

SURVEYS IN CONNECTION WITH THE PREPARATION OF CONSTRUCTION PLANS FOR SEWERS IN DERRY, N. H.

BY HARRY R. FELDMAN,* *Member*

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THOSE of you who have driven through Derry, N. H. have done so perhaps by way of the Londonderry Turnpike (Bypass 28) and think of it as being simply a route junction with two service stations and an ice cream stand. The main portion of Derry is about one mile west of the above mentioned intersection, called West Derry, and is actually a picturesque modern community with a population of about 6,000. It has several successful industries among which is the original Harvey Perley Hood Milk Farm.

As in so many other similar towns, however, it had failed to develop a satisfactory sewage disposal system. The present Board of Selectmen realized the need for urgent action on this problem, "because of the increasing deterioration of Derry's water supply and the antiquated and unsanitary method of the town's sewage disposal system—" and engaged Camp, Dresser and McKee, consulting engineers, to propose and follow through a satisfactory solution.

After making sufficient preliminary studies, the consulting engineers engaged Harry R. Feldman, Inc. to make the surveys from which contract drawings could be made. It is with this phase that this paper is concerned.

The survey requirements were these:

(1) Plans of all streets to be drawn at a scale of 1" = 40' showing buildings, trees, utilities, travelled ways, and other pertinent topographic features.

(2) Profile data along all streets with sill elevations to 0.1' or better.

(3) Topography of two cross-country strips (for interceptors) to be plotted at forty scale and with two-foot contours or better.

* President, Harry R. Feldman, Inc., Boston, Mass.

(4) Research and field work in regard to land takings or easements.

From an existing small scale map of the town, it was estimated that there were about one hundred streets averaging 1,000 feet in length or approximately twenty miles of streets to be mapped. Also, through this area of about three square miles, were two brooks which met at a "Y" intersection in the south west part of the town close to the area of the proposed sewage stabilation ponds. It was felt that these brooks were suitably located and, with their natural gradients, would be ideal along which to place the trunk line interceptor sewers. These were the two cross-country strips to be surveyed as mentioned above and were each about 7,000 feet long.

Realizing the relative magnitude of the job, the question arose of how best to make the necessary surveys keeping in mind the usual parameters, for the least cost in the shortest time. Aerial methods were immediately considered. Although aerial photogrammetry is more than one hundred years old, it has only been in the past decade that it has made its greatest advances and then thought of mostly in terms of large highway projects. Then too, the elevation requirements were, for the most part, too fine for standard photogrammetric methods.

An estimate of time and cost, therefore, was made up in two ways:

(1) Complete conventional ground survey.

(2) An aerial survey for planimetric data with conventional methods for elevations. The results indicated that the combination aerial and ground method would be better in that the cost would be about 30% less and would take only half the time of the conventional method. Needless to say, the job was flown.

The U. S. G. S. "quad sheet" (Fig. 1) was delineated and the area flown by Lockwood, Kessler and Bartlett, Inc. in the early Spring before the foliage appeared. In the interim, surveys were started along the banks of the two brooks keeping in mind to have the survey lines as close as possible to satisfactory interceptor sewer locations.

The aerial photographs were delivered with requests to locate and coordinate 18 horizontal control points. Since there were no geodetic coordinated points in the area concerned, it was decided to

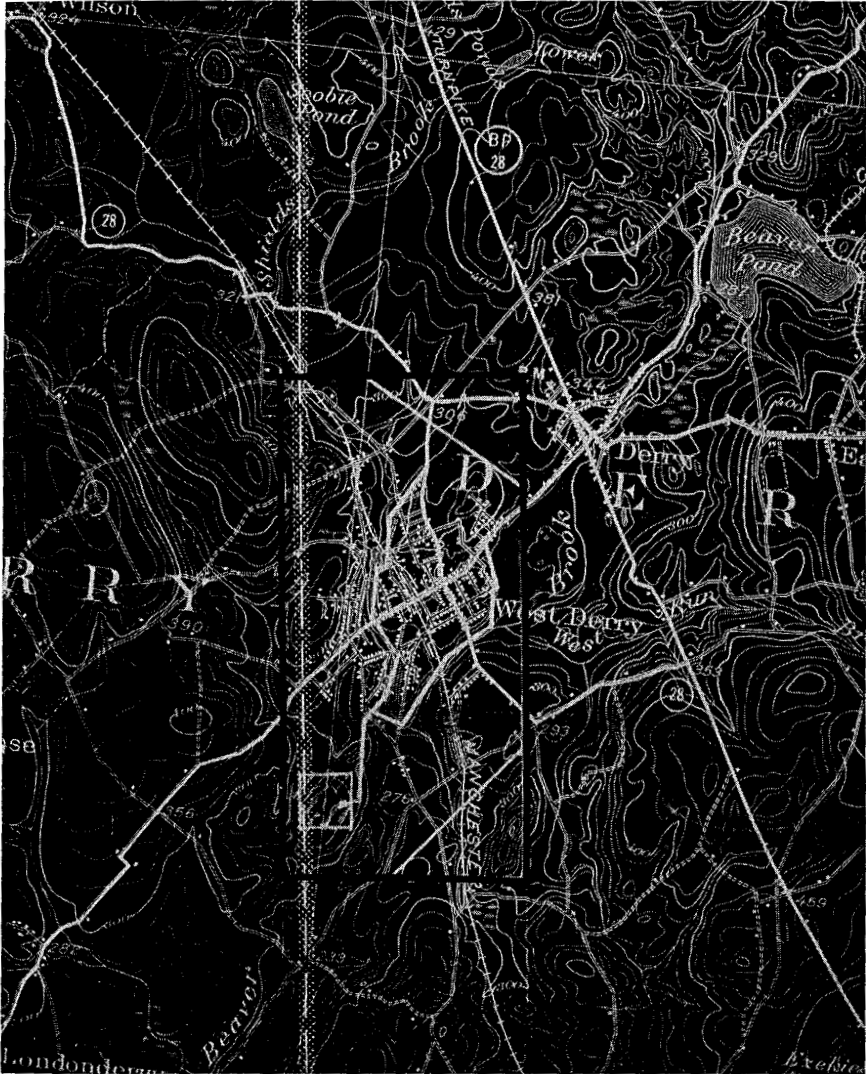


FIG. 1.

use an arbitrary coordinate system with a value of N 10,000, E 10,000 in the center of town at the intersection of the main street (Broadway) and the B & M R. R. Broadway and the railroad made an "X" intersection and it was along these that the main control traverses were run with closing sides to make two loops called the "A & B" traverses. The bearing system used was based on the R. R. baselines. The closures of the loops were of second order accuracy. The traverse points were of a semi-permanent nature, painted for future reference.

The cross-country trunk line surveys, which were originally random traverses, were tied into the aerial control lines to give a check on these and create additional loops with a minimum of work.

As soon as the traverses were run and checked out, the coordinates of the ground control points were calculated and noted on the 9" × 9" aerial contact prints. They were returned to Lockwood, Kessler and Bartlett, Inc. with these instructions:

- (1) Provide working drawings only, at a scale of 1" = 40'.
- (2) Show streets, buildings, poles, large trees, travelled ways, ponds and brooks.
- (3) Indicate any other planimetric data which may be helpful for determining property lines such as walls, fences and cultivated fields.

Briefly, the essence of photogrammetry is the creation of a measurable spatial model, the basic principle being similar to the manner in which our brains perceive a three dimensional scene with depth provided by superimposed images from our two eyes. In one method, light rays which originally went from the object (in this case, the ground surface) to the camera are reversed. The reversal of the light rays is done by pairs of projectors which are closer than were the original adjacent camera positions during flight and thus making a "model" which is smaller than the object. For planimetric data, the operator traces the desired details such as buildings, roads, and the outline of wooded areas. If contours were needed, the operator would follow a "floating point" over the model which had been pre-set with identifiable points of known elevation. As the operator moves over the model a plan is created by means of suitable linkage arms not unlike a pantograph.

While the aerial photographs were being processed through the plotting machines, the vertical control points were established on the

ground. The U. S. Geological Survey provided bench mark information on the Seal Level Datum of 1929. Three bench marks were found to be useable, two along the B & M R. R. and the third at the town fire station on Broadway. Several level loops were made from these and the turning points and temporary bench marks were located, painted, and described to facilitate the profiling of each of the streets to be done later.

A field office was set up and a procedure was arranged for profiling each of the streets. Stations were marked off with a cloth tape from L to L of travelled ways. Using the pre-established T. P's, elevations were taken at 50 ft. intervals and at the sills of the buildings on each side of the street. This data was turned into the field office where it was checked and plotted on the photogrammetric work prints. The stationing on the ground and the scaling on the plans between streets checked out very well. Also added in colored pencil were underground utilities as observed in the field and as indicated by the various town departments.

All of this work was accomplished and turned over to Camp, Dresser and McKee in less than three months. The key point in this whole process, we believe, was that duplication of work was eliminated by following through with working plans from the outset to the final contract plans. This was accomplished by close cooperation between Lockwood, Kessler and Bartlett, Inc., Harry R. Feldman, Inc., and Camp, Dresser and McKee. It was found also that the aerial method provided at all times a "bird's eye view" of the project and the photogrammetric plans gave infinitely more details than would be economically feasible by ground surveys.

There remained only to obtain property owners and lines for easements and taking plans. Although, from our point of view, the assessors' records were incomplete, the town officials were extremely cooperative and helpful. The work involved with property lines will not be detailed here, but a few points will be mentioned. Here again the photogrammetric plans were exceedingly helpful in that they showed walls, fences and hedges which were excellent clues to the property lines. For the most part, it was a matter of going from door to door to obtain the owners' names and other information.

In this regard, it may be of interest to quote here verbatim a small portion of the report by one of the men working on this phase of the project. "Horne Brook Easement—Owners unknown—Land

north of Maple Street, between the Derry Dressed Poultry Company's land, and that of the Derry Fibre Mills, Inc., including a gravel drive and a small wooden building. The abutters believe that this parcel belongs to the Boston and Maine R.R. The Boston office of the B & M denies ownership. The Selectmen's Clerk believes that it is owned by the Derry Fibre Mills. There was no one around the small building, nor was there any identifying name on it. A January 1955 plan of the area, by a local surveyor, has the building labeled 'Marr Scaffolding Co.' This plan was made for land taking purposes for a proposed street, but the Selectmen dropped the project when a question over land ownership developed." Possibly, had the researcher scrutinized the little wooden building more closely he may have discovered a design cut in the door—a crescent shaped moon.