Changing Character of Pavement Maintenance

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•THE COST PER MILE of routine surface maintenance on the hard-surfaced secondary roads in Virginia has been decreasing in recent years and, as a result, the total cost per mile of surface maintenance on these roads has remained almost the same for the past 5 years. This paper examines some of the changes in policies and procedures that have contributed to the cost trends, and discusses the implications of the cost trends to management in making decisions regarding surface maintenance. In this discussion, the terms ordinary maintenance, maintenance replacement, and total surface maintenance are defined in terms of surface maintenance as follows. Ordinary maintenance is routine surface maintenance and includes skin- or seal-type patching, filling potholes, and scarifying and re-treating short sections of under 1,000 ft in length. Maintenance replacement is the resurfacing of a road where the new surface does not exceed the depth of the original treatment; it includes seal treatments, mixed-in-place treatments, drag treatments, and bituminous concrete treatments. Total surface maintenance is the sum of ordinary maintenance and maintenance replacements.

Figure 1 shows the trends in cost per mile for ordinary maintenance, maintenance replacement, and total surface maintenance for fiscal years 1953-1954 through 1967-1968. (Data are not available for costs prior to 1953.) The significant reduction in costs for the fiscal year 1959-1960 was brought about by the recession in the late 1950's and should not be considered typical of the trend in expenditures. The trends shown in Figure 1 are based on actual dollar costs. Figure 2 shows the costs adjusted to the 1957-1959 base period.

In 1959, we established as a goal the resurfacing of approximately 20 to 25 percent of the secondary mileage each year. Approximately 95 percent of the resurfacing on the secondary system is a chip seal, which at base-year prices costs approximately $1,000 per mile. From fiscal year 1960-1961 to date, we have been resealing approximately 20 percent of our hard-surfaced mileage annually. At the same time that we began to seal 20 percent of the secondary mileage, we began to get a decrease in the amount spent per mile for ordinary maintenance.

The apparent relationship between the amount of maintenance replacement work performed each year and the amount of the required ordinary maintenance must be studied further to determine the point of maximum economy in surface maintenance that can be achieved for a given service level and that can meet the overall objectives of the total maintenance program at the same time. For instance, it is possible to achieve significant reduction in the ordinary maintenance costs by increasing the frequency of re-treatments. However, as the frequency of re-treatment passes a certain point, total maintenance costs begin to increase.

The determination of the point of maximum economy is not a one-time analysis, but is something that must be revised almost every year. Figure 1 shows that, based on actual dollars, we have had almost constant expenditures for the three costs occurring during the past 4 to 5 years. If we continue to maintain a 5-year re-treatment cycle, our total costs are going to increase in the future. Ordinary maintenance and maintenance replacement both represent the placement on a road of a certain number of tons of stone. The cost index for ordinary maintenance is increasing much faster than the cost index for maintenance replacement, which represents mostly contract work. We can keep total surface costs from increasing by placing fewer tons of stone on roads

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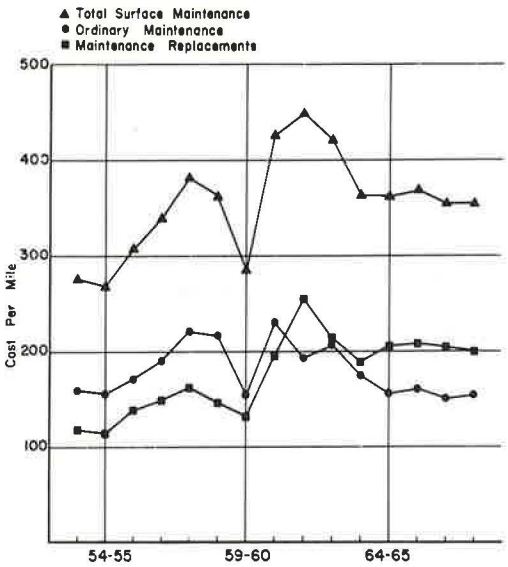

Figure 1. Cost of surface maintenance of hard-surfaced roads in secondary system.

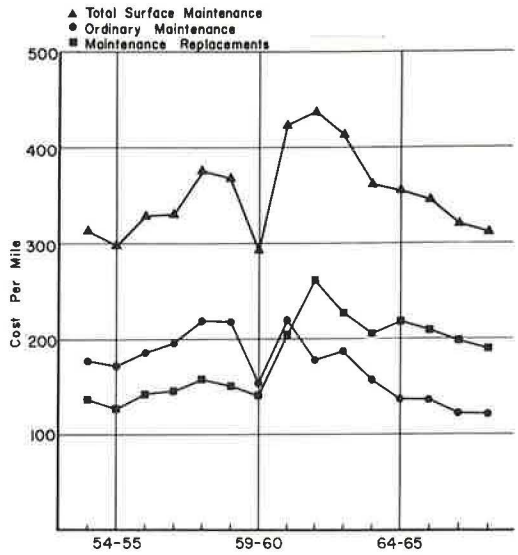

Figure 2. Adjusted cost of surface maintenance of hard-surfaced roads in secondary system.

by ordinary maintenance, and more by contracting and by increasing the efficiency of ordinary maintenance. Determining the point of maximum economy or a range of values will necessitate additional collection of data because our historical records are of dollar costs that have been influenced by efficiency of maintenance crews and field decisions that do not conform to policy. In addition, the point of maximum economy will also vary by geographic regions.

There are two counties, A and B, that illustrate the problem. Figure 3 shows, for county A that is performing somewhat better than the state averages, the maintenance replacement and total maintenance costs as a 3-year moving average. This was done because, in our contracting and accounting system, it frequently happens that all or a portion of 2 years of maintenance replacement costs are paid for in one fiscal year. This causes large fluctuations in annual costs and makes the trends on a chart hard to see. When the decision was made to re-treat approximately 25 percent of our mileage each year, county A attempted to comply. It has treated an average of better than 20 percent of its hard-surfaced mileage each year since fiscal year 1958-1959. This, coupled with the increase in amount of re-treatments, has decreased the cost per mile of ordinary maintenance below that of the state average.

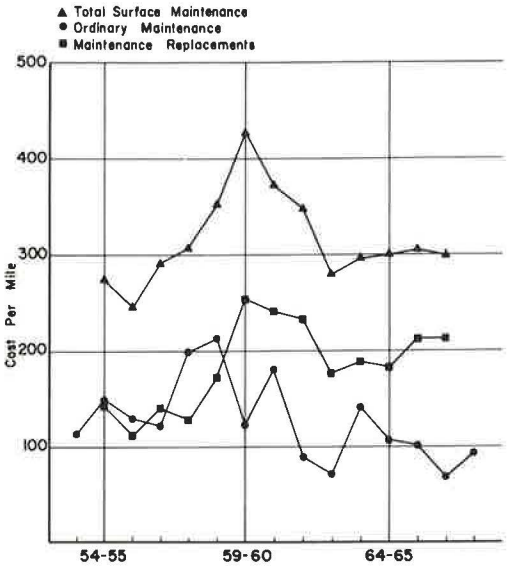

Figure 3. Cost of surface maintenance of hard-surfaced roads in county A.

Figure 4 shows that trends in county B are quite different from those in county A and the state average. The maintenance replacement and total maintenance costs are shown as a 3-year moving average similar to that in Figure 3. The amount

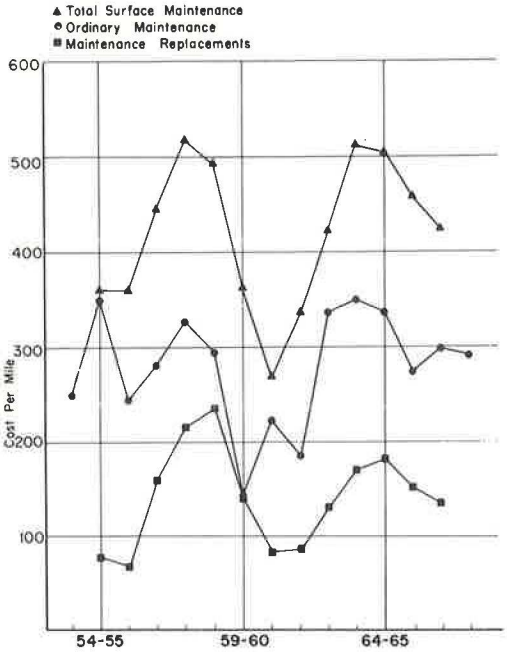

Figure 4. Cost of surface maintenance of hard-surfaced roads in county B.

spent per mile for resurfacing has been very erratic through the years, while there has been less change in the amount spent for routine maintenance. We might assume that the high rate of routine maintenance reflects the low and erratic amount spent for resurfacing. The amount of resurfacing is only part of the problem, however. Performance data indicate that it costs county B approximately 50 percent more than it costs county A to place a ton of patching stone.

A portion of the problem occurs in the attempt to use fiscal accounting records when trying to document management decisions and when attempting to develop guidelines for future decisions. For the past 1½ years, we have been accumulating additional information such as the productivity of the work crews, unit cost of placing a ton of material, and the number of tons of patching material placed.

It is believed that we can develop from this information a relationship between tons of stone used for patching and the frequency of resurfacing. By applying unit costs to these two items, we can develop the relationship that is most economical and also other relationships where economy is secondary to reducing labor requirements on routine maintenance.

Construction and improved maintenance methods have undoubtedly contributed to the reduction of ordinary maintenance costs. However, we believe that resealing our roads at a frequency of 5 years has been the major factor in reducing ordinary maintenance costs. The information I have shown, although inconclusive, indicates that the relationships just mentioned do exist, and the information further points the way to continued study and analysis.