Part I

Current Highway Applications of Photogrammetry and Aerial Surveys

STANDARD SIZE PLAN SHEETS PREPARED FROM CONTROLLED AERIAL PHOTOGRAPHS IN GEORGIA

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The varied topography in Georgia, from mountains approaching 5,000 ft in elevation to coastal areas where major towns are at an elevation of only 20 to 30 ft above sea level, presents a variety of problems and challenges to both highway and photogrammetric engineers.

In the summer of 1960, the Division of Surveys and Aerial Mapping received a request from the Urban Design Department for a base map covering a section of I-95 in McIntosh County, Ga. The specific area involved was an area 15 mi long lying parallel to the coast and just west of the town of Darien. Some of the problems involved were: (a) unavailability of accurate base maps at any scale; (b) no suitable aerial photographs, (c) smooth and nearly level topography with a maximum elevation of 35 ft above mean sea level; and (d) stipulation that the work be done immediately (during the middle of the summer when normally the foliage would be most dense). The time of year, however, was not catastrophic because the area involved is completely covered with 20-yr-old pines, coastal grasses, and other perennial vegetation.

A topographic map could not be compiled feasibly with a Kelsh double projection, stereoscopic plotter because of the levelness of the ground (some areas average only a 2-ft elevation differential per horizontal mile) and presence of the perennial vegetation. Moreover, topographic maps would have little value, because some map sheets would not contain a single contour and would be nearly void of planimetric features. It was, therefore, decided to produce the best planimetric map or substitute possible in the least time and at the least expense.

The project area was photographed using a 6-in. focal length, Wild RC-8, aerial camera from a flight height of 1,500 ft. After processing, the contact prints were sent to the field where a horizontal distance was measured between identifiable points on every fifth photograph. From these measurements, an enlargement factor was computed for each photograph. The photographs were enlarged approximately 3 diam to a scale of 83⅓ ft to 1 in. (1:1,000). These photographic enlargements were assembled on boards to form a semicontrolled photographic mosaic covering the plan area of a standard plan-and-profile sheet.

The photographic mosaics were then copied and reduced to the desired scale of 100 ft to 1 in. Points on the highway centerline had been hubbed and targeted before photography for ease of identification on the photographs. In copying the photographic mosaic, the image of the highway centerline was used to center the photograph in the plan area, and centerline measurements were used to further refine scale. The copy was produced on DuPont Cronar Masking Film to give a continuous-tone or low-contrast negative. A standard plan-and-profile sheet was copied to produce a negative mask, and the plan area was cut out. The negative of each segment of the photographic mosaic was inserted in the plan area of the mask and the complete plan-and-profile negative assembly was inverted to make it reverse reading. This negative was contact printed, using a pinpoint light source, on DuPont Commercial Matte Film producing a positive film of a plan-and-profile sheet with a photographic base in the plan area. Caution was used to produce a low-contrast positive film, because most blue-line paper is of high contrast. The negative was inverted to produce the desired positive. It is possible to draft on the clear upper surface of this positive without damaging the photographic images printed to represent the bottom surface.

This program, while not entirely new, proved to be highly successful under the conditions described. Field personnel using these sheets for highway location, right-of-way, and/or construction purposes were definitely pleased. Part of the acceptance was attributed to the fact that scale was easy to control because there were little or no image displacements due to absence of ground relief and lens distortions. The photographic base showed all identifiable images.

Considerably less time and expense were required to produce this type of photographic base map than would have been incurred in compiling a topographic or planimetric map. General acceptance of photographic base maps wherever topography is fairly flat is expected throughout the State Highway Department of Georgia, as other divisions learn of their advantages and the possibilities.

TOPOGRAPHIC MAPPING OF PATHS BETWEEN MICROWAVE TOWERS

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The problems and work of compiling topographic maps for use by Western Union in placing towers for its system of microwave transmission is very similar to those of reconnaissance survey mapping to determine feasible routes for highways, especially where distances of 30 mi or more are involved. Topographic maps were compiled for microwave paths, beginning in Los Angeles, Calif., extending northwest to Oakland, and thence eastward to Sacramento, Salt Lake City, St. Louis, Cincinnati, and New York City; and for branch microwave paths to Denver, Houston, and Kansas City, and from St. Louis to Chicago, Detroit, Cleveland, Niagara Falls, Syracuse, and Boston.

Before the aerial photography flights were made, the tower sites were located by the microwave engineers. Aerial photographs were then taken of the path strip between these points at a scale of 1:24,000. The average distance between tower stations was about 35 mi, and ranged between 25 and 40 mi. The position of these tower points was determined in the field by tying to known points in the existing network of horizontal control. With the coordinates known (usually geographic coordinates), the midpoint coordinates and the distance between the microwave stations were computed. The geographic coordinates were conveted to the State plane coordinate system.

To control these strips adequately for compilation of the topographic maps with a Kelsh stereoscopic plotter, an attempt was made to control each stereoscopic model independently. After several attempts, it was decided the needed horizontal control could be obtained for each stereoscopic model more easily and economically by a radial line plot. The compilation manuscript, convenient in size for a Kelsh instrument workir surface, is large enough to cover a strip 2.5 mi long in flight-line direction. For a microwave path map of 30 mi, a radial plot bridge of 20 stereoscopic models is required. Adequate control for this length of bridge with close tolerance would be almost prohibitive in cost if measured by the standard transit traverse and spirit leveling methods in the field. After considering the allowable tolerances in horizontal position and elevation, it was decided to use existing information wherever available and to resort to field survey methods only in isolated areas where maps or other control information did not exist.