REPORT OF COMMITTEE ON MAINTENANCE

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MAINTENANCE COSTS

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The subcommittee on maintenance costs can only report progress and describe some of the ramifications of the problem to be solved.

The value of maintenance costs within government units such as counties and States, lies in the extent to which they may be employed for five main purposes

1 As guides for estimating probable future expenditures
2 As gauges of efficiency
3 As means for ascertaining the degree of economy in expenditure
4 As records in the economic life of the surface
5 As factors in problems of design of surface for construction or reconstruction

The principal value of such data among agencies charged with highway maintenance lies in their being amenable to comparison on fair bases

There are a number of factors entering into any attempt to compare maintenance costs, particularly among the States, that are not generally realized, such as quality of maintenance, cost accounting, type of equipment used, traffic, width of surface, climatic conditions, variations in labor and other cost items

In considering the quality of maintenance we may take as an extreme example the States' reported costs of maintaining gravel roads The cost per mile per year as reported runs from two hundred dollars per mile in one State to fifteen hundred dollars per mile in another The former is a Rocky Mountain State and the latter is a State on the Atlantic Seaboard The first State has an area of one hundred thousand square miles and a population of two hundred thousand, and the second an area of but eight thousand square miles and a population of four million The annual expenditure for highways in the first State is about three million dollars and in the second thirty million dollars The mountain State has about all it can do to keep the surface of the roadway in barely travelable condition and the drainage clear The eastern State spends a great deal on such work as the grassing of shoulders and embankments, roadside clearing, highway beautification, etc The difference is in the

quality of maintenance attempted Variation in costs due to this factor of quality is found in all types of road Between the extreme cases cited is a range of varying costs influenced by quality

Before cost data reports from States can become really comparable, more uniformity in methods of cost accounting among the States must be had Items included in maintenance costs by some States are charged to other work in other States. For example, many States charge to maintenance items of cost that, properly, should be charged to additions and betterments Many States fail to account for equipment rental, depreciation, etc in maintenance cost estimates The same is true with respect to supervision charges

Many States are still using old war-surplus trucks and tractors, at excessive expense to keep them in repair, while others are operating new equipment

Some States have a considerable mileage of roads that, when first built, were provided with surfaces adequate for the traffic to which they were then subjected, but which have since become worn out with the traffic increase Often such States are unable, for financial reasons, to reconstruct their roads with suitable surfaces On the other hand, other States can rebuild their highways to meet traffic increase, thereby reducing their maintenance costs Therefore, traffic data, and the age and suitability of surfaces to bear the traffic, are of paramount importance

Maintenance costs are usually reported in terms of cost per mile per annum The width of the surface is a pertinent factor that should be considered The amount of work necessary to maintain say a 20-foot road is usually greater than to maintain a 16-foot road—other things being equal The maintenance of shoulders of narrow roads costs more than on wider surfaces, due to the tendency for vehicles to leave the pavement more often

Some States, with large mileages of low type earth and gravel roads, have an average annual precipitation so low that it is impracticable to properly maintain smooth surfaces Other States with the same character of surfacing have ten times the precipitation and are able to have smooth riding highways of gravel and earth Frost action and other detrimental subgrade features, due to climatic conditions, vary considerably among the States

In comparing reported costs in terms of dollars per mile per annum, the variation in cost of labor, materials, etc in different sections of the country is often neglected Some adjustment must be made for variables of this nature to render cost data truly comparable

These are a few of the elements involved in the problem of obtaining any fair basis for maintenance cost comparison

It seems apparent that maintenance costs are not comparable as among all of the States Any comparison to be of value must be made

among States having similar conditions as to quality, standards of maintenance, financial ability, climate, topography, width of surface, traffic, etc In other words, for comparative purposes the States must be grouped

The Bureau of Public Roads has recently established a section charged with the study of this particular subject Briefly, the object is to arrive at the proper correlation of quality of maintenance with other important factors—and cost, weighting all essential elements, in order that definite formulae may be evolved that will provide means of estimating maintenance on fair bases The scope of such a study, with the difficulties incident to the collection and compilation of reliable data will mean the expenditure of considerable time It will, perhaps, be several years before there is sufficient information collected and digested, and before concrete recommendations can be made

DISCUSSION

ON

MAINTENANCE COSTS

MR A H BLANCHARD, *Consulting Engineer, Toledo, Ohio* I would like to ask Mr Bishop how far he has gone in investigating the cost of maintenance of concrete pavements He had a great deal to say about gravel roads Due to the fact that we have a large amount of concrete pavement in the United States, it would seem to be very desirable to have reliable maintenance costs on this type of pavement Excellent data, based upon certified statements may be obtained from the Michigan State Highway Department

MR H K BISHOP, *U S Bureau of Public Roads* The gravel road was used in this discussion to illustrate the fact that there are such wide variations in costs The committee as I said at the start has not yet really commenced its work We have assembled a vast amount of cost data, including Michigan's, and we find in analyzing them that the greatest trouble is that the variable factors have not been taken into account, and therefore they should not be compared The conditions are so different, including the methods of cost accounting One State may include several items that the other State leaves out In one State the quality of maintenance is rated very low and in the other State very high, and when we start to collect some data we will say, of a concrete road, we find the cost ranges all the way from $150 per mile to $1500 per mile The differences are due to certain causes, perhaps the age of the road, perhaps the quality of the maintenance or a number of the other factors, and for that reason the committee is attempting to

reduce the data we have collected from the States and weight it as to traffic, labor cost, quality of maintenance and other factors, and bring it down to some common standard if possible

MR BLANCHARD If the committee can devise a method which can be used universally so that maintenance costs may be equitably compared it will be a great help to the highway profession

MR BISHOP· We are attempting to set up certain headings like surfacing, drainage, shoulders, service to traffic, etc , with arbitrary weights, so that when an inspector goes over the roads in the various States, he rates the quality under each one of these headings, gets an average for each road, an average for a number of roads, and an average for the State I rather hesitate to say very much about the scheme We are only just starting and we do not have enough information and experience to say whether or not it is practicable We hope to be able to work out something so we can get a factor for the quality of maintenance that can be applied to maintenance costs which have been reduced to some common standard, taking into account the variable factors On the riding qualities of the road, I had in mind the use of a roughometer

PROFESSOR T R AGG, *Iowa State College* It would be exceedingly useful to the engineer who is making a cost study, and who would like to make comparisons of that sort, if these maintenance costs could be related to the density of traffic on the highway There seems to be very little information available at the present time as to the extent to which cost builds up with increase of traffic

DOCTOR J G MCKAY, *Director Cleveland Highway Research Bureau*· I would like to introduce this proposed theory Having seen maintenance costs in a number of States over a period of some several years and agreeing with Mr Bishop in the lack of a common basis, even within the same State, by means of which they can be compared, nevertheless, I am inclined to think that the differential between pavement lives is by far the more important factor For example, the differential between lives of 15 to 20 years of the same comparable types is so much more important than what I understand Mr Bishop is getting at, that maintenance costs become an unimportant factor So I am inclined to agree with Professor Agg that on higher type surfaces it is a major influence. The differential in the period of length of life, certainly 15 to 25 years, would offset average maintenance costs per year that might range between $200 and $400 per mile Oh the other hand with respect to lower cost surfacing, such as gravel and similar types, maintenance cost

becomes an important factor, and I certainly would like to endorse Professor Agg's statement that the major element involved is left rather unsettled Personally, I have little sympathy or little reliance on statistical data concerning maintenance facts starting with the flexibles and moving up to the rigids, in that the quality of construction is changed

REPAIR OF PAVEMENT SETTLEMENTS

W H Root, *Project Chairman*

Maintenance Engineer, Iowa State Highway Commission

A survey of this problem reveals that until this year three methods of repair of pavement settlements have been in general use These methods are as follows·

1 Filling the settlement with bituminous mixture

2 Raising the pavement with jacks and filling underneath with earth, or with sand forced in by compressed air

3 Breaking up the old slab, filling in the sub-grade and constructing a new slab

Each of these methods has its limitations and weaknesses The first method, which is probably the most used, produces a smooth riding surface but it has one serious defect, namely, that the voids under the pavement are not filled and further settlement is, therefore, not stopped or retarded

The second method is effective but it has the disadvantage that traffic must be detoured, also, it is expensive (Iowa's average cost is $1 75 per square yard of pavement raised) This method is not feasible where the lifts are less than 2 or 3 inches, due to the fact that material cannot be properly forced into such a narrow opening

The third method is entirely feasible if the slab is badly broken and if no further settlement is likely to occur, however, if this type of repair is adopted and further settlement does take place an embarrassing situation results

The engineering profession is familiar with the laws of hydraulic pressure and their various applications to engineering problems, however, it remained for John Poulter, a mechanic of the Iowa State Highway Commission, to apply this hydraulic principle to the raising of pavement slabs For a considerable period of time he experimented with simple homemade devices for producing hydraulic pressure and applying it to slabs When he had convinced himself that slabs could actually be raised by hydraulic pressure he developed a machine to produce the pressure and applied for a patent on the process

Figure 1 shows the first machine used for raising a slab by this method It consists of a tractor valve and valve guide The guide was grouted