REPORT OF COMMITTEE ON MAINTENANCE COSTS

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SYNOPSIS

The project consists of compiling and classifying maintenance costs for the purpose of establishing a fair basis for comparison among the various States Through the facilities of the U S Bureau of Public Roads, 47 States have cooperated in a uniform study of the cost of maintaining various types of surfaces, comprising a total of 18,716 miles Reports are now tabulated for a three-year period for 30 States, a two-year period for 11 States, and a one-year period for 6 States Variations in costs were found to be pronounced Assuming proper design and construction, factors largely responsible for this variation are listed as budget limitations, differences in cost of labor and materials, traffic, climate, quality of maintenance and width of pavement Because figures over so short a period are apt to be misleading, the Subcommittee will continue to accumulate these costs over a period of years

The problem of the Subcommittee is to present comparable highway maintenance costs with carefully defined contents The principal value of such data among agencies charged with highway maintenance, and material men interested in the economy of products, lies in their being available for comparison on a fair basis. Maintenance costs must, therefore, be accumulated over a period of years as averages and weighted to a common base for quality of maintenance, difference in labor, material and equipment prices and other factors affecting the data, such as character and weight of traffic, classification of maintenance operations, deferred maintenance work, inadequate design, drought, wind erosion, frost action, poor subsoil conditions, inadequate drainage, slides and floods

The work of the Subcommittee started in 1933 with a survey, through the facilities of the U S Bureau of Public Roads, of maintenance costs available at State highway departments, the principal agencies charged with highway maintenance It was found that the meaning and contents of the maintenance dollar had as many variations as there are States In order to secure uniformity it was proposed that each State select about twenty representative sections, each section composed of one type of pavement and cross section, and report the cost on a form having a uniform classification of maintenance operations and other pertinent data necessary to give uniform meaning and interpretation to the maintenance costs Forty-seven States expressed a desire to cooperate in the study and 1,233 sections were selected, comprising 18,716 miles of highways These sections are representative of the various types of surfaces now in use

We now have reports under these standards for a three-year period from 30 States, for a two-year period from 11 States and for a one-year period from 6 States These reports were reviewed and tabulated during the past year In some instances they were returned with suggestions for revisions when not prepared with the uniformity desired Correspondence and conferences were had with respect to omissions and revisions in reports and clarification of abnormal costs At the same time the comparative weight of the various conditions affecting maintenance costs were studied Maintenance engineers of the U S Bureau of Public Roads also made inspections and reports with respect to the quality of maintenance on the sections for correlation with the costs It is felt that this work focused attention on the need for uniform classification of maintenance operations and

definition of nomenclature and is bringing about a better understanding by maintenance men of the distribution and meaning of costs

The period for which the information has been collected is too short to give representative figures for the different highway surfaces Reference to our cost summary sheets at this stage of the study, however, indicates that there are large variations in cost per mile for projects of the same type Also there are considerable variations in the detail items making up the total cost per mile on projects of the same type Traffic density does not appear to have a consistent effect on the costs, probably due to the fact that other conditions overshadow the effect of volume of traffic

Assuming a proper design in the original construction including drainage, subgrade, base support and thickness of surface, there are several factors probably responsible for the large variation of costs for similar types, mentioned in order of their importance, as follows

1 Budget limitations
2 Variations in labor, material, equipment and overhead costs
3 Traffic, amount and weight
4 Differences in climate, including drought, moisture, temperature and snowfall
5 Quality of maintenance and efficiency of maintenance organization
6 Width of pavement and nature of shoulder materials

In order to illustrate the difficulties encountered in attempting to make comparisons of costs between States and types of surface, we will quote some of the data obtained from the study to date

LABOR COSTS

Let us first take the question of labor costs in six of the States which reported maintenance costs for a two-year period Table 1 gives some interesting information

The average rate for common labor in the first group is 45 and 23 cents per hour, respectively, in the second group 50 and 40 cents, and in the third group 55 and 30 cents Apparently labor rates have a very important effect on the maintenance costs It is, however, also evident that labor rates are not entirely responsible for the widespread differences in costs between the three groups of States in this tabulation Traffic has a decided influence, the quality of maintenance has an influence and, of course, climate and available funds must be taken into consideration

TABLE 1
HIGH TYPE PAVEMENT

Group	Location of State	Maximum traffic		Average annual maintenance cost per mile
		Cars	Trucks	
1	Central State	6,160	757	$355 36
	South Atlantic State	816	349	116 02
2	Pacific Coast State	4,077	780	640 15
	Central State	1,548	143	150 87
3	North Central State	2,845	427	240 86
	North Central State	801	149	104 51

TRAFFIC

Now let us take the question of traffic A study of Table 1 gives some indication of the influence of this factor on maintenance costs Take for instance the first group of two States where the maximum traffic is 6,160 cars and 757 trucks against

816 cars and 349 trucks We have an annual maintenance cost per mile of $355 36 against $116 02 In the second group where the maximum traffic is 4,077 cars and 780 trucks against 1,548 cars and 143 trucks, we have a maintenance cost per mile of $640 15 against $150 87 In the third group of States where the maximum traffic is 2,845 cars and 427 trucks, the maintenance cost per mile is $240 86 against $104 51 It appears from these data that traffic has a direct influence on maintenance costs Some indication of the influence of weight of traffic may also be had from observing that in the States with high maintenance costs, truck traffic is about two to four times the truck traffic in the States with low maintenance costs

The comparison just made refers to one type of pavement Let us examine other types and observe whether a similar traffic influence is apparent Comparing a high type of pavement in a New England State on which the maximum traffic is 8,349 cars and 604 trucks against a Central State with a traffic of 598 cars and 51 trucks we have an annual maintenance cost per mile of $329 65 against $154 26 On a medium type pavement in a Western State having a maximum traffic of 1,941 cars and 216 trucks against a South Atlantic State with a traffic of 606 cars and 255 trucks we have a maintenance cost per mile of $131 60 against $334 34 On a low type pavement in a North Central State with a maximum traffic of 1,299 cars and 153 trucks against a Central State with 387 cars and 166 trucks the maintenance cost per mile is $355 12 against $951 72 The last two groups of States show inconsistencies as far as traffic is concerned

The high maintenance costs on the low traffic roads just cited are undoubtedly due to other factors which can be described only after a more extensive analysis of the data submitted Weight must be given to the fact that in some States considerable roadside maintenance work having no direct relation to traffic is included in the maintenance costs It is also necessary to consider that some of the high traffic roads with high costs are located in States having severe winter climatic conditions requiring expenditures for snow removal, ice treatment and other traffic service charges included in the maintenance costs These may alter an apparent relation between traffic and maintenance costs Therefore in the final analysis of expenditures by types of surface the cost of the pavement and shoulders will have to be segregated from the total expenditures for all maintenance operations Regardless, however, of the inconsistencies shown in some of the cases cited it is felt that the remaining maintenance costs presented and other cases not referred to herein for which data are available justify a conclusion that traffic, particularly weight, does have an important influence on maintenance costs

In order to bring out more forcibly the difficulty involved in a study of this nature and the variations that occur let us take the yearly costs in the same State In a Central State the weighted average maintenance cost per mile of all sections having a high type of pavement was $363 07 per mile in 1934 while the cost per mile on the 23 sections included within the average figure ranged from $213 41 to $1,017 72 per mile In 1935 the weighted average cost per mile in the same State was $347 66 while the range was from $215 74 to $1,094 44 per mile On one section of high type pavement in a Western State the cost per mile varied from $513 19 in 1934 to $1,197 25 in 1935 In another Western State the cost per mile on a section also having a high type of pavement varied from $341 37 in 1934 to $1,045 00 in 1935

When routine maintenance of any element considered in this study has been more or less neglected for a year, or perhaps two years, it usually follows that

the deferred maintenance in the succeeding year shows a cost that would seem out of all proportion, while at the same time, if the job is well done in the third year, there may be only slight charges against the same element for a year or two following To illustrate this point we cite a section of highway in a Southern State No expenditure for drainage appears to have been made on this section in 1937 while is was necessary in 1936 to expend $212 05 for cleaning out, widening and lowering ditches in addition to extensive repairs to drains which amounted to $388 02 The reason for the heavy expenditure in this case was due to the fact that the particular element had been neglected for some time prior to 1936 These variations in cost illustrate the importance of analyzing maintenance data over a long period of years and the danger of drawing conclusions from such information gathered over a short term of years

WIDTH OF SURFACE

Now let us take the width of surface and see what influence it has on maintenance costs We have a Western State with 18-ft pavements and an average cost per mile of $348 00, three Central States, one with 18-ft pavements and an average cost per mile of $363 00, a second State with 18-ft pavements and a cost of $333 00 per mile, a third State with 20-ft pavements and a cost of $155 00 per mile, two North Central States, one with 20-ft pavements and $189 00 per mile and the second State with 20-ft pavements and $344 00 per mile, and one Pacific Coast State with 20-ft pavements and an average cost of $706 00 per mile The above figures refer to a high type of surface It may be well to note that the high maintenance cost in the latter State is largely due to extensive shoulder patching The shoulder maintenance cost on one section with a 20-ft pavement included in the average was $777 33 per mile, practically all expended for patching The traffic on this particular road was 2,991 cars and 835 trucks We might conclude from the information reported that this extensive shoulder repair was due to heavy traffic, particularly trucks getting off the pavement However, we take another section in this same State with a traffic of 5,254 cars and 1,219 trucks and we find that the shoulder maintenance is only $66 53 per mile—again showing inconsistency

Let us examine a little more into the subject of width of pavement. Let us take a North Atlantic State which has a considerable mileage of 16, 18 and 20-ft pavement

From Table 2 it will be noted that the cost for maintaining a 16-ft pavement is $341 82 per mile, the cost for maintaining an 18-ft pavement is $398 02 while the cost of a 20-ft pavement is $592 25 Considered on the basis of width alone this must mean that the greater the width of pavement the higher the maintenance cost, which is certainly erroneous

The figures again show that the 16-ft pavement has an average traffic of 999 vehicles per 24 hours while the 18-ft pavement has an average traffic of 1,269 vehicles for 24 hours This is in approximate proportion to the cost On the 20-ft pavement we have an average traffic of 3,043 vehicles per 24 hours which is about three times the traffic on the 16-ft width and 2½ times the traffic on the 18-ft width, while the cost of maintenance for the 20-ft pavement is about 1 7 times the cost for the 16-ft width and about 1½ times for the 18-ft width Undoubtedly the 20-ft width being of later construction and on the heavier traffic roads received more intensive maintenance than the 16 and 18-ft widths located on the lesser important route From the information we now have there is still a question of the extent of the influence of width of pavement on maintenance costs

While the Subcommittee is able to report progress and that a large amount of available data are being accumulated, the period of time has been too short to present information that would be of value in answering the question before us To give out at this time information relative to comparative maintenance costs would be misleading and of no particular value The Subcommittee, therefore, must ask for further time for study of this complicated and perplexing question

TABLE 2

NORTH ATLANTIC STATE

HIGH TYPE PAVEMENT

Year	Width	Mileage	Cost per mile	Traffic count		
				Average	Highest	Lowest
1935	16	22 76	$237 28	945	1,350	450
	18	98 64	304 25	1,274	3,600	621
	20	50 48	465 25	2,200	4,100	398
1936	16	13 09	467 55	1,016	1,350	620
	18	92 59	529 30	1,269	3,950	417
	20	50 55	729 94	4,133	8,973	1,819
1937	16	13 09	397 86	1,075	1,350	750
	18	78 10	360 80	1,262	4,345	650
	20	41 80	579 12	2,744	4,895	1,050
3-year weighted average	16	16 31	341 82	999	1,350	576
	18	89 78	398 02	1,269	3,936	559
	20	47 61	592 25	3,043	6,057	1,092

DISCUSSION ON MAINTENANCE COSTS

CHAIRMAN DICKINSON One element which is very important and which was not covered in the report is the question of inventory We must know what we have left over at the end of the year For instance in determining maintenance costs of an automobile it does not do much good to keep track of what is spent unless we can also determine the real value of the vehicle at the beginning and end of the year There is no good way of determining the current value of the road which we have had at the beginning and again at the end of the year and yet it seems that is an important element in the determination of current cost A store has to make an inventory once a year of what it has on the shelves or else it cannot tell very much where it does stand

MR BISHOP We realize that the question of depreciation has to be taken into consideration In the sections chosen we took pavements in good condition and with good foundations and of practically the same age in each case, and still the cost figures barely reflect the cost of maintaining that pavement in its original condition during its life We realize that at the end of that life it must be replaced but the great trouble at the present time is that the pavements have to be replaced before they are worn out because they are obsolete While we build pavements to last 10, 15 or 25 years, by changing the automobile types which last two or three years, we are running 1937 automobiles over 1922 or earlier constructed pavements