Pavement Rehabilitation: Background and Introduction

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- THE MAINTENANCE of road surfaces is usually defined as the preservation of the surfaces in the condition or to the standard to which they were originally built. Because of the rapidly increasing volumes of traffic, as well as the increasing loads to which the roads are being subjected, more is required than that maintenance necessary to preserve the road's original load-carrying capability. The roads are exposed to loads beyond those for which the surface was originally designed, and something must be done to make the road structure adequate to carry the greater loads and volume of traffic.

Much of this rehabilitation and reinforcement is accomplished by maintenance forces or by maintenance contracts, whereas it should be accomplished by reconstruction. Reconstruction contracts would accomplish more than simply the strengthening of the riding surface. Such contracts usually and logically involve bringing roads up to modern standards by widening the roadway, widening the shoulders, flattening the slopes, and eliminating hazards such as excessive vertical and horizontal curvature. This requires, of course, the commitment of funds considerably in excess of those for increasing the load capacity of the road structure and maintaining it to tolerable standards. Finances for that sort of a program are totally inadequate. Funds are not and have not been available to build, rebuild, and maintain a system of highways adequate to accommodate the steadily increasing volume and weight of traffic. I wonder if they ever will be.

As a case in point, let me cite the situation in Minnesota, which I venture to say is typical of situations in most states. On the basis of a comprehensive needs study made by our Planning and Programming Division, we estimated that starting in 1966 to bring our state trunk highways up to standards by 1985 will require $1,520 million, based on 1965 dollars. It will cost $960 million to bring the county state-aid system up to standards by 1985, and $340 million for the municipal state-aid system. These amounts are substantially in excess of the finances available, and whether the finances of the foreseeable future will be adequate is a moot question. In the meantime we have had hundreds of miles of old concrete and bituminous pavements on arterial highways carrying a high volume of heavy trucks. Obviously something had to be done to these deteriorating pavements that could not be reached because of higher priorities on the system. The only practical solution was to embark on a resurfacing program that would maintain a reasonable standard of adequacy for perhaps ten years with the hope that by that time funds might become available to bring them to more adequate standards. It was decided to provide overlays of bituminous surfacing to furnish a good riding surface and to make no additional improvement except to remove existing sloping curbs on the older pavements that are usually less than 24 ft wide.

This has developed into a rather substantial program amounting to the following mileages and contract costs:

<table>
<thead>
<tr>
<th>Year</th>
<th>Miles</th>
<th>Cost</th>
<th>Year</th>
<th>Miles</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>93.3</td>
<td>$785,002</td>
<td>1967</td>
<td>384.5</td>
<td>$4,898,871</td>
</tr>
<tr>
<td>1965</td>
<td>230.2</td>
<td>2,653,585</td>
<td>1968</td>
<td>422.4</td>
<td>6,383,437</td>
</tr>
<tr>
<td>1966</td>
<td>243.4</td>
<td>3,693,659</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,373.8</td>
<td></td>
<td></td>
<td></td>
<td>$18,614,554</td>
</tr>
<tr>
<td></td>
<td>Average cost per mile</td>
<td>$13,550</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The experience with this program has been good. It has rehabilitated to date approximately 1,400 miles on which improvements had to be made and for which funds for reconstruction to modern standards were not available because other projects requiring construction or reconstruction had greater priority. If the resurfacing has a ten-year life, which appears reasonable with adequate routine maintenance, it would appear to be a very good investment. And routine maintenance would not have been adequate to carry the loads to which the road would have been exposed.

The following excerpts are quoted from the 1949 Minnesota Legislative Interim Commission report to the Legislature: "Public demands for improvements in all classes of roads far exceed the ability of the people to finance the desired improvements. It is not economically feasible to meet all public demands for road improvements. Progress can best be made by meeting the more urgent needs first. In some cases the existing pavements can be widened, with or without resurfacing, depending on the condition of the slab. In some cases complete reconstruction is necessary due either to poor alignment or to deterioration of the slab."

These statements are as true today as they were twenty years ago, except that the pavements have deteriorated further. Twenty years ago Minnesota spent about $4.5 million for maintenance annually on the 7,000 miles of state highways. Today, with a 12,000-mile system, we spend over $30 million a year for maintenance. I would expect that similar increases in maintenance costs are being experienced in other states.

In 1965 we decided to develop a more rational approach to the establishment of priorities by employing the Present Serviceability Index (PSI) used on the AASHO test road at Ottawa, Illinois, to evaluate performance of the sections. A team of engineers was set up to review all the pavements that needed resurfacing as reported by the district engineers. The ratings on the scale of 0 to 5, as used on the AASHO test road, were determined visually and independently by each member of the team; agreement among the ratings by each member was surprisingly good. On the basis of these surveys, priorities for resurfacing projects were then established, with low PSI-rating projects receiving first consideration for resurfacing.

The road condition surveys were conducted in 1966 by district teams. The inspection technique was improved in 1967 by furnishing each team with a PCA roadmeter. This meter gives uniform riding characteristics for roads throughout the state for use in conjunction with the structural ratings. The pavements in the poorest condition were rated in 1967 and the remainder in 1968. The total effort was reviewed, the previously planned programs revised, and the resurfacing programmed for 1969, 1970, and 1971. The revised program for the next three years is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Miles</th>
<th>Estimated Cost</th>
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<tbody>
<tr>
<td>1969</td>
<td>546.1</td>
<td>$7,808,000</td>
</tr>
<tr>
<td>1970</td>
<td>371.4</td>
<td>4,991,000</td>
</tr>
<tr>
<td>1971</td>
<td>384.8</td>
<td>4,896,000</td>
</tr>
<tr>
<td>Total</td>
<td>1,302.3</td>
<td>$17,695,000</td>
</tr>
</tbody>
</table>

Although we have been quite pleased with the results obtained in our rating surveys, particularly with the PCA roadmeter, we have temporarily suspended our rating operations. We have entered into a contract with the University of Minnesota to develop relationships useful for predicting the surface life of flexible surfaces and the service life after resurfacing. We are hopeful that we will be able to implement the University's findings in time to provide ratings for the 1972 and subsequent resurfacing programs. It is expected that we will continue to use the roadmeter for the evaluation of the old concrete pavements still requiring rehabilitation.

Depending on the condition of the pavements, resurfacing has varied from a spot leveling course to correct the more seriously deteriorated areas, to a leveling course of 1½ in. and a wearing course of 1½ in., to two courses consisting of leveling and wearing courses. The aggregate used has been almost exclusively gravel, with or without the addition of filler to the wearing course mixture.

This has been a brief recital of Minnesota's approach to the problem of pavement rehabilitation. It seems to us that this approach is the only feasible one for economically
maintaining these pavements until such time as finances are available for reconstruc-
tion. Other approaches to this very serious problem may vary from state to state de-
pending on the circumstances. It appears to me that the following facets of the problem,
not listed in order of importance, must be given consideration to arrive at the optimum
solution or solutions:

What are the traffic volumes, present and projected, and the proportion of high axle
loadings? What are the road's riding characteristics? What is the structural condi-
tion? Is deterioration extensive and uniform? When is reconstruction programmed?
Are subgrade corrections warranted? Will widening of the pavement be required now
or in the future? Is crack reflectance anticipated? How long must the resurfacing last?
Should the existing pavement be broken to reduce reflectance cracking? Should a gran-
ular cushion or base course be used to reduce reflectance cracking? How much money
is available for resurfacing? Should the resurfacing consist of portland cement con-
crete or asphaltic concrete? If portland cement concrete, how thick should it be and
what should be the design of the steel reinforcement? If asphaltic concrete, how many
courses, how thick, and what should be the mixture design of each course? What will
be the cost per mile? Are the costs and anticipated life such that it would be more
economical and logical to go into a reconstruction project?

Experience has indicated that despite improved use of materials, pavement designs,
and construction practices, maintenance problems will continue. Rehabilitation of older
pavements is a continuing fact of a maintenance man's life, and we cannot be so optimis-
tic as to believe that pavements presently being constructed will not sometime in the
future require rehabilitation. Modern and future maintenance practices and vigilance
will probably postpone the day of reckoning, but the necessity of rehabilitation will un-
doubtedly become a reality. Effective and economical maintenance will continue to be
a challenge, and rehabilitation of pavements is not the least of the challenges that faces
us now and will face us in the future.