saic 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 workin 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.

For these 30-mi microwave path maps, copies of current or late compilation manuscripts of 1:24, 000-scale topographic maps with a 10-ft contour interval were found to be suitable. These manuscript copies have numerous points identifiable on aerial photographs, thus providing adequate control for the individual stereoscopic models. The exact scale for the models within the strip was determined by accurately joining together existing topographic maps of the area through which each microwave path extended and connecting the tower sites with a straight line. This line was checked by comparing with the coordinates of the two tower sites and their midpoint previously computed. A segment of this line, beginning at the midpoint and extending 2½ mi in either direction, became the baseline for single model compilation manuscripts, which, of course, are at a scale 5 times larger than that of the aerial photographs and of the assembly of 1:24, 000-scale topographic maps. X and Y distances to map points were measured from this baseline and plotted on the compilation manuscript. Using these points, the radial line plot was adjusted to achieve correct scale between the two tower sites.

This system of establishing horizontal control for each stereoscopic model allows all control points required in the map compilation, both horizontal and vertical, to be established for the microwave corridor or path through utilization of an adequate distribution of the well-defined and identifiable image points, as transferred from the original maps of the region. Because some corridors extended across geographic quadrangles where no modern 1:24, 000-scale topographic maps exist, needed control data were ascertained from smaller or larger scale maps where possible.

The northeastern part of the United States is well covered with modern 1:24, 000-scale topographic maps, which can be obtained from the map information office of the U.S. Geological Survey. This office can also supply river survey maps and Army Map Service 1:250, 000-scale series of maps covering most of the United States. These published maps are reduced-size copies of the compilation manuscripts. The larger scale manuscripts, when enlarged photographically, are useful in providing map coverage of the quadrangle areas not covered by the 1:24, 000-scale topographic maps recently compiled by photogrammetric methods. Thus, the careful and judicious use of available map information and ground control provided the control data needed in making the radial plot bridge for reasonable distances and to sufficient accuracy.

Maps compiled by photogrammetric methods generally produced satisfactory corridor mapping. Only where the old ground-survey compiled maps were used for control were the corridor maps less accurate than required, as determined by the profile measured from the maps between microwave transmission towers. The 1890 series of topographic maps were unusable.

Tower height increments were 25 ft. Corridor width for profile control of microwave transmission was 0. 5 mi. Clearances below a straight line between towers over ridges, trees, and man-made features on the ground had to be sufficient to prevent any reflection. The tower sites were selected by reconnaissance on the ground before the mapping was undertaken for obtaining profiles along each corridor 0. 5 mi wide. Tower site selection was more difficult over the less rugged regions, as between Omaha and Houston, than between cities in mountainous areas. Mirrors were used to test lines of sight during tower site selection.

The dependability of the microwave corridor maps was questioned by the contracting agency, Edwards and Kelsey, microwave engineers. Following the few field checks which were thought to be advisable, the necessary control was established and substandard areas were remapped. Evaluation of the project, by use of data obtained during the investigations, gave the contracting agency and the mapping contractor, International Mapping Co., Los Angeles, confidence in the profiles measured from the maps.

For highway reconnaissance survey purposes, this system of establishing control for and compiling small-scale topographic maps can be used very well with the incurrence of minimum costs. Highway agencies having a minimum of photogrammetric equipment can produce topographic maps of this type with no outside help, except for the aerial photography. By such mapping several feasible routes between designated terminal points may be economically compared.