HIGHWAY LOCATIONS BY AERIAL PHOTOGRAPHY IN NEW JERSEY*

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DR. JOHN FINLEY, sometime College President, later Editor of the *New York Times*, and one of the wisest of men of our times, once observed that the advent of the airplane had made it possible for man to obtain for the first time a "planetary view" of the universe. He even urged that geography be taught from the air to enable students to secure this planetary view. While educators have been slow to heed his advice, engineers have been prompt to recognize the unique value of the airplane, not only in making reconnaissance surveys but also in detailed mapping. Many of the larger Highway Departments in the country have utilized aerial photographs in the design and location of new highways for some time. In New Jersey aerial photography for highway location has been used for the past twenty years.

Today aerial photography in the field of Highway Engineering presents an ever-widening usefulness not only in the planning of highways, but in their location, design and construction. Moreover, the use of this new photogrammetric tool in all these four stages is destined to play an indispensable role as we embark on an integrated program of modern parkways and freeways, and seek some permanent relief from the traffic congestion in our urban areas. There have been at least ten clearly delineated uses of aerial surveys in New Jersey in different stages of highway development which can be outlined as follows:

In the first place, aerial photography has an important use in the study of alternative alignments as well as the selection of a preliminary alignment of a new route previous to making the extensive surveys and necessary plotting of topography which must follow in the field survey. Such aerial photography has particular value in New Jersey in connection with the location of routes to relieve traffic congestion on main highways where the topography is rugged and the establishment of grades and curvatures is extremely important. The development of contour maps, showing the topography, are extremely helpful for this type of survey. From such maps it is possible to develop the necessary engineering and economic data to support the preliminary plans. Making topographical surveys and plotting is at best a time consuming task which can be very greatly facilitated with the development of such aerial photographs.

In the second place, aerial photographs, both vertical and oblique, can profitably be employed in the secondary stages of design work. Such projects as interchanges and traffic separations can be located and planned in advance by use of aerial photographs. Moreover, tentative profiles can be studied to determine where underpasses and overpasses should be constructed, and the conclusions can be demonstrated and exhibited. Aerial data, while it cannot replace models does save the expense of preliminary ground surveys as well as the time and expense involved in the building of models.

In the third place, aerial photography has a special utility in laying out the alignment of new parkways where it is essential not only to select scenic areas, but also to adapt the roadway to the terrain. The Parkway Engineer is under a special obligation to so locate, design and construct the parkway as to enhance the beauty of the countryside through which it passes, so he welcomes the aid of the photogrammetric surveys.

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In 1939 aerial mosaics were used by the State Highway Department in studying the alignment of the Rockefeller Memorial Highway, a scenic highway leading from Camden easterly to the seashore. The scale of the mosaics was 1″=1,000 feet. More recently, in planning our Route 4 Parkway through the densely populated metropolitan area of northeastern New Jersey, aerial mosaics were made at the convenient scale of 1″=800 feet. Also, it could easily be enlarged to 1″=400 feet for more detailed work in laying out a new alignment. Such mosaics provide an accurate picture of all visible relations between terrain, rivers, woodland, roads and existing structures.

In the preliminary planning of the Palisades Interstate Parkway following the course of the Hudson River from Bear Mountain in New York to the George Washington Bridge in New Jersey, aerial surveys were utilized most effectively not only to determine the location of the New York Section of this Interstate Parkway but to determine the proper location of this route as it entered New Jersey from New York. The work was done far more expeditiously than it could feasibly have been done by other means, and at approximately one-third the cost of the usual type of reconnaissance surveys and office work necessary in the past.

In the fourth place, aerial photography has an added use in connection with the location and determination of the nature and limits of landscaped borders on the proposed parkways. The location of trees and shrubbery in landscape plans are frequently spotted rather than accurately located. The aerial survey provides a more accurate location of all native material. Planting plans can accordingly be more effectively evolved on the basis of such photography.

In the fifth place, the aerial photograph provides a unique way of protecting the survey party and sometimes the Highway Department from the embarrassment of going over private property and arousing either the resentment or speculation of the property owner concerning the possible location of the proposed roadway.

In the sixth place, aerial photography can perform a very valuable function in presenting to both public officials and laymen the relation of the highway to the ground development. While aerial photographs disclose only a horizontal plane, they have very real value for display purposes. They can at times resolve doubts in public hearings as to the definite location of a new roadway.

An interesting example of the use of such a mosaic in connection with a public hearing took place recently in connection with the projection of Route 100 Freeway through Elizabeth. The City of Elizabeth employed a firm of Consulting Engineers to prepare a plan for a controlled access freeway through the City. The City Engineer also had an alternate suggestion on a new alignment. These two proposed alignments, together with the proposed alignment of the Highway Department provided three alternate choices. When, however, they were put on a mosaic map and exhibited at the public hearing, it became clear that the proposal of the State Highway Department not only took less in the way of ratables than that of the Consulting Engineers but also produced an alignment more satisfactory than either of the other two proposals. The alignment of the State Highway Department was thereupon adopted subject to a minor modification.

In the seventh place, aerial photography can be usefully employed in the preparation of highway maps. In the development of the very valuable Planning Survey Maps in New Jersey, basic information was taken from ground traverses along the State Highway System. Additional information, however, was transferred to these planning survey maps from the aerial photographs. The result

is the completion of the finest set of highways maps that the State has ever had.

In the eighth place, the photogrammetric engineer can provide a much needed service to a highway department depleted in engineering personnel as it seeks to augment its staff for the preparation of reconnaissance surveys and plans for future highway expansion.

In the ninth place, the aerial survey of densely populated urban areas, where traffic relief is urgently needed, discloses where new routes serving to relieve traffic may also remove blighted areas.

Finally, the aerial survey can become an indispensable adjunct in the preparation of soils data. At the present time in New Jersey we are engaged in the development of a soils map of the State which will aid us in the selection of suitable road materials. This is a Joint Research Project with Rutgers University. It is planned to employ aerial photography in preparing the soil map. This use of aerial photographs which has been worked out successfully in Indiana by the State Highway Department in cooperation with the State University, should prove to be no less useful in New Jersey in the cooperative preparation of the soil map.

These then are ten clearly demonstrated uses of aerial photography in the development of our modern highway program. There is one suggestion that has come out of our experience which may be relevant for the purposes of this discussion, namely, that in the mechanics of making flights for planning purposes, a photograph made over a wider and longer area than is deemed necessary should prove to be very valuable. Contour maps can be prepared within the limits thought sufficient. If it is found necessary subsequently to extend these lines, additional length or width in the area can be obtained from these inclusive photographs. The season at which the photographs will be taken also depends upon the type of data that is desired. Generally aerial surveys in the spring or fall are most useful.

As aerial photography proceeds it will develop both as an art and as an indispensable tool in the hands of the highway engineer. Present costs are high, but will undoubtedly be reduced as the demand increases. Today such photography costs between $600 and $800 per mile for mosaics 5,000 feet wide and $1,500 a mile for topographical maps 1,500 feet wide at the scale of 1″ = 100 feet with a two foot contour interval. Where buildings are omitted the cost is, of course, less. With the increasing usefulness of aerial photography the expense of such photographs is small in comparison with the far-reaching results of this method.

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