

If kept up without interruption for ten hours this would mean 1,200 lineal feet of trench.

As to the general cost of operation and the average daily output a fair estimate would be as follows: It takes three men to run this machine—an operator, a fireman, and a rigger or oiler. In addition to this, add half the wages of a blacksmith. One blacksmith readily takes care of two machines. The 24 horse-power engines that run the machine average 1,500 pounds of coal per ten hours of steady work. The water is hauled in a tank; and, as one of the teams engaged in backfilling is used for hauling the water at intervals, there is really no appreciable charge for water. If the water haul were long, its cost could be easily estimated by allowing a gallon of water for each pound of coal.

The daily work of such a machine has been as high as 1,200 lineal feet 26 inches wide by 7 feet deep in ten hours under good management and with a skilled operator. This would mean only 700 cubic yards per day. But with an operator of short experience, a fair day's work was 700 lineal feet and a good day's work was 900 lineal feet.

Laurin & Leitch found that they could cut two feet of frost and in an eight-foot trench make 350 lineal feet in a little over eight hours.

The average cost of operating a machine would be as follows:—

	Per Day.
1 operator .....	\$ 4.50
1 fireman .....	2.50
1 oiler .....	2.50
1 labourer .....	1.75
½ blacksmith .....	1.30
Coal—½ ton .....	2.50
Total per day .....	\$15.05

It will be plainly seen that by good handling in favourable conditions the cost can be cut to about 3 cents per cubic yard.

Of course different conditions will vary this price considerably; but these figures show conclusively the advantages of these machines.

#### COST DATA OF ROAD BUILDING.\*

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Highway improvement is at the present time a live question in the Province of Ontario, a question which demands the attention of every unit of government from the Village and Township Councils to the Legislature. The old systems of road building and management, which have been in vogue for the last fifty years, are now generally admitted to be totally inadequate for the changed conditions and are fast becoming obsolete. Much credit is due the Provincial Public Works Department, for the information given to the public in respect to scientific road building. The statistics given by this Department go to show that much money has been wasted through wrong methods, and the necessity of placing road construction and administration on a correct basis.

At the present time the township, the county and the province are providing means for the construction and maintenance of country roads, and the cost data given in this paper are based on the actual cost of roads built in the County of Peel according to the Regulations of the Public Works Department in respect to highways.

Although it is getting away from my subject, I would

\*Read before the Good Roads' Association.

like to say here, that I consider the Highway Improvement Act has done a good work in establishing County Systems of good roads. But the roads on the County Systems are not connected, and there is no doubt the time has come when we should have a Provincial System of well designed, well constructed, continuous roads, to meet the conditions of the present time. It is obvious that a system of main roads, connecting links between cities and towns, such as would be taken into a Provincial System, cannot fairly be built and maintained at the expense of the rural municipality. For an example, take the Lake Shore Road through the County of Peel, which is the main highway between the cities of Toronto and Hamilton. It is estimated that more than half of the travel over this road is non-resident. On this highway, we have built about three miles of first-class stone road, at a cost of about \$10,000, for which we receive great praise from the people of Toronto, the people of Hamilton, and the people of the County lying West of us, by whom this road is used. Now the praise is all right as far as it goes, and we appreciate it very much. But it does not help to pay the piper. The only fair and equitable way to build roads of this description, and the only way we will ever get a system of trunk roads such as we require, is for the Government to take up a Provincial System. This appears to be the opinion held by the Deputy-Minister of Public Works, who says in his annual report on Highway Improvement for 1909,—“County road building is, however, a matter of magnitude and expense, as compared with the number and wealth of those upon whom it now commonly rests. Wherever it is left solely to the farmer it will be years before the condition of the roads will be adequate to the complete development of the resources of the country. It is a great public work in which the entire citizenship must bear a part of the cost.” And the only way we can get the entire citizenship to bear a fair part of the cost is for the roads to be built and paid for by the Province. These roads would be object-lesson roads for the sections through which they run. They would be a lesson for local road builders in the correct principles of road construction, and would demonstrate the advantage of properly built roads. And if in connection with the Public Works Department a laboratory was established, where samples of materials proposed to be used could be sent for analysis and comparative tests, it would further enable the municipality to ascertain the best local material available for road building.

The cost of roads varies widely in different localities, owing to the difference in the conditions under which they are constructed, such as nature of the soil along the proposed road, the general grade of road,—level, rolling, or hilly,—the condition of the road in respect to drainage, the cost of labor per day, the kinds of road building materials that are available, and how far they are situated from the road, the amount of travel over the road, and, if bridges or culverts are to be built, the span, the nature of the foundations, the kind of bridges or culverts now in use and the condition of each.

The extent of the plant required for road making is governed by the requirements of each case. The outfit for a macadam road usually consists of scrapers, plows, road machine, steam roller and sprinkler. The average outfit of this description will cost about \$3,800. Where stone is available for crushing, a crushing plant may be added, consisting of a crusher, elevator, revolving screen and bins, at a cost of about \$1,300.

An expert road foreman and machinery engineer are necessary to get the best results and to keep the work running smoothly. Competent men are available for these positions at from \$2.50 to \$3 per day.