MISSISSIPPI HIGHWAY DEPARTMENT CONDUCTS TRAINING COURSE IN HIGHWAY PHOTOGRAMMETRY

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THE officials and administrators of the Mississippi State Highway Department responsible for establishing policies and methods of procedure by which highway engineering work will be accomplished, have long recognized the advantages and savings that result through the application of the science of photogrammetry in highway engineering. The department has utilized this science to varying degrees for approximately nineteen years; however, it has not been exploited to its fullest extent in the past due to the fact that there has always been a shortage of personnel trained in this field.

Nevertheless, the Mississippi Highway Department is indeed fortunate in one respect in that it has a man who has spent many years in the study of aerial photography and its application to highway work, and is recognized nationally as an authority in this field of photogrammetry. Mr. *I. W. Brown*, State Manager of the Traffic and Planning Division, and for many years location engineer for the department, has promoted and advocated the use of aerial photography in the department for more than nineteen years.

Late in 1950 the officials of the highway department encouraged Mr. Brown to conduct an In Service Training School on Aerial Photography for personnel of the department. Several things prompted the officials to encourage such a course at this time, the most important probably being that most of the men previously trained to do this type of work had left the department. Also, the rising cost of highway construction and the shortage of engineers trained in highway work are placing hardships on highway departments throughout the nation; thus any measure to save time and to reduce the cost and manpower should not be left undone.

Mr. Brown spent several months preparing a short course in Aerial Photo Interpretation which is believed to be one of the most extensive courses of its kind ever conducted by a highway department. The course was designed for about twenty men, and required four weeks to complete. It involved two hundred hours or more of classroom work and consisted of four exercises and approximately forty-one practical problems to be worked by each student. The course covered in a somewhat condensed form what under average conditions would require four and a half months.

PURPOSE OF SCHOOL

The primary purpose of the school was to train personnel from various branches of the highway department in the basic fundamentals of aerial photo-interpretation stereoscopic work and its application to highway engineering. In the past, many of the engineering functions performed by the department, especially in highway location work, have entailed costly field surveys. Some of these can be done cheaper, faster and more accurately by utilizing aerial photographs. Thus it was felt that the department could operate more efficiently and save much of the taxpayers' money by training personnel in this field of science.

Another purpose was to impress upon those taking the course the advantages of doing certain phases of highway engineering with vertical aerial photographs, through having them solve practical problems and make comparative

time and cost analyses of doing the same job with and without the use of aerial photographs.

SCOPE OF THE COURSE

The course, as designed, offered four phases of work in highway photogrammetry. To satisfactorily complete the course, each student was required to do in a creditable way each of the following:

1. Interpretation work required in the average problems encountered by the highway location engineer.
2. Run out the drainage network, dividing ridge drainage areas, compute the watershed areas and structure openings for the cross drains.
3. Make stapled index and semicontrolled mosaics suitable to the needs of the highway engineer.
4. Make ground form-line sketching and contour mapping.

SELECTION OF PERSONNEL TO ATTEND SCHOOL

The personnel who attended the school were selected from the six construction and maintenance districts of the Mississippi Highway Department, and from the Traffic and Planning Division. When contacting the district engineers. Mr. Brown requested that each send two men, preferably young graduate engineers with normal vision in both eyes, without the use of glasses. Also preference was to be given men who knew nothing about stereoscopic study work but were willing to learn. The district engineers were cautioned to use the best of their judgment in choosing men who would go places, so to speak, in the field of highway engineering.

Mr. Brown also selected eight men from various sections of the Traffic and Planning Division. The majority came from the drafting section where personnel trained in this science is needed for mapping and other work.

THE TRAINING COURSE

The course consisted primarily of the solution of practical problems. Mr. Brown gave short lectures as the course progressed from one phase of work to another, and was available at all times to answer questions and offer assistance. In addition, a textbook was prepared by the instructor and a copy given each student at the beginning of the school for study, and for later use as a reference.

The course of instructions was divided into seven different phases and taken up in the following order:

1. Airphoto Interpretation
2. Stereovision
3. Stereoscopic Study
4. Drainage Structure Development
5. Mosaics and Mosaic Making
6. Ground Form Line Contours
7. Field Altimeter Work—Form Line Contours

Perhaps the best way to explain the extent of the training is to state briefly what was covered in each of these seven phases.

Airphoto Interpretation. At the beginning of the course, the methods and equipment used in making aerial photographs were explained to the class. Emphasis was placed on aerial pictures being made to many different scales, the size depending upon the use to which they are to be put. The difficulties usually encountered in recognizing or understanding them were discussed. The fact that the view on the photos is vertically down was cited as one of the

most common difficulties, because ordinarily the eyes see the objects in a more or less horizontal plane and in this way only one object is viewed at a time, rather than an attempt to take in the entire area at once as is done when viewing a vertical photograph.

The first five problems of the course involved identification of various objects and features on vertical aerial pictures. The students were taught that interpretation requires the study of four different qualities in the prints: namely, (1) tone, (2) size and shape, (3) light and shadow, and (4) the shadow which it cast.

Upon completion of the first five problems, which required approximately seventeen hours of classroom work, the students had become familiar with vertical photos and could identify most of the objects and features usually encountered by the highway engineer.

Stereovision. The second phase of the course was designed to teach the "Theory of Stereovision." This phase contained four exercises and four problems. Their purpose was to teach the students to see relief with a pair of overlapping photographs, without the aid of a stereoscope. This proved to be the most difficult part of the course for several students. While the ability to see relief with a pair of overlapping photographs with the eyes unaided has numerous advantages and enhances the interest in stereoscopic study, many hours of training are required by most individuals before they master the art of stereovision by this method. However, before the course was over, nearly all of the students had satisfactorily solved the two drainage area problems that were required to be solved without the aid of an instrument.

Stereoscopic Study. The orientation on Stereoscopic Study covered this subject very thoroughly. It was pointed out that there is a correct way to set up aerial photographs and to correctly adjust the stereoscope, but unfortunately too few people really understand and appreciate how this is done and the benefits to be derived therefrom. The two outstanding advantages gained were cited as: (1) the full value of the three dimensional view is obtained, and (2) eyestrain is eliminated even when used constantly over long periods of time.

This phase of the instructions covered those steps that are considered necessary when undertaking stereoscopic study work, such as: (1) locating the principal point on an aerial photograph, (2) transferring the principal point to an adjacent print in the same flight line, by both the visual and stereoscopic methods, (3) locating the base flight line, (4) orienting the prints and (5) proper adjustment of the stereoscope.

Drainage Structure Development. Following closely, and in conjunction with the orientation in stereoscopic study, was that phase of the short course dealing with drainage structure development. This might be called one of the primary phases of the course, because it involved seventeen or more problems requiring approximately one hundred hours of classroom work. The purpose of this phase was threefold and was designed to teach the student to do a creditable job in the following three phases of stereoscopic study work:

1. Run out the drainage network of watershed areas.
2. Run out drainage divides and compute watershed areas.
3. Compute the waterway opening for the location in question.

One very interesting problem in this series afforded an opportunity to compare the time required to measure a drainage area with and without the aid of vertical aerial photographs. First, the students were given the aerial pictures of an area involving a drainage structure across a stream known as Cow Creek in Lauderdale County on U. S. Route 80. They were instructed to run out the

drainage network of the watershed area, run out the drainage divide and compute the watershed area, and compute the structure opening required. The time required by the average student to do this work was approximately four hours.

Next, the students were given the field notes for this same area, and were instructed to plot them and make the same computations as required in the problem with the aerial pictures. Just to plot the field notes and make these computations required approximately five hours by the average student.

This impressed the students very much because it proved that drainage structure openings could be computed with the use of aerial photos in less time than it required to plot the notes from a field survey, to say nothing of the time consumed in making the field survey.

Another advantage of the use of aerial photos was also brought out in this problem. It happened that there was an error in the field notes and the traverse would not close. Further field surveys would probably have been necessary to make the traverse close satisfactorily. It was apparent that such repetition of work is never necessary when aerial photos are utilized. This proved that drainage areas can be obtained from aerial photographs with less possibility of an error and that as a rule they are more accurate than those obtained by the usual field survey methods, because they follow more closely the dividing ridge.

Mosaics and Mosaic Making. The instruction included index mosaics, uncontrolled mosaics and semi-controlled mosaics. The building of controlled mosaics was explained, but actual construction was not undertaken. It was pointed out that controlled mosaics are required for more exact mapping needs than is ordinarily encountered in highway location work, and that should the need arise for a controlled mosaic, it is a most certain possibility that the actual construction can and will be contracted by some reputable company which is capable and prepared to do this class of work.

An index mosaic was assembled by each student covering approximately one half of one of the counties in the state. These mosaics were mounted on large boards, and photographs were made of each and given to the students to illustrate the method used in making an index for a group of aerial prints.

There were several problems in building uncontrolled and semi-controlled mosaics. During this instruction, the students were taught the proper way to trim, featheredge and mount the prints to make a complete mosaic. The straight-line-method of control was used to build the semi-controlled mosaics, and two such mosaics were constructed by each student. At the conclusion of the school, the students were given the mosaics they had made as souvenirs.

*Form Line Contours.*The final two phases of the short course involving Ground Form Line Contours and Field Altimeter Work—Form Line Contours were very closely related and can be covered as one phase.

The first problems in this phase involved the sketching of unknown elevation contour form lines on vertical aerial photographs to show the configuration of the earth's surface. Next to seeing stereoscopically without the aid of an instrument, this was probably the most difficult work encountered by the students. It was apparent to most of the students that to become proficient in the art of drawing ground form lines, much practice would be required.

Following the ground form line contour work, the students were given photographs on which spot elevations had been placed. On these prints they were required to sketch form line contours at five foot intervals. Finally, the students were taken into the field with altimeters where spot elevations were determined on several vertical aerial pictures, then the form line contours drawn on the prints in the office.

CERTIFICATES AWARDED

At the conclusion of the school, each student was awarded a certificate signifying that he had satisfactorily completed a four week course of study in Photogrammetric Engineering. The certificates were signed by the three Commissioners of the State Highway Department, the Director, the Chief Engineer and the Instructor, and bore the State Highway Department Seal.

The author can testify that the school was a success in every respect, because he labored along with eighteen other students through this extensive four weeks of training. The success of the school and amount of material covered in such a short period of time was due principally to the very excellent manner in which Mr. Brown had prepared and presented the course.

It is the opinion of everyone connected with the school that it will pay for itself many times over, and without exception, every student expressed a desire to attend another school of this type to further advance his knowledge in this field of science.

Tentative plans have been made to hold similar schools each year, or as often as it appears necessary to keep a sufficient number of trained personnel in the department. Plans have also been discussed to offer an advanced course for those holding certificates from this first school.