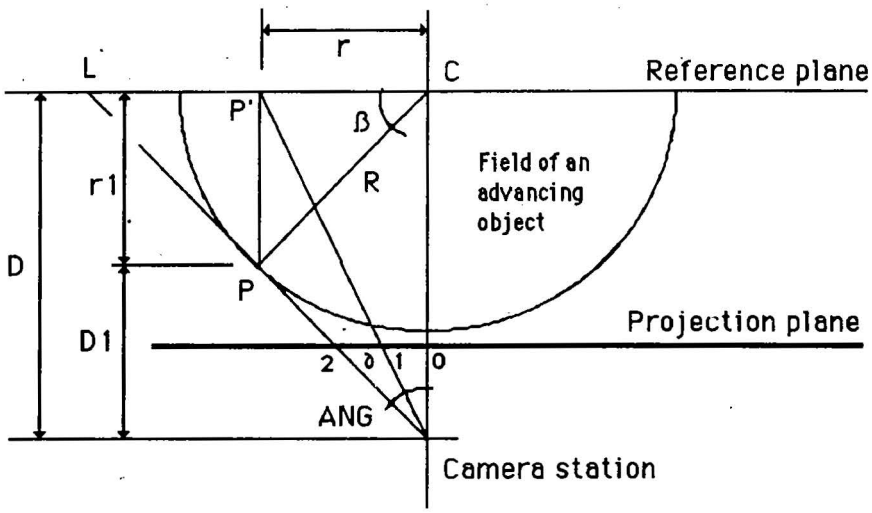


Fig. 1: Deformation in cylindrical or spherical objects.

cosß=R/CL; CL=R/cosß; tanANG=CL/D; D=CL/tanANG (ANG being one-half the lens' horizontal field of view); D1=D-r1; cosß=r/R; R=1; ß=ANG; r=cosANG; sinß=r1/R; r1=RsinANG=sinANG; by similar triangles: 01=r/D, 02=r/(D-r1); deformation for the whole figure is ∂=(02-01)/02*100/2

Now, tabulating the above:

f=200mm, ANG=6°, D=9.56R

| ß | r | r1 | D1 | 01 | 02 | ∂, % |
|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 9.56 | 0.105 | 0.105 | 0 |
| 15 | 0.965 | 0.258 | 9.309 | 0.101 | 0.104 | 1.34 |
| 30 | 0.866 | 0.5 | 9.067 | 0.091 | 0.096 | 2.39 |
| 45 | 0.707 | 0.707 | 8.86 | 0.074 | 0.08 | 2.82 |
| 60 | 0.5 | 0.866 | 8.701 | 0.052 | 0.058 | 2.49 |
| 75 | 0.258 | 0.965 | 8.602 | 0.027 | 0.03 | 1.45 |
| 90 | 0 | 1 | 8.567 | 0 | 0 | 0 |

| | f=400mm, ANG=3°, D=19.1R | f=800mm ANG=1.5°, D=38.46R |
|---|---|---|
| ß | ∂, % | ∂, % |
| 15 | 0.66 | 0.33 |
| 30 | 1.16 | 0.57 |
| 45 | 1.36 | 0.67 |
| 60 | 1.19 | 0.58 |
| 75 | 0.69 | 0.33 |

Table I

In practice, D is a multiplier for camera-object distance as a function of the object's diameter. Regarding depth (or 3-D), it is obviously the basis of present-day formal photogrammetry; but in our situation, where a rectifier is not available (and, frankly, not an immediate aspiration), we have written an original program in Basic, based on our observation of parallax in our stereoscopic pairs, which allows its calculation. We call this procedure, *in-house stereometrics* (Fig. 2; but the plain truth is that for most situations dealt with in this paper, it is easier to measure depth directly on the object):

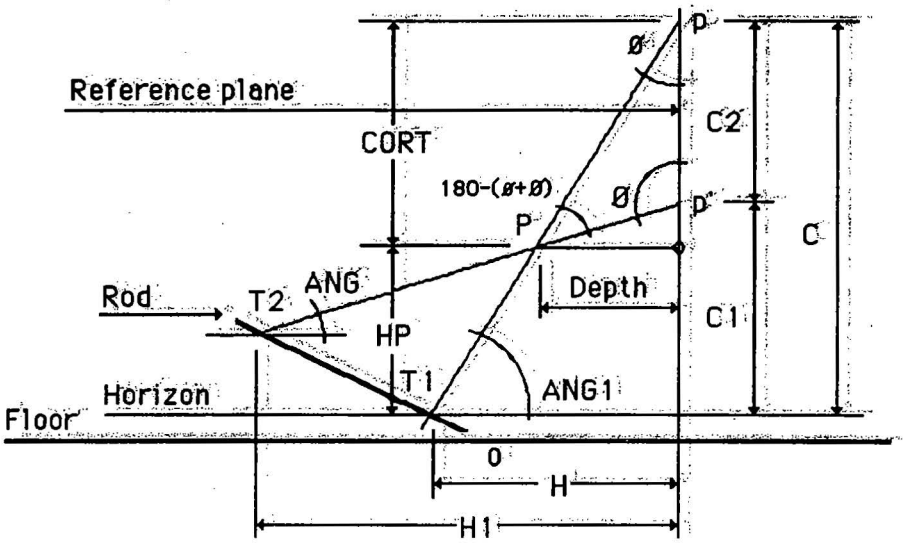


Fig. 2: Stereoscopic exposure with the camera tilted on one plane, perpendicular on the other.

C2=C-C1; H1=H+T1T2cos(90-INC); ø=90-ANG1; Ø=90+ANG
Pp=C2sinø/sin(180-(ø + Ø)); CORT=Ppcosø; Depth=CORTtanø

Empirically, we find the following configuration for a simple rectifier that corrects for an exposure with a 135mm telephoto lens and $\beta=20^{\circ}$ approximately :

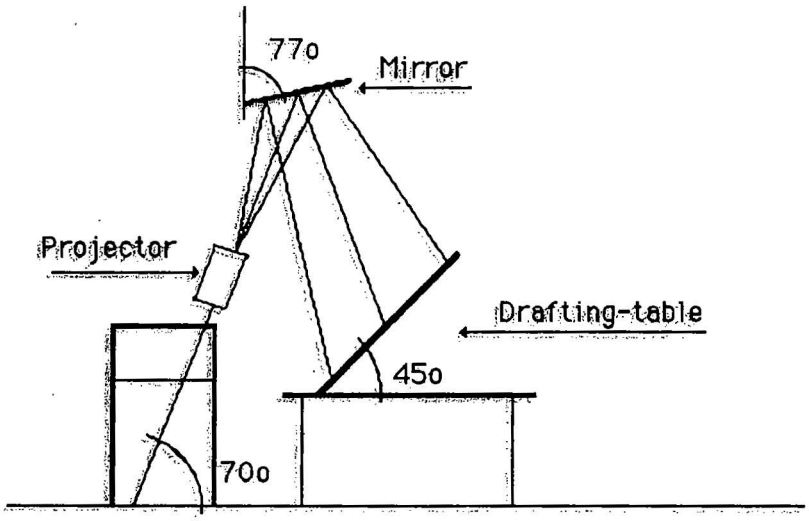


Fig. 3: A simple rectifier.

**Operation**

Regarding execution, rectification, and reprographics: we usually do large drawings, 90cm wide, freehand in ink with an ordinary fountain pen or fine-tip marker, or with instruments in pencil, tracing directly from slides projected unto bond paper (a zoom projecting lens, or the projector's distance from the drafting surface serving to set the scale of the drawing; the xerographic copier can also be used for the purpose). Corrections can easily be made with white correction fluid; one can even do collages, especially for faces, which are difficult, prior to copying or reducing xerographically on a better-grade paper, such as Canson. Lines become finer on reduction, giving a pleasing effect.

CONCLUSION

Architectural offices and agencies dealing with heritage conservation, as well as individual researchers and groups dedicated to its protection, will benefit from the use of commonly-available resources for the timely, practical and modestly-priced execution of useful surveys with an accuracy acceptable for numerous applications: projects, inventories, publication, research. For these applications, the price-time- accuracy relationship seems to favor simple procedures as outlined herein.

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