

Aerial Surveys for Special Purposes*

J. E. HARWOOD,
Asst. Location and Design Engineer,
Virginia Department of Highways,
Richmond, Virginia

ABSTRACT: *The use of aerial photography in connection with the expanded Highway Program in Virginia is discussed. The paper describes initial studies and reconnaissance surveys by the Department in determining route locations for the Interstate System, with special emphasis on the manner in which the aerial photography was used. Also discussed are different uses of aerial photography in connection with the location and design of controlled access highways.*

I AM convinced that in the use of aerial photography and photogrammetry in the highway field, we have only scratched the surface.

When the Federal-Aid Highway Act of 1956 was signed into law on June 29 of last year, this nation was embarked on a road-building program, the like of which has never before been known in the history of man. I have heard it said that this program is the biggest job this country has ever undertaken short of war. We are entering it with an acute shortage of engineers and, if it is to succeed, as I know it will, we must avail ourselves of every possible shortcut and time-saving device at our command. *Aerial photography, photogrammetry, and the by-products offer the greatest opportunity to do this that I know of.* That this was recognized by Congress is evident from Section 121 of the Act which specifically refers to the use of photogrammetry in expediting the program.

We, in the Virginia Department of Highways, like most of the other States, are exceedingly short of qualified highway engineers. For many years, we have been interested in photography and photogrammetry; we have used it in almost all of the conventional ways—reconnaissance, route selection, preliminary location survey, comparative estimates and so forth. We are constantly alert for additional uses. Some of these I will discuss in this paper.

The 1956 Federal-Aid Highway Act requires each state to estimate the cost of

completing the Interstate System in the state. These estimates are to be made in some detail and to a uniform degree of accuracy throughout the country, since they will be used as a basis for funds distribution after the first three years of the program. The estimates must be submitted to the Bureau of Public Roads by July 1, 1957.

To estimate the cost of a highway with any degree of accuracy, it is essential that the location be established. Recognizing this, the Bureau of Public Roads requested the states to submit a route location for the entire System by January 1, 1957.

Mr. Pryor's discussions of highway location have made evident that long and detailed study, investigation, and analysis are required. Virginia has 1,012 miles of Interstate Highways. In July 1956 we were asked to locate this great mileage in about five months. In addition to route location, within this short period, we had to prepare a report with substantiating maps for submission to the Bureau of Public Roads.

A firm of consultants to aid us in the route selections was employed.

Of course, our first consideration was the use of aerial photography, both for the studies and for the report. Fortunately, we had photography which we had previously secured; this covered most of the routes. We also had Department of Agriculture photography of recent date over the remainder. It was, therefore, decided to the fullest extent possible within the available

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time to utilize this photography in making the reconnaissance surveys and route location studies.

Our first problem was to secure mosaics for use in the report and field work of reconnaissance and route studies. We could not prepare or get the work done commercially in the time specified. After much discussion, we concluded that maybe we were asking for too much and that we did not actually *need* a finished mosaic. In the end, we used a glorified index map—a stapled mosaic with the photograph numbers and symbols cut off and with a little more attention paid to matching than would be done with an ordinary photographic index. Of course, this mosaic was not assembled to a uniform scale, and each photograph along the flight line may not have been exactly oriented. But we were not seeking an *exact* route location; we wanted only a general routing. Using these mosaics and the photographs in conjunction with available U.S.G.S. topographic maps and old plans, we could not stray too far afield.

This was a simple use of aerial photography, certainly not a very scientific one. I mention it because I believe that we are sometimes inclined to strive for perfection where this is not really necessary. *If we recognize the limitations of the materials we use, and keep in mind the desired accuracy of the final product, striving for a balance between the two, I think we will find that much time, energy, and manpower can be conserved.* I cannot emphasize too strongly, however, that we must recognize the limitations of the materials we use. In using the stapled mosaics I have described, it must always be kept in mind that they are not maps, not true to scale and possibly not correctly oriented. They are only pictures and not scale-accurate pictures at that. If this be remembered the use of these mosaics and similar materials can help a great deal. If it be forgotten, then we are in trouble.

To continue with our reconnaissance survey and route location studies, the procedure briefly was:

1. Photographic interpretation of geologic data by stereoscopic examination of the contact prints, as a means of estimating sub-surface conditions. The results were recorded on the prints and mosaics used in subsequent field reconnaissance and route location in the office.

2. Stereoscopic examination of the con-

tact prints for the purpose of selecting several alternate route locations. U.S.G.S. topographic maps were used in conjunction with the photographs. Among other things, the photographs were invaluable for right of way estimates and for comparison of routes because they had been recently taken.

3. The geologic data, together with alternate routes and other information on traffic, points of interchange, etc., were placed on copies of the mosaic for field study. For this purpose, a translite film positive of the mosaic was made and blue line prints were run off for use in the field. While there was, of course, loss of detail, these prints provided the field crews with an inexpensive work sheet which could be marked on, taken out in all weather, folded, and generally handled the same as the usual blueprint.

4. A field reconnaissance survey was made of all routes. Each route was studied and comparisons were made in as much detail as was possible within the time allotted. Notations and recommendations were made on the prints by the field engineers; sometimes new routes were sketched in and any unusual conditions noted. The prints were then reviewed by the Consultants, the Bureau of Public Roads, and the Highway Department. General agreement was then attained on a routing to be included in the report.

For the printed report, the route locations together with the proposed location of interchanges, structures, service roads, etc., were drawn on the mosaic for reproduction and inclusion in the report.

I have explained this reconnaissance survey and route study work in some detail because I think it is an excellent example of how aerial photography can be adapted to almost any phase of highway location. Before leaving this subject, however, I should like to again caution that you know and constantly remember the limitations of the materials you are using, and never attempt to use them for any purpose other than the one for which they were intended.

The standards for the Interstate System require full control of access. This requirement means that a great deal of reconnaissance surveying of large areas and investigation and comparison of route alternatives are necessary in the route location and design stages to determine how best to serve properties split up or cut off from out-

lets to other roads by the "barrier" which the controlled access highway forms. This is especially true when an existing conventional type highway is converted to one with full access control. In both cases, it is essential to have information on all properties along the route, the full property lines, existing entrances, and so forth. In Virginia, where property lines are irregular, we believe that aerial photographs on a fairly large scale can be invaluable in this work. From recorded needs, property lines and boundaries can be plotted on the photographs with sufficient accuracy to permit access requirements to be worked out, especially since existing entrances and roads can be readily identified. The property lines can be generally plotted by reference to fence lines, streams, etc., which are easily recognizable. Thus, with the photographs and ownership limits, speedy and accurate decisions can be made on such problems as service road locations, whether or not to purchase residues, installation of farm crossings, and other attendant problems.

We have made use of aerial photography in other ways. Oblique and vertical photographs have been utilized for public hearings. Sometimes the proposed highway route location has been superimposed on them. We used stapled mosaics most often. This was done by photographing the photographs assembled to form the mosaic and running the negative through the blueprint machine to make a handy and expendable print for field and office use and for reports. I am sure many of you know other special uses. Some that occur to me now are for pavement performance studies, for right-of-way evaluation, for "before and after" pictures, for records, and for use in right-of-way acquisition where property is condemned and damages are assessed after the road is built. In such cases, a photograph showing conditions before construction, and after, often indicate to viewers, benefits to property by reason of new construction that might otherwise never have been noticed; and, of course, the opposite is also sometimes true. In pavement performance studies, photographs taken from a low flight height and enlarged can

sometimes be used to tabulate cracking in concrete pavement, and, when taken at intervals, they provide valuable information of the pattern and extent of pavement cracks and other failures.

I have mentioned only a very few aerial surveys for special purposes. I hope that these give some indication of what can be done and that I have started you thinking of other uses. We, in Virginia, certainly want to avail ourselves of every possible use and we will welcome any and all ideas and suggestions.

MR. PRYOR:

It is important to emphasize at this moment that photogrammetry is actually the medium by which a large number of specialists in the highway engineering field get together. Heretofore, each one of them has had a language of his own. We all know the effect of language barriers. They cause difficulties, many misunderstandings, and on a national basis, they may have caused wars.

Highway departments have highway wars with the public, fellow engineers, fellow specialists, and so on. And, as Mr. Meyer pointed out, if we can dispel suspicion between the various specialists and the public who are being served by the highway engineering profession, we have accomplished a great deal by employing photogrammetry properly. But to properly employ it, we must, of course, educate not only ourselves but the people who will have access to the information that we provide through the use of photogrammetry.

Now, as a part of this cooperation and specialization on the engineering team, highway engineers are not, shall we say, complete any more in and of themselves. They must bring in many specialists, important among which are photogrammetric engineers and the photogrammetric engineering profession as a whole, to help them perform those technical services they neither have the time or the education, nor the equipment to do for themselves. Qualified photogrammetric engineering firms can do much to fill the gap in highway engineering.