

The following is a summary of the maintenance and repair work performed during the past season, including sums obligated on uncompleted contracts:

276 miles of highway resurfaced or reconstructed at an average cost of approximately \$5,471 per mile; total expenditures and obligations under this item	\$1,510,112
2,086 miles of highway given a surface treatment of bituminous material and cover of sand, fine gravel, iron ore tailings or fine crushed stone, at an average cost of \$419 per mile; total expenditure and obligations under this item	874,137
728 patrolmen employed in the work of maintenance and minor repairs, at a total cost for labor	403,047
Expended for material and temporary labor in making miscellaneous repairs and supplying material to patrolmen for maintenance ...	998,462
Expended for rentals of large units of repair equipment	58,135
Expended for purchase of equipment and tools	31,958
Expended for engineering, supervision, inspection and expenses incidental thereto	334,724

Total amount expended and obligated for all purposes, approximately\$4,210,575

The State Highway Law, or our authority, provides for the maintenance and repair of improved highways either by contract or departmental forces, and all work which can be properly anticipated and foreseen, is incorporated into contracts which are awarded to the lowest responsible bidder, and emergency work and work of a minor nature, particularly such repairs as cannot be definitely measured or expressed in contract units, is performed by departmental forces.

During our past working season there were 230 maintenance contracts prepared, advertised and awarded to the lowest responsible bidder for a sum aggregating \$2,271,566.59, or 61 per cent. of the total amount expended.

There was expended directly by the department for materials, labor, rental and purchase of equipment and tools, the sum of \$1,604,285.

A study of the experience of our Maintenance Department in maintaining and repairing highways during the past year indicated that the expenditures are divided into three groups:

First. Maintenance, or the act of maintaining and preserving the various features of the highway in the same or uniform condition; the cost of such maintenance of all the improved highways of all types was approximately \$350 per mile, which involves the cost of the patrol system and the material used by the patrolmen, together with the cost of the surface treatments with bituminous materials and cover and supervision.

Second. Repair, or the act of restoring the highway to its former condition after more or less extensive deterioration during the winter season with the contingent freezing, thawing, unstable foundation, obstructed drainage, floods, washouts, sliding banks, etc., and that the cost of such emergency repairs was approximately \$140 per mile for roads of all types.

Third. Reconstruction and resurfacing. While on many of the improved highways it appears possible, with efficient maintenance, to preserve a standard of improvement from year to year, there are those that show marked deterioration in spite of efforts at maintenance and ex-

tensive repairs from time to time. This deterioration is generally due to peculiar traffic conditions, combined with unsuitable materials used in the original improvements, and is often the result of insufficient foundation material in the roadbed.

The total amount expended and obligated for all purposes in the year will average \$750 per mile when distributed over the entire mileage of improved highways.

This statement is misleading in that a large percentage of the total improved mileage is of recent construction.

The first highways improved by the State under the Higbie-Armstrong Act were completed in 1899, and in thirteen years, or to the end of 1911, there had been completed and accepted but about 2,600 miles, while in the last four years there have been completed and accepted 3,226 miles. In other words, 55 per cent. of the improved mileage has been constructed an average of two years, while the 45 per cent. has been improved an average of ten years.

Assuming that no pavements should require resurfacing for a period of four years after construction, it is necessary to eliminate the 3,226 miles which have been improved during the past four years from the consideration of the cost per mile for resurfacing and reconstruction. Therefore, the total expenditure for this subdivision of the work should be distributed only on such mileage as has been constructed or improved for a period of four years, and when so distributed the cost per mile for this subdivision during the past year is approximately \$560 per mile.

It would seem, however, that the average life of a pavement after reconstruction would be greater than that of the first improvement, as foundational weakness that has developed would be provided for in the reconstruction. Also, the maintenance and repairs for the first five years after the original improvement are greatly increased by heavy items which are properly chargeable to improvement, and are really a completion of the improvement, such as removal of slides from banks which have been cut into at the time of improvement; the construction of retaining walls to sustain such banks, and for the protection of the highway from the erosion of streams. Also the drainage conditions, as provided in the original improvement, are often the subject of much complaint from the abutting owners and necessitate modifications and construction of storm water sewers, all of which develop and are taken care of in the first few years, after the original improvement. It can, therefore, reasonably be expected that the cost of maintenance repairs and reconstructions will decrease in some proportion to the age of the improvement and that the high cost of \$560 per mile for resurfacing and reconstruction, when applied to all the improved highways, would never be attained, and that the reduction in the item of repair would offset the increase in reconstruction as the improvements increased in age owing to the gradual elimination of weakness, together with the effect of efficient maintenance.

It would accordingly seem by this manner of reasoning that the improved State and county highways of all types could be perpetually maintained for about \$750 per mile.

Our expenditures for the past have been segregated into groups to determine the expense of maintaining the roads of various types, the expenditures in each instance being charged to the type in which the highway was classed at the beginning of the season or before reconstruction.

There were under maintenance during the season 192 miles of gravel roads, upon which the average expenditure, including reconstruction to a different type, was \$955 per mile, and the average expenditure, exclusive of recon-