

MACADAM ROAD MAINTENANCE.*

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THE revolution in the character of highway traffic within recent years has resulted in a demand for road surfaces very different from those which have heretofore been considered quite satisfactory. This change in character, and increased intensity, of traffic has also brought about a marked change in the methods of maintenance, and has advanced the question of maintenance from a position of importance second to that of construction to one at least of equality. Whereas formerly, a properly constructed road was looked upon as built almost for all time, the present tendency is to consider no road or pavement permanent, much less that type composed of crushed stone bound with its own dust and known as macadam. Formerly, the road-builder looked at the completion of the road as the end of his work; to-day it is only the beginning; for no builder of highways would claim the ability to construct a road or pavement that will withstand the severe strain imposed on it by present-day traffic. True, one may read and hear extravagant claims for almost any of the expensive types of pavement, some of which are protected by patents, but how many of them will live up to these representations? In the case of water-bound macadam, and even bituminous macadam roads, which are to carry even only moderate traffic, the scheme of highway improvement is considered incomplete if it does not at the beginning provide for constant and efficient maintenance of the roads to be constructed.

Almost every treatise on the maintenance of macadam roads has for one of its first sentences the statement that "Maintenance should begin on the day the road is opened for traffic," or "The proper time to commence maintenance is immediately after the completion of the road," or words of like import. The truth of these exhortations is admitted, and acted on by the municipal official, who would preserve his investment. The day on which the road is completed is the proper time to commence systematic maintenance, but many of the plans should be laid long before this. Realizing that a well-built road will require much less expenditure to keep it in good condition than one built to a lower standard, it will be well, before commencing construction, to consider carefully the relation between original cost and the cost of subsequent maintenance.

The annual cost of maintenance on macadam roads may be quoted roughly as from one to ten cents per square yard, depending on many conditions, such as the nature and intensity of traffic, quality of material and standard of work originally employed, character of the sub-grade, excellence of the drainage facilities, and efficiency of the maintenance organization, with much emphasis on the last named. While we have come to the conclusion that roads carrying heavy concentrated traffic must be something more than ordinary waterbound macadam if they are to be maintained in good condition at reasonable cost, financial considerations in many instances decree that the expenditure on construction must be limited as nearly as possible to the cost of the ordinary type. In such cases it is well to remember that a moderate increase in the cost of construction may materially lower the annual maintenance charge. For example, if an increased outlay of 20 cents per square yard will give a road surface on which

the yearly maintenance cost will be reduced $1\frac{1}{2}$ cents per square yard, the saving in maintenance will repay the increment in 20 years, and the expenditure will be justified. And 20 cents per square yard added to the cost of the average waterbound macadam road will make a vastly better road. It will, for instance, permit an increase of from two to three inches in the depth of stone, and a corresponding increase in the strength of the road. Or it will provide an extra inch or two of stone, and in addition a bituminous carpet coat to protect the surface and prevent dust. The latter will result in an improved road, both top and bottom, and it cannot be denied that the annual maintenance cost of such a road surface will be reduced by at least $1\frac{1}{2}$ cents per square yard. Or, in the case of a 12-foot road costing \$1 per square yard, the equivalent of 20 cents per square yard on this width, added to the cost, would allow for an increased width of from two to three feet, and would permit of a wider distribution of traffic over the metalled surface.

To first-class construction must be added constant care in maintenance, in order that the cost of the latter may be kept down. The less attention a road receives, the more it will require in the end, and the greater will be the cost of eventually bringing the surface back to its original good condition. Efficient maintenance consists in more than keeping the travelled roadway smooth; it must include careful protection of the metalled surface, and also the earth shoulders and sub-grade from the numerous agencies which tend to destroy them. Such a programme will include careful attention to the drainage facilities, and the improvement of these wherever possible. The growth of grass and weeds on the earth shoulders is one of the most effective enemies of surface drainage, and should always be discouraged. Not only does the vegetation prevent the rapid draining off of all surface water, but the accumulation of the remains of successive years' growth will, before many seasons have passed, raise the shoulder above the metal, and form a basin for the retention of water to soften the stone surface and sub-grade, and hasten wear and rutting. The use of the log-drag is being emphasized in connection with the maintenance of earth roads. It may also be used with profit on the earth shoulders of macadam roads, both in keeping them smooth and maintaining a proper chamber, and in preventing the growth of weeds.

By improving the conditions under which a road performs its work of supporting traffic, and by taking such precautions as are practicable to decrease wear and deterioration, and the consequent necessity for maintenance and repair, much expense may be saved, and the annual charges materially reduced. Some of the destructive agencies to which the road is subjected are almost entirely preventable, and may, with proper construction, be almost eliminated. Of these, the chief is probably the action of water and frost in the sub-grade. With proper drainage there will be no water under the road, and where there is no water, there is no danger of damage from frost. Internal movement and attrition may also be prevented by precautions to secure a solid sub-grade and thorough consolidation and binding of the stone. Other agencies, however, such as the abrasion and pulverization caused by horses' feet and vehicle wheels, the shearing action of fast-moving automobile tires, and the chemical action set up on the weathering of the stone, cannot be entirely prevented, and protection against them consists mainly in minimizing their effects.

While effective maintenance will depend largely on the attention given the road and the labor expended on it, there are influences which may be exerted to reduce the

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