MAINTENANCE OF ROADS.*

By D. C. Wedgeworth.

The importance of highway improvement depends not so much on its engineering elements, as on the fact that a real improvement adds a certain percentage to the value of the property it affects. The rural districts are beginning to understand that the slight increase in taxes, if spent on properly improved highways, is a good investment.

This work of improvement has been entrusted to the engineer, and it is safe to say that it has not proved a very simple problem. The usual method is to lay a macadam roadway. This has been to a large extent successful, but the writer believes that a slight alteration of the method will add to the life of the road and lessen the cost of construction as well as maintenance.

This cost is dependent on many things, mainly the source of supply of material, stone, filler, water, etc., and, unfortunately, the cost of improvement of a highway is a large factor in its treatment. Against increased cost may be balanced a cheaper construction with probably a poorer highway. For this reason the engineer must strike a fine balance between an ideal roadway at high cost and an inferior roadway at less cost. In arriving at a final result there should be no better criterion than the results obtained from methods and materials heretofore used.

Given a road having a porous yet stable soil, well drained, it is frequently found that a slight improvement of natural conditions affords a good roadway. The worst natural conditions require the best road, the most thought, and frequently the most expense. Under such conditions an ideal road may be prohibited by great expense.

The engineer is then forced to find the material and method of construction which will give the best road for the money to be expended; or, in other terms, the limit of expenditure is determined by the value of the results obtained per dollar of expenditure.

The basic principle of a macadam road is the placing of a suitable wearing surface over a solid base in such a way that the macadam will perform two functions, first, sustain the wear of traffic, and second, transmit to the base the loads imposed by the traffic.

Had the engineer always at hand—or the money to bring to hand—materials which would furnish the macadam capable of carrying out these functions, the problem would be more simple; but, to bring about these results with the materials at hand, calls for much thought, experience, and common sense.

Although the matter of general location and sub-base of a roadway is very important, it does not enter into this presentation, as the writer wishes to deal only with the construction of the macadam proper. Having settled upon the location and prepared the base, or sub-base, as the case may be,

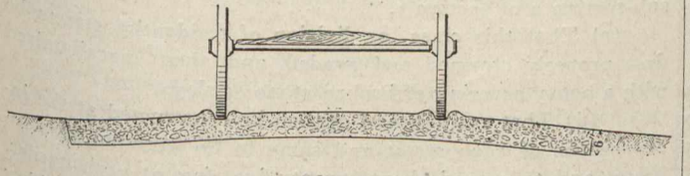

Fig. 1.

the present method has for its object the formation of a 6-inch layer of crushed stone, bonded and placed in such a way as to form a solid mass impervious to water. To this end a stone of good binding qualities must be found. This must be bonded with a proper filler, and the whole consolidated by successive manipulations until this result is approached as nearly as may be. The roadway is then put on trial; if it stands, the material and manipulations have been correct; if not, reasons and repairs are in order. Considering the varieties of stone and filler at hand, differing with various roads, it is rather remarkable that so large a percentage of roads shows satisfactory results.

The point the writer wishes to bring out is this: The stability of the macadam is dependent on the bond, and this is dependent on the filler and the manipulation. Under the best conditions, there are seasons of the year when this bond is temporarily destroyed by the action of freezing and thawing. Heavy loads, also, may destroy the bond before the load is transmitted to the base. This fact is shown by the early repairs necessary on roads built under the present method. It is a fact, also that when a country road is macadamized,

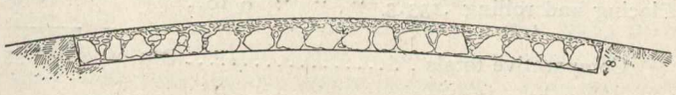

Fig. 2.

not only will the number of vehicles be increased, but the weight of single loads will be doubled.

Fig. 1 illustrates this point. The stones are pushed up on each side of the wheel track, and not down into the base, simply because the bond is not sufficient to hold them together. A close examination during repair work will show that this is exactly the case.

Proposed Method.—Would it not be a more logical and common sense way to place the stones in the macadam before crushing, as far as possible, than to break them up and try to bind them together again? Does a carpenter cut a post in sections with the intention of splicing it again when in the building? Why not save this expense of crushing and rolling as much as may be?

Fig. 2 represents a section built after the following method: Having prepared the base in the usual manner, the larger stones are hauled upon the base and placed near one another, no special care being taken, as that would take much time and cause expense. These stones, in their vertical dimension, should average about 7 inches for an 8-inch thickness of macadam. Smaller stones, from the crusher, or spawls from the quarry, are then drawn in, and the spaces between the large stones well filled. A wearing surface of about 2 inches is placed over all, and the whole well rolled. As much stone dust as the stone will take up is then applied, and the surface is puddled, as in the present method.

The large stones transmit the load directly to the base. Filler is not depended on to bind the whole together, as the smaller stone between the large ones will do this. In fact, very little filler will reach the bottom, thus leaving it open for drainage, and avoiding the danger of disintegration by frost.

Comparative Cost.—To make an accurate comparison between the cost of the present and the proposed methods, similar conditions must be imposed on each. On roads where local field stone can be used without crushing, and crushed stone can be imported at reasonable rates, the percentage saved will be greater than where all stone must be hauled from the quarry in either case. Whatever the conditions, there is a saving of 50 per cent. of the crushing and 40 per cent. of the rolling in comparison with the present two-course road. Another point not to be overlooked is the utilization of the total product of the crusher. This method takes out the dust and 1-inch to 2-inch stone, putting all the remaining product in one bin. This product should be used to fill the spaces between the large stones, and the 1-inch to 2-inch stone for the wearing surface. In case a local stone is used for the body of the road, and trap is imported for the top, very little crushing on the ground will be necessary, and the whole product, with the exception of the dust, may be put in one bin and used to fill the spaces between the large stones.

On an average road, with field stone convenient to the roadway, and a good limestone quarry along the road, a comparison of cost would be somewhat as follows:

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