PHOTOLOGGING - A MAINTENANCE MANAGEMENT TOOL

Charles E. Dougan, Louis E. Sugland
Connecticut Department of Transportation

Use of the photolog system as an aid in the decisionmaking process involving the management of Connecticut highway-maintenance operations is outlined. Areas where the photolog system is highly useful, moderately useful and of limited use are denoted. Annual savings in man-hours and fuel consumption as a result of photolog usage are presented. Second generation photolog equipment and its capabilities are discussed.

In the United States, the various administrations responsible for transportation have invested vast sums of capital in their highway, rail, and airport systems. In Connecticut alone, our overall investment in transportation systems has been estimated at several billion dollars. In this connection, there is every justification to document them and maintain them in the best possible condition to ensure an adequate rate of return on invested capital.

In 1973, the Office of Research, Department of Transportation (ConnDOT), in cooperation with the Federal Highway Administration (FHWA), undertook the development of a photolog system to provide a pictorial documentation of our 6440-Km (4,000-mile) State-maintained highway system. The project was completed in 1976 at an estimated cost of $130,000. At that time, the entire photolog system, including a completed library of positive prints documenting the 6440-Km (4,000-mile) system in both directions, was turned over to our newly created Engineering Data and Inventory Photolog Unit.

The Photolog Unit is currently housed in the Rocky Hill Laboratory from which required field filming and editing tasks are performed. Since 1976, the initial library has been located in the highway engineering complex in Newington. A second library was placed in service at the Main Administration Building in Wethersfield in 1979, and a third is planned for the Division of Traffic in Hartford. The latter is scheduled for service in the fall of this year. These libraries are readily accessable to all engineering and management personnel, with the exception of personnel in our four district offices.

Our system is composed of a 35-mm Flight Research Model 4C camera and control unit installed in a 1973 Ford Econoline Van. We normally operate the system at a rate of one frame every .0161 Km (1/100-mile) traveled, but vary this increment for special purposes. The camera is oriented at 5° to the right and 6° down for two-lane roads, and at 2° right, 3° down for multiple-lane roadways /1/.

The film used is 35-mm color negative from which an appropriate number of positive prints can be processed. The format of each frame includes space for data entered via light-emitting diodes (direction traveled and cumulative mileage) and via a mylar data slate (handwritten information such as date, route filmed, and camera angles). Appendix 1 shows photos of this system, which were gleaned from available reports /1,2/.

The system is being maintained such that 1/3 of the highway network is updated each year. In addition, routes that have been reconstructed or relocated are given a priority status for refilming. Thus, the libraries will ideally contain film that is no older than three years.

As previously stated, our photolog was turned over to operating personnel in 1976. Since that time, log-type usage records have been maintained and periodically provided to the FHWA. Annual savings due to reduced man-days required in field trips have increased steadily to an estimated $65,500 in 1979 (Fig. 1). This figure is thought to be somewhat conservative, because of the indifference shown by certain employees in the matter of signing the usage log. This so-to-speak "apathetic" behavior could account for a 25-50 percent increase in savings over and above the figures listed. Figure 2 shows the estimated miles of travel saved by personnel in state-owned vehicles through use of the photolog. Conversion of these mileages to cost savings based on a $ .20 per mile operating cost would result in annual figures ranging from $11,600 to $15,000 or 13,110 to 19,000 liters (3,450 to 4,000 gallons) of gasoline conserved annually depending on your method of analysis. These savings are, of course, the result of use by the entire Department, and not by Maintenance personnel alone.

In maintenance activities, primary use of the photolog is made in spot checks of locations exhibiting high-accident frequencies. Geometrics, signing, fixed objects, and other possible contributing factors can be viewed within the office by both operations and administrative personnel.

Figure 1.

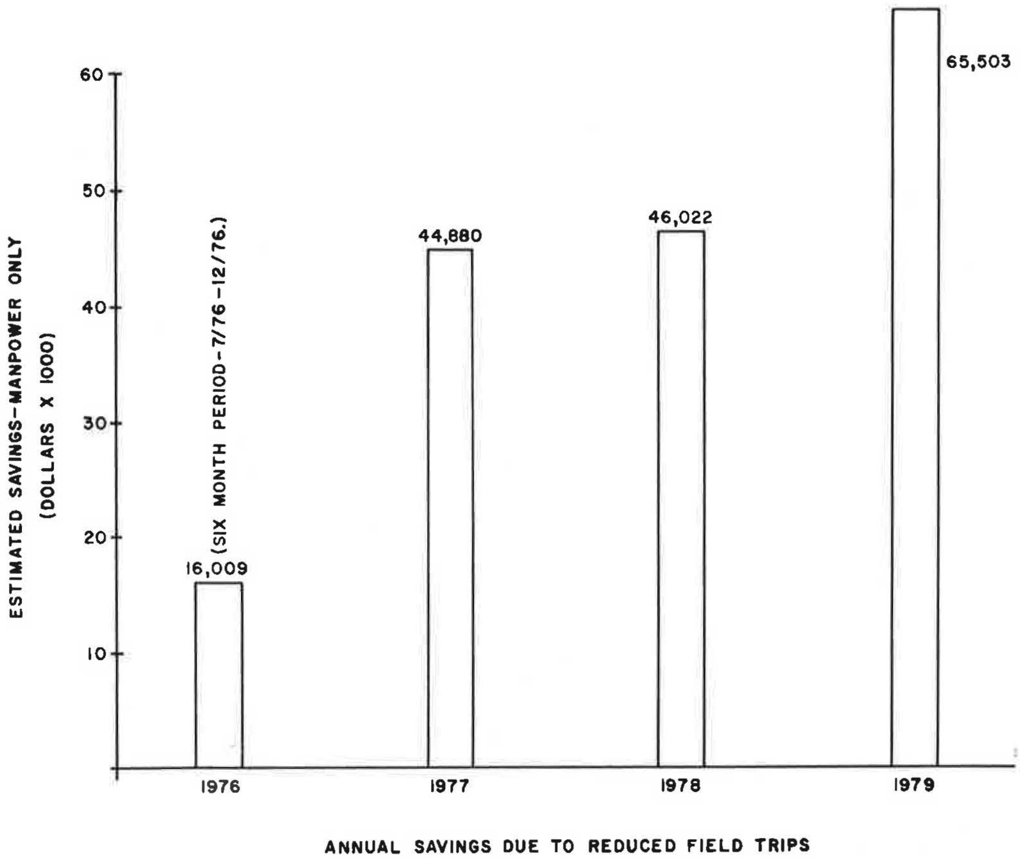
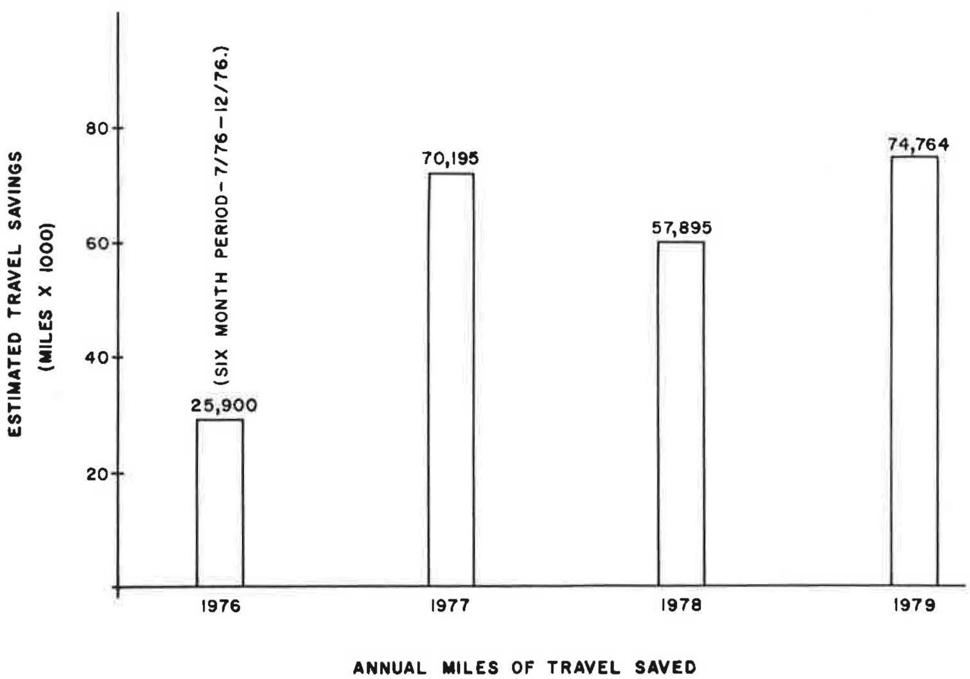


Figure 2.



Lateral distances are estimated from the film by using grids overlaid on the viewing screen. The grids were developed for each camera orientation used and we have measured the accuracy of this method to 15.24 cm (6") in 9.15 m (30'). We are now developing the grids required to obtain vertical dimensions which will expand our anlytical capability.

Another area of high use is the development of future projects or project programming and scheduling. A needs survey is conducted twice a year in this connection. Here, use is restricted to recently updated routes, since obviously a three-year old film would not suffice for this type of work. Specific uses include the application of a Jersey-type barrier to portions of the Connecticut Turnpike. In this case, we were able to determine quite accurately the areas that would accomodate the barrier and those that would present difficulty in the application.

The photolog is ideal for before-and-after studies of projects involving pavement surfaces. We are currently using the photolog to evaluate new emulsified asphalt surface treatments. By filming the section in question prior to application of a treatment, we can easily determine the trouble areas and thus have a base on which to attribute any failures that might develop in the new surface.

Also along these same lines, we have used the photolog to document the condition of the road surface prior to the application of an experimental crack-inhibiting material. Transverse and longitudinal reflection cracks were located from the film. The effectiveness of the crack-inhibiting material beneath the overlay can then be determined from later films of the same area. As applied to crack surveys conducted on continuously reinforced concrete pavements, the photolog is approximately 80 percent effective. The fineness of the transverse cracks makes it difficult to discern them from the film, even when the camera is tilted 11° down and the filming interval reduced to 1.55 m (5 ft).

ConnDOT has also employed the photolog concept to determine the effects of various salt and sand applications on pavement surfaces during snowstorms. Various road sections were given applications of different proportions of deicing chemicals at set time intervals. The effect of these chemicals was monitored by driving the photolog van over the same section at preset time intervals. The outcome was not as fruitful as we had expected, however, because of the low-light levels and heavy snow that occurred during the runs. Subsequent analysis of the film revealed an inability to discern between similar meteorological conditions on the roadway. Specifically, the physical state of the pavement surface moisture (frozen, liquid, or a combination thereof) could not be determined.

The Department has recently installed raised pavement markers at various locations on the state's expressway and interstate systems. Subsequent to these installations, the need arose to devise an effective means of monitoring these sites in order to develop criteria for the repair and replacement of damaged markers. The most effective method of surveying the large number of these markers requires dark-hour observation of actual reflectance characteristics. To reduce the risk of accident generated by a slow-moving observation vehicle or an inspection team walking the shoulder, it was suggested that the photolog van be run at 40 mph over the areas in question during nighttime hours. This would obviously minimize the danger to both the inspection team and passing traffic, and also greatly accelerate the survey process.

The resulting film could then be studied in the safety of an office. Specific marker failures could be pinpointed from the film and odometer readings associated with each exposed frame.

Analysis of the film revealed that the best combination of conditions were: normal headlamps and an additional pair of quartz-halogen lamps; a standard photolog film (Eastman Kodak 5247); a driving speed of not more than 64.4 Kmh (40 mph); and, a shutter speed not faster than 1/60th of a second.

Connecticut's present photolog system will be augmented shortly through the acquisition of a new dual purpose photolog vehicle from Techwest Research. This vehicle, in addition to possessing a sophisticated second-generation data-gathering system, is "high-rail" equipped, thereby affording the capability of monitoring both rail and highway systems. Along with the pictorial aspect, this second generation system will digitally present on the film and magnetic tape the following data: grade; curvature; cross slope; side friction; and, roughness. The acquisition of these quantitative data in the past was generally a time-consuming and potentially hazardous task. Photos of this system are shown in Appendix 2.

The ability to visually review various pavements with a concurrent display of roughness should prove to be an effective device in determining overlayment priorities.

In Connecticut we were encouraged by the efforts of others to embark on a photolog program. Our savings support the fact that our system continues to be a productive and useful management tool. With our continued deployment, new uses for the photolog continue to evolve. Somewhat hesitant and/or reluctant personnel have been shown that we now possess another tool to use in managing our transportation system.

1. Bowers, D. G., Hudson, J. H. and Sugland, L. E. "Operations Manual for Photolog System," Connecticut Department of Transportation, March 1974
2. Bowers, D. G., "Photologging Guidelines for the Update and Refilming of the State Highway System," Connecticut Department of Transportation, March 1974.

APPENDIX 1
Photos of Highway Photolog Unit
First generation

Fig. 1A Photolog Van with Camera mounted in filming position.

Fig. 1D Distance Measuring Instrument (DMI) and Distance Event Marker (DEM) mounted in dash.

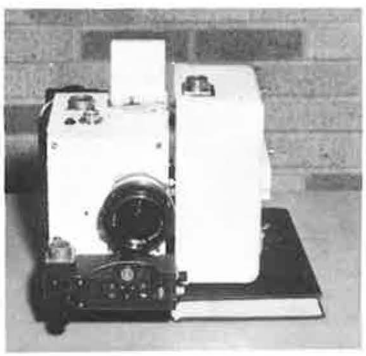


Fig. 1B Front View of camera showing lens, light-sensing element and data chamber.

Fig. 1E Front view of control console.

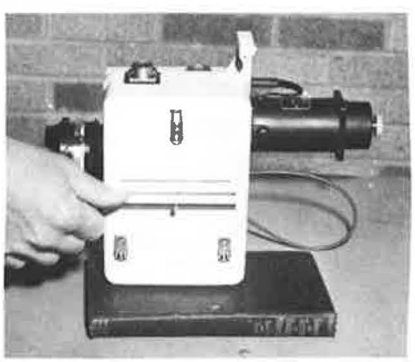


Fig.1C Side view of camera showing attached data chamber with trap door open.

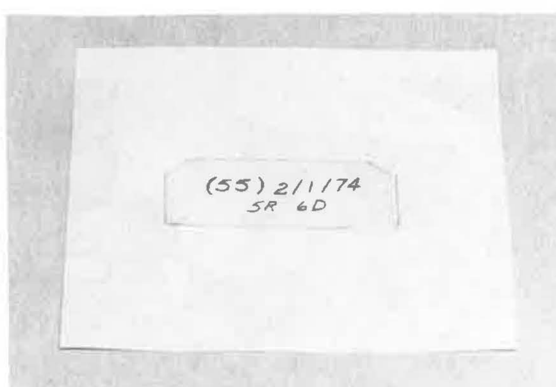


Fig.1F Mylar data slate showing position of data with respect to clipped corners.

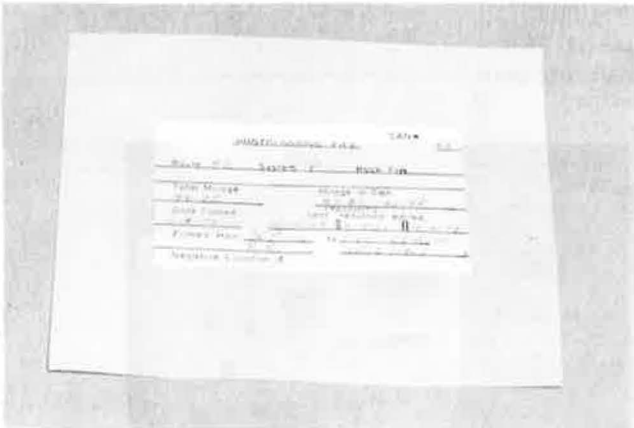


Fig. 1G Reference card for route file.

APPENDIX 2
Rail Photolog Unit
Second Generation

Fig. 2A Front view of rail photolog van, Chevrolet Chassis, High-rail equipped.

Fig. 2C Track viewed from inside of van. Camera is mounted immediately to left of passenger's seat.

Fig. 2B Close-up of high-rail assembly engaged on track.

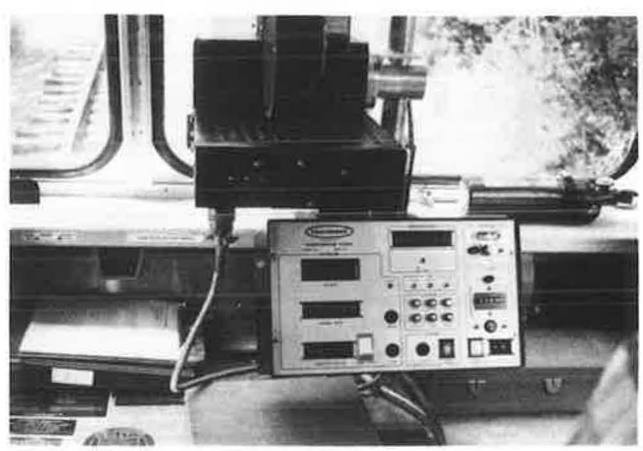


Fig. 2D Data chamber in van.