SYMPOSIUM ON EDUCATION

Compiled by G. C. Tewinkel

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FOREWORD

The September issue of a year ago was dedicated to Education in Photogrammetry. Articles were contributed by many universities throughout the country. Comments from various members of our Society have indicated the advisability of continuing to publish periodically information relative to this subject. Publications Committee asked Mr. G. C. Tewinkel, Chairman of Education Committee of the Society, to monitor a brief symposium for this issue. The following worthwhile articles are the result of this request.

The Publications Committee expresses its gratitude to Mr. Tewinkel and other contributors identified in the symposium.—*Publications Committee.*

PHOTOGRAMMETRY IN THE ENGINEERING CURRICULUM

Eldon C. Wagner, Ass't Professor of Civil Engineering, University of Wisconsin

MANY engineering schools are now introducing courses in photogrammetry. In preparing a course, or courses, the instructor is faced with many questions and problems which must be answered before planning of the course can be started. These questions are paramount enough to warrant discussion and exchange of opinion among those who are now confronted with them. A few schools now offer sufficient courses to give degrees with a major in photogrammetry, but the vast majority offer either a very limited amount of material in conjunction with their standard surveying courses or nothing at all. This gives rise to the question of how much time should be devoted to photogrammetry.

It is fortunate that a few schools have seen fit to allot sufficient time and money to the subject to enable them to produce well trained photogrammetrists. The average school will not be equipped to do this and it is not necessary that they should. However, it is believed that every graduating civil engineer should have a good understanding of the fundamentals of photogrammetry just as he should have, for example, an understanding of the fundamentals of surveying. Photogrammetry is not only of importance to the topographical engineer but is of great value to many of the various branches of civil engineering, mining engineering, forestry, geology, agriculture, and numerous other fields. Due not only to a lack of trained personnel but largely to a lack of personnel with an appreciation of its possibilities, its use is often overlooked resulting in loss of time and money. It is felt that civil engineering students should be given a minimum of a one semester three credit course in photogrammetry. This should be sufficient to give the student an understanding of the fundamentals and an appreciation of the subject. It would be desirable to give the student sufficient training

* Information regarding Education in Photogrammetry which was not available for the symposium published in the September, 1947 issue.

to enable him to handle a project whether it be in mapping, route location, property development, or any other problem which may confront him. The young engineer is likely to find himself confronted with a situation in which he knows the best way to handle a particular problem is by the use of photographs. He may be hesitant to do so because it is a new method and there is no one in his organization that he can fall back on for advice and help. He should have sufficient training to give him confidence to discuss the question with superiors and to tackle the job. In addition to the regular course in photogrammetry, students who have a particular interest in the field should be offered an opportunity for thesis subjects. It offers an abundance of material particularly adaptable to thesis study in either research or practical applications.

FITTING PHOTOGRAMMETRY INTO THE CURRICULUM

Almost without exception every school will have the problem of finding a place for another course in an already overcrowded curriculum. The solution is not simple and will vary with local conditions. In the case experienced by the author the course was started as an elective. It would be desirable to have it required of all civil engineers, but after considering all the problems it was decided to start it as an elective and then, if desirable, at some later date it could be made a required course. Advance courses could be added as electives. This has the advantage of permitting the instructor to build up the course and also start with smaller classes until more equipment can be obtained and until he has gained more experience in teaching the subject. Once the course is organized there will be demands for it from other fields.

In fitting photogrammetry into the curriculum one of the first thoughts is to eliminate some of the present surveying work. Suggestions have been made to eliminate all plane table instruction, stadia instruction, and reduce the amount of field work on transit and level problems. This should be done with extreme caution. During the past ten years there has been a tendency to reduce the amount of surveying instruction and as a result most civil engineering curriculums have a topographical engineering schedule which is already at a minimum. A sound knowledge of surveying is essential to the photogrammetric engineer. It should be remembered that photogrammetry has not replaced our old methods. For example, in highway location it may eliminate the field work formerly necessary for reconnaissance and preliminary location and estimates, but the final line must be staked on the ground by the usual methods. The theory of the location is the same regardless of the methods used. In all aerial mapping, where any degree of accuracy is to be acquired, ground control obtained by normal surveying procedures is required.

EQUIPMENT REQUIRED FOR TEACHING PHOTOGRAMMETRY

The choice of equipment and supplies necessary for teaching a three credit course in photogrammetry may be varied to fit the available budget. A drafting room with a drafting table per student should be supplied. In most cases drafting rooms used for the regular drawing courses will be suitable. Each student should be supplied with a simple lens stereoscope. The design and cost of these varies considerably. If the budget is extremely limited satisfactory stereoscopes can be made at a small cost with inexpensive lens.

Some type of equipment will be needed for making parallax measurements. For purposes of teaching the theory an accurately graduated scale can be used. In order to bring the student closer to practical methods parallax bars or stereocomparators of some type should be available. While these are not used for ex-

tensive mapping projects they are used in practice and they are excellent for training the student in elevation measurements and stereoscopic plotting. It is desirable to have a stereocomparagraph available for each student in a class. Due to the cost of the equipment this probably will not be immediately possible and the quantity of equipment can be built up over a period of time.

Equipment for radial line plotting will be required. Several types are available but the slotted metal templates commonly known as "mechanical triangulators" or "Lazy Daisy triangulators" are recommended since they can be used repeatedly with a very small loss.

A projection board will be required if students are to compute and plot map projections. A piece of $4' \times 6' \times \frac{3}{4}''$ plywood is suitable for this purpose. Material for laying mosaics will be needed. Plywood, masonite, or similar material is satisfactory. While not too desirable, the mosaic may be laid on a cloth stretched over the board. This permits reuse of the boards. Gum arabic, rubber cement, or other suitable adhesive will be needed for the mosaic.

Miscellaneous equipment and supplies include pins, sandpaper, magnifying glasses, beam compass, drop bow compasses, straight edges and scales.

It is felt that the above is the minimum equipment necessary for a basic course. There are numerous minor items the instructor will find convenient.

In addition, many other items are desirable and can add to the value of the course. Reflecting projectors and vertical sketchmasters are useful in transferring detail from the photograph. Drafting arms to provide a parallel mounting movement for the stereocomparators are necessary if more than a minimum amount of work is to be given. Multiplex or equivalent equipment is desirable but not essential for a basic course. The cost normally prohibits its use for instructional purposes. A photographic laboratory is a convenience but not a necessity. If negatives are available a small laboratory will probably be more economical than the purchase of all contact prints, enlargements, etc. If extensive courses are given the laboratory is a necessity and should be equipped for developing, printing, enlarging, copying, and rectifying photographs.

Contact prints are available from the Department of Agriculture, Production and Marketing Administration, at a cost of 35 cents each. Enlargements may also be purchased from the same source.

In summarizing the above, the average cost for the minimum amount of equipment will be approximately $1,000.00. More elaborate equipment can run the cost to $20,000.00 or more.

Course Material

It is believed that when a student has completed a basic course in photogrammetry he should have a good understanding of the geometry of the aerial photograph to include scale determination; tilt determination and displacement, relief displacement and the standard nomenclature connected therewith. The difficulties of the practical application of the theory should be pointed out. He should have an appreciation of the magnitude of errors introduced due to tilt and relief displacement, under what conditions they can be disregarded, and when they should be considered.

The student should understand the theory of determining differences in elevation by means of parallax measurements and the operation of various types of equipment made for this purpose and the advantages and limitations of each type. He should have sufficient training to give him confidence in his ability to make measurements.

He should know the requirements for ground control and field methods used

in obtaining it. The methods of extending ground control should be understood and problems in radial plots should be worked by the student.

The uses and limitations of mosaics should be pointed out. The student should have practice in laying both uncontrolled and controlled mosaics. The various techniques of laying mosaics should be pointed out and methods of "dressing up" the mosaic illustrated.

Photo interpretation should be covered sufficiently to enable the student to readily identify terrain features, type of vegetation and construction by man. He should be able to identify various types of road surfaces. Some work on soil identification is desirable.

In many cases mapping work may involve the revision of existing maps. For this reason it is believed advisable to give the student some practice in revising existing maps from aerial photographs with the view of teaching him how to take advantage of the existing information on the map as control. The methods of transferring the detail from the photograph to the map and correcting for displacement due to tilt and relief should be understood.

It is not necessary for the student to have a detailed knowledge of the problems involved in taking the photographs. He should know the standard type cameras in use and sufficient understanding of procedures and methods to enable him to make cost estimates. He should know what qualities are desired in the final product to enable him to write specifications for photo coverage.

In a limited course it is not believed advisable to spend much time on ground photogrammetry or mapping from high oblique photographs; while both are important, their use is limited.

In the study of the theory the practical applications should be pointed out and wherever possible the theory taught by the use of practical problems.

PHOTOGRAMMETRY OFFERED AT PURDUE UNIVERSITY

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SOME interest has been expressed with regard to the background or reasons for offering a course in photogrammetry at Purdue University for the academic year 1948–49. The interest has taken the form of several direct questions. My answers to those questions are perhaps as good a way as any to tell about the course.

One of the leading questions was "Why was it decided to inaugurate the course?" Strictly speaking, the course is not being inaugurated this year, since the foundation was laid several years ago by Professor M. C. Todd. Considerable appropriate elementary equipment is on hand: Professor Todd had received instruction at the plant of the Abrams Instrument Company in Lansing, Michigan; and, in general, the course had been started in a small way, when ill health overtook him and brought about the abandonment of the course. Since that date, it has been the intention of the Civil Engineering Department to get the course under way, as soon as someone on the staff was in position to go ahead.

Upon retirement from the U. S. Coast and Geodetic Survey a year ago, I returned to my Alma Mater with a background of 33 years of field work in most of the branches familiar to all Coast and Geodetic Survey officers. It was understood that my employment contemplated making some practical use of my experience. Since Indiana is an interior state, geodesy was the obvious outlet, particularly as the U. S. C. & G. S. has increased the intensity of the control net of the State in the past few years. It was felt that if this net were to be made