in. wide and 72 in. long. The accuracy of the photogrammetrically compiled topographic maps are tested by traverses and profiles measured by field survey parties.

The designed alignment is projected on the topographic maps, and the mathematical description thereof is actually computed by plane coordinates. Topographic data and listings of grading quantities are obtained by automatic data processing. In general, the "Reference Guide Outline, Specifications for Aerial Surveys and Mapping by Photogrammetric Methods for Highways, 1958" is used in the administration of all contracts awarded for aerial photography, ground control surveying, and topographic mapping by photogrammetric methods.

USE OF AERIAL PHOTOGRAPHY IN REGION 15, U. S. BUREAU OF PUBLIC ROADS

(Eastern National Forests and Parks)

An aerial photography contractor was engaged in March 1961 for topographic mapping of a 10-mi section of the Natchez Trace Parkway in Mississippi. The preliminary P-line was staked on the ground by conventional survey methods.

To stake the right-of-way, it was first necessary to design a centerline of the highway for the projection of the right-of-way taking lines and preparation of the development plans.

The Public Roads division office set photographic targets on survey control points. The targets were cross-shaped and made of white and black cloth strips 8 in. wide and 10 ft long. All vertical and horizontal survey controls were tied to the targets, which were centered by a tack in a wooden stake driven flush with ground surface.

Under the negotiated contract, the aerial surveys contractor furnished the following:

1. A route map at a scale of 500 ft to 1 in., and two sets of contact prints, 9 by 9 in., of the 500 ft to 1 in.-scale vertical photography.
2. State plane coordinate computations for all preliminary P-line control points and for all other control points for which photographic targets were set.
3. Topographic maps extending 1,000 ft on each side of the P-line at the horizontal scale of 100 ft to 1 in. with a contour interval of 5 ft and three sets of prints of each map sheet.
4. An index map of the map sheets and a photographic index of the aerial vertical photographs.

For such work, the contractor was paid $500.00 per linear mile of highway.

The contract stipulated the contours should not be in error by more than ¼-contour interval (1.25 ft) for 90 percent of the points tested, and not more than ½-contour interval for the remaining 10 percent. Numerous checks made by the U. S. Bureau of Public Roads showed that in no case was a contour in error as much as 1.25 ft; for over 90 percent of the points tested the contour error was less than 0.5 ft. Horizontal accuracy was also very satisfactory.

The 2,000 ft width of topography mapped provided much latitude in design for centerline projection. Such width also contributed greatly to the expeditious design of drainage structures and preparation of a complete set of construction plans.

Photography flying was done on March 14, 1961, before the trees began leafing out. The airplane used was a Cessna 180; the aerial camera was a K-17 type (modified) with a 6-in. focal length Metrogon lens tested by the National Bureau of Standards. The contractor completed all photography, plane coordinate computations of control, and photogrammetric compilation of the topographic maps by the latter part of April 1961.

The cost of such topographic mapping, if done by conventional ground survey methods would have been approximately $16,000 and would have taken from 4 to 5 mo to complete

The cost of this contract was $4,909.21 and less than 2 mo were required to complete topographic mapping of a route band approximately 2.5 times as wide as would have been surveyed if the work had been done by a survey crew on the ground.

Successes achieved in aerial mapping on this project encourage serious consideration of the use of aerial surveys for measuring original ground cross-sections of the constructed highway for computation of earthwork in payment of construction contractors. If this experiment proves successful, aerial survey methods may be used for measuring cross-sections of future grading projects along the Natchez Trace Parkway.

A test survey is under way to compare costs and accuracy of ground survey and photogrammetric methods for measuring earthwork pay quantities on a 4-mi mountain grading project on the Foothills Parkway in eastern Tennessee. The original ground cross-sections were measured by conventional ground survey methods and by use of precision stereoscopic plotters. After grading is completed, the constructed highway cross-sections will be measured by both methods.

The initial aerial photography for these tests was taken after the construction contractor had completed clearing operations and before any grading was done on the project. The photography was taken by the Tennessee Valley Authority and the photogrammetric measurement of cross-sections of the cleared construction zone was done by the Aerial Surveys Branch, U. S. Bureau of Public Roads. The ground control surveys were made and field measurements of cross-sections of the same zone were accomplished by field division personnel of Region 15. After completion, all cross-section data will be sent to the Bureau's computer center for computation of earthwork volumes.

In the Washington, D. C. metropolitan area, most highway survey areas have been photographed, and small-scale topographic maps compiled from photograpy by photogrammetric methods are available from other Government agencies. These maps, along with contact prints of available stereoscopic coverage by aerial photography, are utilized by Region 15 in reconnaissance surveys for route determination and comparison purposes. Once the best route has been determined, large-scale photographs are taken and used in compiling topographic maps for design purposes at scales of 100 or 50 ft to 1 in., according to need, with a contour interval of 5 ft and 2 ft, respectively. It is expected that an aerial survey contract will be let for any future highway survey and design project where topographic maps of adequate scale are not available and where the area of survey is extensive enough to justify such contracting.

Region 15 also uses contact prints of aerial photography in conjunction with the available topographic maps to determine the size of drainage areas for the design of drainage structures.

USE OF AERIAL SURVEYS IN CONNECTICUT

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Aerial photography for highway engineering purposes was first used by the Connecticut State Highway Department in 1930 for locating, developing schematics, and preparing preliminary right-of-way acquisition maps for the Merritt Parkway through Fairfield County, a distance of approximately 38 mi. The photographs were enlarged to the scale of 200 ft to 1 in., the scale to which planimetric maps were prepared from the photography.

Using photography taken in 1934, aerial photographic mosaics were assembled of the entire State at the scale of 600 ft to 1 in. and were used for many years thereafter for planning purposes.

In 1944, the first topographic maps compiled by photogrammetric methods were