RESEARCH PAYS OFF

Maine DOT Calculates Bituminous Overlay Quantities—ASAP

FIGURE 1 Maine DOT data-acquisition vehicle.

The increase in weight and number of axle loads and the numerous freeze-thaw cycles encountered in the state of Maine take a toll on the highway system. During the life of a pavement segment, the surface cross section is often left rutted and otherwise distorted. Before the application of layers of surface course for an overlay project, the Maine Department of Transportation has historically used a layer of bituminous leveling course to fill ruts and restore the road to the designed cross slope. This procedure provides a uniform base for the surface course and helps prevent differential compaction.

Problem

Initially, crude volume calculations were used to estimate the quantities of this leveling course (referred to as "shim") for project budgeting. Because the roadways were so distorted, many overlay projects required more shim than estimated. The result was the overspending of established project budgets.

In pursuit of more accurate estimations, survey crews were asked to take cross-section elevations. Four-member survey crews took 3 to 5 survey readings every 50 feet for the length of the projects. These elevations were then manually plotted by designers, and quantities were measured. The latter process evolved into a computer program for which the survey elevations were manually entered.

This survey method resulted in more accurate shim quantities but did not address quantities for filling wheel ruts. Also, the operations were tedious, time consuming, and labor intensive. In addition to these costly hindrances, the survey cross-sectioning was dangerous because of continued increasing traffic on Maine's highways.

Solution

In the early stages of purchasing a data-acquisition vehicle (see Figure 1), MeDOT recognized the need for transverse profiling capability, which would provide an opportunity to automate the shim quantity procedure.

On the data-acquisition vehicle, a bar is mounted across the front approximately 1.5 feet above the roadway (see Figure 2). Ultrasonic sensors attached every 4 inches across the bar take measurements for lane widths from 6 to 12 feet. The sensors and a roll gyroscope are programmed to fire at every 50-foot station between the project limits. The readings from the roll gyroscope are used to correct the ultrasonic sensor readings to the true horizon. Data from adjacent lanes are combined to obtain the transverse profile for the entire pavement width.

To calculate adequate shim quantities, MeDOT was required to write customizations and new programs to supplement the existing canned software that accompanied the vehicle. These programs directly superimpose the designed cross slope over the existing profile at each station. The area

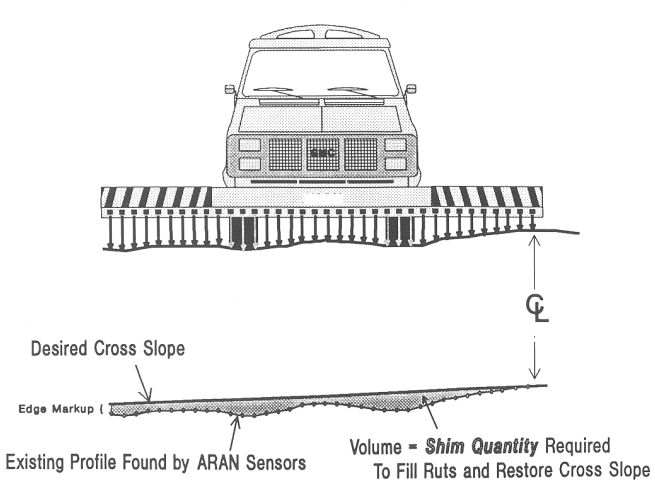

FIGURE 2 Ultrasonic sensors attached to bar mounted across front of vehicle take measurements for lane widths from 6 to 12 feet.

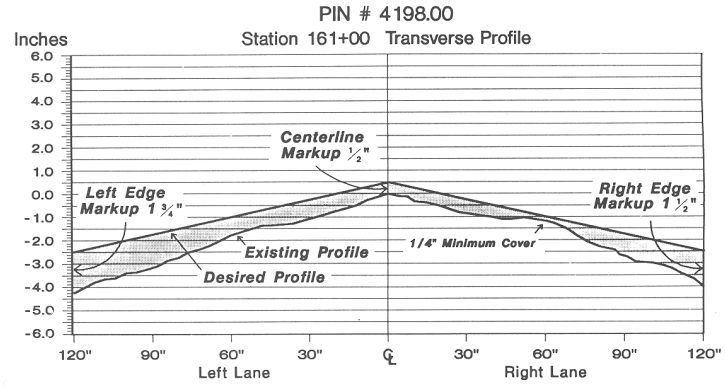

FIGURE 3 ASAP is used to estimate volume of shim between each station (shaded area).

between these two curves is calculated to estimate the volume of bituminous mix between each station (see Figure 3). The software, ASAP (ARAN® Shim Analysis Program), incorporates all needs voiced by the Design and Construction divisions. This user-friendly software not only provides a shim quantity but allows designers to analyze existing cross slopes and profiles to establish the best design for the overlay project. The output from this program provides the construction engineer with existing and desired cross slope, station and accumulated bituminous mix quantities, and the overlay depths at centerline and edges of pavement required to restore the road to the designed cross slope.

Application

The shim estimation operation has now been fully implemented. Little training is necessary to use the software. This software, along with a recorded videolog, provides engineers with a useful design tool for analyzing projects. Construction engineers as well as designers are using the software and the output to identify and make strategy decisions for various problem areas.

During the 1989, 1990, and 1991 testing seasons, ASAP was used on 122 overlay projects corresponding to 380 centerline miles. Feedback from the users has led to software enhancements that were easily incorporated through in-house programming.

Benefits

The data-acquisition vehicle and the ASAP bituminous quantity estimation procedure have numerous advantages over conventional methods. For the first two seasons of data collection, MeDOT realized $350,000 in labor savings from this procedure alone. (Savings from the automation of other procedures are not discussed here.) In addition to direct cost-related savings, other benefits have been achieved by implementing this operation.

First, safety has been improved. Survey crews no longer need to spend many days taking cross-section elevations in the middle of busy highways. Reducing the number of these activities reduces the probability of accidents.

The procedure is also faster Because the vehicle collects overlay information at 30 to 40 mph, expensive, time-consuming traffic control is no longer needed.

The savings in labor, traffic control, and turn-around time, and the benefits of safety, more and better information, and versatility have ensured a quick return on investment. MeDOT will continue to develop new uses for data acquired by the vehicle and will enhance the ASAP software for further savings and benefit.

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Suggestions for "Research Pays Off" topics are welcome. Contact Crawford F. Jencks, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2379).