MASTER PARALLAX GRAPH

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Synopsis: The Master Parallax Graph provides a rapid and accurate solution for converting parallax differentials to differences of elevation.

Photogrammetrists who compute elevations from vertical photographs will find the Graph a time saver.

The Master Graph has been constructed for a flying height of 10,000 feet and conversion factors as indicated must be used for other flying heights. Secondary Graphs can be plotted for any flying height thus eliminating all computations. Elevation differences can be read to an accuracy of one two thousandth of the flying height.—*Publication Committee.*

THE Master Parallax Graph, illustrated and described in this paper, provides the photogrammetrist with a rapid and accurate solution for problems of differential parallax related to vertical photography.

It has been constructed according to the equation:

$$dp = \frac{B_m h}{(H - h)}$$

wherein

dp = difference of parallax in millimeters;
B_m = measured image-base length in inches;
h = difference of ground elevation in feet;
H = flying height above lower point of reference.

Throughout this paper, the term "base-length" should be interpreted as the "image base-length."

The graph has been plotted for a flying height of 10,000 feet; its use is founded on the fact that the difference of ground elevation represented by a specified measurement of differential parallax on photographs of a given base-length varies in direct proportion to changes of flying height.

On photographs of one common base length, a given measurement of differential parallax represents exactly twice the ground elevation when exposed at 20,000 feet as on similar photographs exposed at 10,000 feet.

Use of the Graph

Information is extracted from the graph in the following manner:—

The difference of parallax, in millimeters, between any two points on the common overlap of two vertical photographs, is used as argument for entry on the left side of the graph. From this point, the horizontal line is followed to its intersection with the curve representing the average base-length, in inches, of the overlap being measured. The vertical line through this point indicates, at either the top or bottom of the graph, the number of feet of elevation difference between the two points. This difference of elevation is true only if the photographs were exposed from 10,000 feet above the lower of the two points; for any other flying height, the difference of elevation must be multiplied by the conversion factor; $H/10{,}000$. This factor is tabulated in skeleton form on the inset at the lower right portion of the graph. The application of this factor may readily be accomplished by means of the *C* and *D* scales of a slide rule; any difference of elevation read from the graph may be set, on the *C* scale, opposite either index of the D scale; the difference of elevation corresponding to the actual flying height may then be read off on the C scale opposite the flying height on the D scale.

Under no circumstances may a measurement of differential parallax be apportioned according to flying height. A given measurement of differential parallax must retain its exact identity; the value of this identity, for 10,000 feet, is the only measure which is directly proportional to variation of flying height.

Accuracy

The accuracy attainable from readings on the Master Parallax Graph is believed to be comparable to that with which present day aero photographic images are rendered. The vertical, or differential parallax, scale has been constructed with an interval of 0.05 mm., the reliability of readings taken beyond this limit being of reasonable doubt when obtained by usual means. The horizontal, or difference of elevation, scale reads to an interval of 5 feet for a flying height of 10,000 feet, which means one and ten foot intervals for respective flying heights of 2,000 and 20,000 feet. These differences of elevation, one two-thousandth of the flying height, are likely to provide a satisfactory degree of accuracy even for automatic plotting equipment.

Secondary Graph

General practice has accustomed us to working from a separate graph for each overlap, or to using one graph for a group of overlaps, thus accepting any deviations due to change of flying height and base-length.

The Master Parallax Graph makes either one of these procedures unnecessary; it yields information to a higher degree of accuracy than that required, and, through its use, variations of flying height and base-length may be dealt with as readily as if there were no such variations.

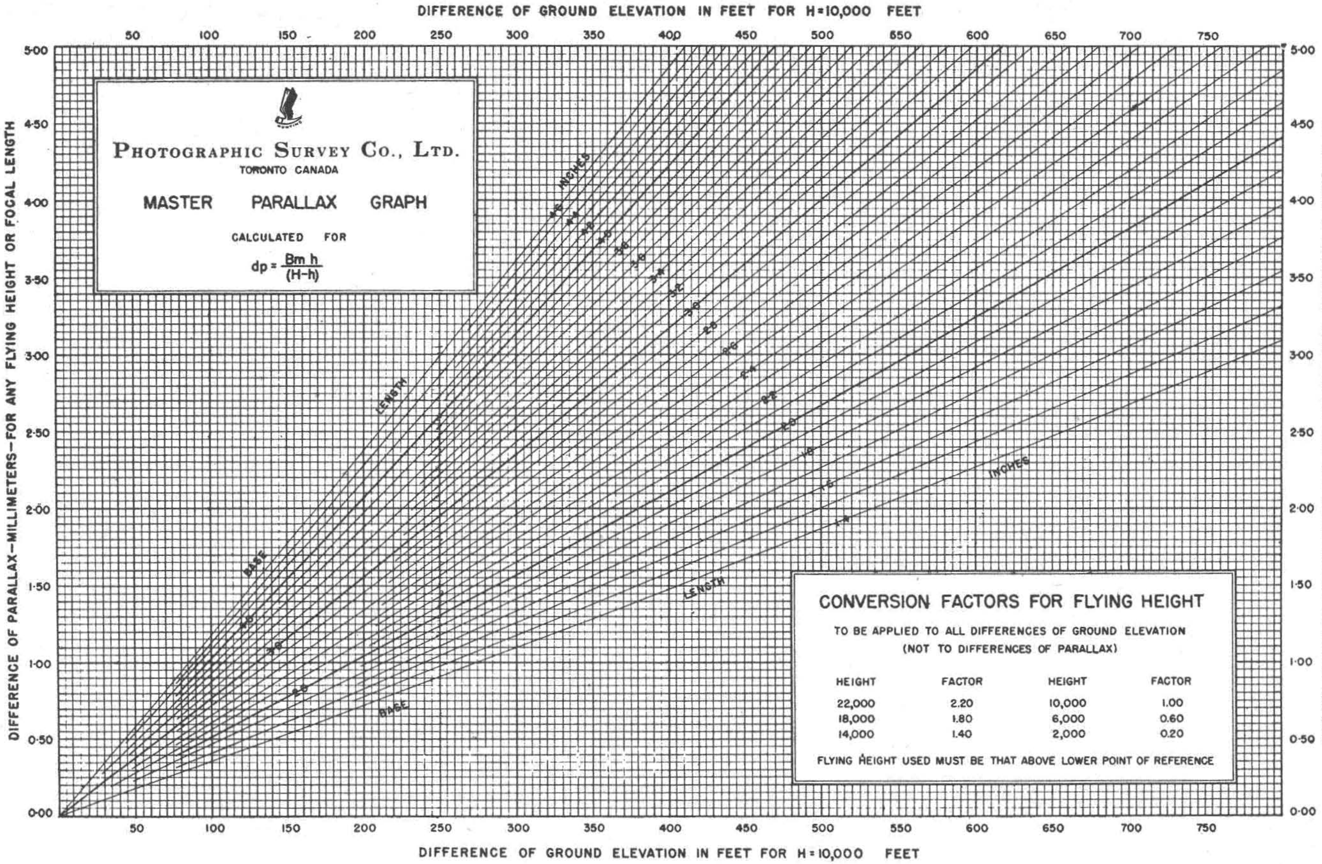
Under suitable conditions, however, a particular convenience results from the construction of a secondary graph from the Master Parallax Graph. Its construction is warranted when one such secondary graph will serve for a large number of overlaps. The advantageous feature of such a secondary graph is that the factor $(H/10{,}000)$ is eliminated, and differences of elevation are read directly for a specified base-length or series of base-lengths.

Let us presume that we wish to construct such a secondary graph for the conditions given at the top of page 412.

The left hand column contains differences of elevation for the intervals required at a flying height of 7,500 feet. The right hand column contains corresponding intervals relative to 10,000 feet; these are found either by slide rule proportion, or multiplication by $10{,}000/7{,}500 = 1.333$. These latter values, relative to 10,000 feet, are used as difference of elevation arguments, to extract from the Master Parallax Graph the differential parallaxes entered in the central columns under the appropriate base-length. From this point onwards, the right hand column is of no further use. The parallax graph is constructed from the information contained in the first three columns.

The resulting graph contains two curves, one for each extreme of base-length, plotted against differential parallax and corresponding difference of elevation.

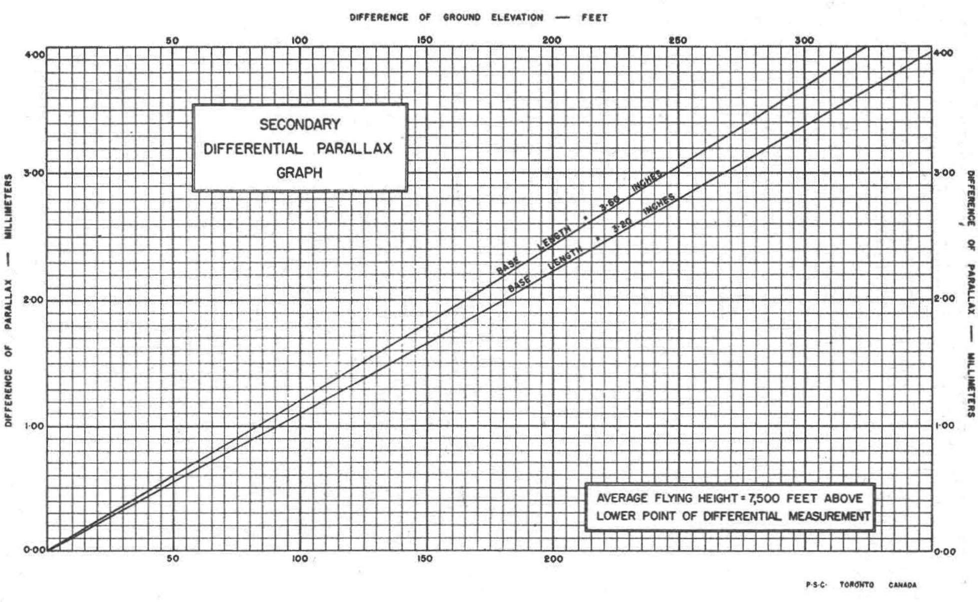
Variations of base-length within the limits plotted may be read by visual interpolation.



DIFFERENCE OF PARALLAX AND MEASURED BASE LENGTH OF PHOTOGRAPHS, UNDER ANY FLYING CONDITIONS, ARE USED TO EXTRACT A DIFFERENCE OF GROUND ELEVATION. THIS DIFFERENCE OF ELEVATION MULTIPLIED BY THE FACTOR H/10,000 RESULTS IN THE CORRECT DIFFERENCE OF ELEVATION FOR THE FLYING HEIGHT UNDER CONSIDERATION.

Average flying height —7,500 feet
Variation of base-lengths —3.20 to 3.50 inches
Contour interval —25 feet
Maximum difference of elevation—300 feet

Difference of Elevation for H=7,500′	Differential Parallax for Base-Length Indicated		Difference of Elevation for H=10,000′
	(3.20 inches)	(3.50 inches)	
25 feet	0.27 mm.	0.31 mm.	33 feet
50	0.55	0.60	67
75	0.82	0.91	100
100	1.10	1.20	133
125	1.38	1.51	167
150	1.66	1.81	200
175	1.94	2.12	233
200	2.22	2.43	267
225	2.50	2.74	300
250	2.80	3.06	333
275	3.08	3.38	367
300	3.38	3.70	400
325	3.67	4.02	433
350	3.97	4.34	467



Conclusion

The Master Parallax Graph has been presented as being an accurate, rapid and simple method for the solution of differential parallax problems.

Results obtainable by its use conform with those derived from the basic equations for absolute parallax, as long as the flying height used is that above the lower point of reference during any differential measurement.

Construction of a secondary differential parallax graph has been discussed and found to be suitable under conditions where an average flying height will suffice for a large number of overlaps. The only advantage of this graph over the Master Parallax Graph, is the elimination of simple slide rule work.

The Master Parallax Graph provides the accurate solution to all problems of differential parallax up to any difference of elevation for which the photogrammetrist may wish to construct his Master Graph; the one included with this paper is likely to cover most usual cases.

NEWS OF PHOTOGRAMMETRISTS

Arthur N. Winsor's promotion to Assistant Professor of Civil Engineering was recently announced by Dean Joseph Weil of the College of Engineering, University of Florida. Professor Winsor joined the faculty of the University of Florida, in July 1945.

William A. Riggs is now a member of the Industrial Relations Department of the Gulf, Mobile and Ohio Railroad. He is to make a systematic appraisal of all natural resources and physical assets in the territory served by the railroad.

Joe K. Bailey formerly with the U. S. Geological Survey at Chattanooga, Tennessee is now Chief of Field Surveys of the Atlantic Division of the Survey.

G. T. McNeil and Benjamin J. Lane have been transferred from the TVA at Chattanooga. Mr. McNeil is now at the U. S. Naval Photo Interpretation Center, Washington, D. C. and Mr. Lane is engaged in photogrammetric work for the Aeronautical Chart Service, U. S. Air Force, Washington, D. C.

Houston H. Bradford formerly Secretary-Treasurer of the Chattanooga, Tennessee Chapter is now a Photogrammetric Engineer in Honolulu, Hawaiian Islands.

Volney J. Cissna, Jr. is now Secretary-Treasurer of the Local Chapter at Chattanooga, Tennessee.

Wm. H. Meyer, Jr., the Society's energetic and enthusiastic Chairman of the Membership Committee has severed his connection with Lockwood, Kessler and Bartlett and is taking a well-earned vacation.

Oliver S. Reading of the U. S. Coast & Geodetic Survey is Chairman of the United States Delegation which will attend the meeting of the International Society for Photogrammetry at The Hague, Netherlands, Sept. 1–10. Other delegates include *E. S. Massie, Jr.* of the U. S. Forest Service and President of the American Society of Photogrammetry: *Talbert Abrams*, President, Abrams Industries; *Professor Earl Church* of Syracuse University; *William C. Cude*, Chief, Technical Division, U. S. Engineer and Development Laboratories; *James J. Deeg*, Chief, Map & Charting Section, Air Material Command, U. S. Air Force; *Lewis A. Dickerson*, Photogrammetric Division, Army Map Service; *Leon T. Eliel*, Fairchild Aerial Surveys; *Professor George H. Harding*, Ohio State University Research Foundation. *Col. Charles F. Hollstein*, Chief of Staff, 311 Air Division Reconnaissance; *Virgil Kauffman*, President, Aero Service Corporation; *Robert H. Kingsley*, Chief of Photogrammetry Division, Aeronautical Chart Service, Air Force; *Col. John G. Ladd*, Chief Engineer, Intelligence Division, Office of Chief of Engineers; and *G. C. Tewinkel*, Asst. Chief, Research Section, Photogrammetry Division, U. S. Coast & Geodetic Survey. Also the following whose appointments were too late for State Department designation, plan to attend the conference:—*Col. Murray A. Bywater*, Equipment Branch, Research & Development Directorate, U. S. Air Force; *Major Joseph J. Pellagrini* of the same office; *Lt. Col. Merle E. Parks*, Headquarters Proving Ground, Elgin Air Force Base; and *Kenneth Reynolds* of Bausch & Lomb. It is known that several others—names not now available—hope to attend as delegates or otherwise.

"Ted" and Mrs. Abrams have started on an "Around the World Trip." They will visit Ireland, England, The Netherlands, Germany, France, Portugal, Spain, Italy, Turkey, Syria, India, Siam, Philippine Islands, China, Japan, and Hawaiian Islands and arrive in San Francisco December 10.

Theodore W. Norcross is not connected with Philip B. Kail Associates as stated in an earlier issue of this JOURNAL.

The Officers of the Sacramento Section are Harrison C. Ryker, President; Sidney W. Smith, Secretary-Treasurer; and Channing P. Van Camp, Chairman of the Program Committee. Mr. Smith has reported that the section has 78 members.