

PROGRESSIVE METHOD OF ROAD IMPROVEMENT*

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IN a country with a comparatively sparse population grouped in centres generally remote from one another, the general problem of road improvement is solved by means of two methods which may be used concurrently according to the amount of money available. On the one hand there is the method generally followed for main communication highways known as "trunk roads." This method is the normal one which is of the same nature as that followed in building railways, with the same complete preliminary studies and a similar organization for carrying out the work. On the other hand, there is what is called the "progressive method," which is better suited for rural road properly so-called. The object of this paper is to call attention to this second method, to describe it properly and make its advantages known.

The population of the province of Quebec is scattered over a very large area, generally in groups and living on long ranges sometimes remote from one another, from railways and from main highways, at distances which, in a densely populated country, would be considered very great.

The consequence of this is that every rural municipality has a very considerable length of roads under its charge. The average length of roads per municipality in this province probably exceeds 40 miles. Some townships have as much as 100, 150 and even 200 miles of roads under their control.

Roads in Agricultural Districts

Their population is chiefly an agricultural one and naturally has not sufficient capital for improving such a long stretch, all the more so owing to the fact that, outside the St. Lawrence Valley, the country is generally undulating and sometimes broken; on the other hand, agriculture and trade have greatly developed within the past four years, and the need of connecting rural municipalities with one another, with railways and highways is becoming more and more felt. The use of automobiles is increasing even in the most remote districts. Requests for roads, on which at least automobiles can run, are becoming more and more insistent every day and the problem is becoming complicated from a domestic standpoint. How can all these requests be even partly satisfied? Such is the question answered by the second method.

Needless work must be avoided and as little as possible of work offering but transitory or short-lasting advantages should be done. All the work executed should be with a view to real, progressive definite improvement, and preference should be given to the work urgently needed. Thus, the works on rural roads may naturally be classified in two principal categories: Works of a permanent nature, and works of a non-permanent nature.

This distinction, as will be seen further on, is very important not only from the standpoint of the capital to be spent in making roads, but also from a technical point of view. It also naturally applies to road-making according to the first method. It must never be lost sight of.

Permanent Works

Permanent works comprise: Drainage, underdrainage; bridges and culverts; earthworks; special work, such as retaining walls, rip-rap, random rip-rap, etc.; work of minor importance, such as cobble gutters, small dry stone walls, earth basins, etc.; lastly, the foundation, which is one of the most important of permanent works.

All these works are called "permanent" because their duration must be unlimited and because the capital spent on them must be a life-long investment. For instance, reducing the slope of a hill from 15% to 5%, is a permanent work. Interest on the capital required for this

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work is and will always be represented by a lower cost per ton-mile as well as by reduction in the cost of maintaining the road, and the amount of interest will be all the greater as the traffic on the road increases.

As a rule, the cuts and fills for improving the profile of a road are permanent works. Deviating a road to get around a low-lying or wet spot, when drainage and underdrainage cannot be done and where no top course can be maintained except at a heavy cost; raising, by means of a fill, a road running through a low place in order to protect it from dampness and from flooding along a stream, are permanent works. All these works must be so arranged for that the capital to be spent on them will permanently yield good interest through the advantages they will procure.

Straightening is Frequently Profitable

The straightening of a road in order to decrease its length, is also a permanent work. If, for instance, one reduces by half a mile the length of a road four miles long on which a wearing course has to be put which will cost \$10,000 per mile, the total cost of that top course will be lowered by \$5,000. Such straightening may sometimes be effected for a smaller sum, including the purchase of the land required, while the expense of its maintenance will be reduced by one-eighth. The more expensive top courses are, the greater will be the advantage of reducing their length by well-arranged straightening.

Concrete bridges and culverts to replace wooden ones, may last indefinitely if they are solidly and carefully built, and the interest on the capital spent on them will be represented by a decrease in the cost of maintaining the road. Wooden bridges are comparatively costly to keep in order and require to be rebuilt from time to time. This cost of maintaining and remaking bridges is heavier, as a rule, than the interest on the cost of properly built concrete bridges.

Generally speaking, the works called "permanent" in connection with road-making, are the same as for railways, less the cost of purchasing, transportation and laying ties and rails. To sum up, their feature, as we have just said, is the effecting of a life-long investment and they must always be understood and executed so that the investment may be an advantageous one. These permanent works also possess the following important characteristics:—

Annual Maintenance Costs Decrease

If properly understood and carried out, the yearly cost of their maintenance will be greatly decreased. Such cost is practically independent of the volume of traffic. It is greater, as a rule, during the years immediately following their execution and it decreases gradually, as the years go by, to a certain fixed lower limit as the road settles down and nature establishes a new equilibrium in the place of that which was disturbed by the execution of the work. In good ground, the new equilibrium is very soon attained and the cost of maintenance rapidly drops to a trifle. But, in bad ground the cost, which may have been rather considerable at the outset and for some years, always ends by reaching its fixed limit.

The maintenance expenses of these permanent works consist chiefly in keeping the slopes in order, clearing the drainage system, repairing the drystone works and the foundations, for the latter often sink owing to uncontrollable changes in the regimen of the underground waters.

Such are the economic features of permanent works. Comparison with non-permanent works will bring them out still more clearly. From an economic standpoint, non-permanent works do not absolutely, constitute a permanent investment, but are rather a yearly expense. In industrial accountancy, they would be considered as more or less transitory investments and be classed among those represented by cost of equipment. Expenditure in connection with them would be classed partly among the items interest, renewals, depreciation, and in the list of fixed charges, and partly among the items of labor, supplies and repairs in the operating charges.

Contrary to the permanent works, the maintenance expenses in connection with them vary with the traffic volume and also with their age. They are almost nothing during