

Niagara Falls have been the constant care of hysterically artistic amateurs of both sexes for many moons. At present my friend, Mr. Isham Randolph, of Chicago, sleeps uneasily and dreams that in a few centuries the magnificent curtain will have become a decrepit rapid, trickling through crevices or gurgling down gopher holes—"unwept, uncoffined and unsung."

Now, why not divert all the water into power that tends to ruin the venerable escarpment, replacing it by a cupid breathing spray from perforated pipes led around the crest? Even the outline of the Indian maid with her white canoe could be produced, and in wintry nights it could be electrically heated or shut off altogether.

Anyway, the possibilities of joint ownership and development by two nations of the greatest power centre in the world have been outlined. It may be assailed as a flight of imagination—well, so was the electric light, the telephone, a few decades gone by. Two generations will accomplish this ideal for the world's greatest valley.

ROAD CONSTRUCTION.*

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IN presenting the subject of road construction for your consideration it is not my intention to go into details, but rather to ascertain what basic principles the ratepayers and councillors must follow in order to obtain the best results from money expended.

While it is essential to give careful consideration to the economic and financial questions of road building, those are only subsidiary to the actual construction. It is possible to have good roads without good financing, but it is not possible to have good roads without proper methods of building them. The construction of the road is then the object of the other considerations, and it is in construction that money is spent. It is, therefore, necessary to investigate the fundamental principles governing this subject.

There are three elementary principles underlying economical and efficient construction. The first is the proper planning of the work so that necessary provision is made for drainage, the best alignment is selected, the economical grades established, and the proper shape of the road decided on. These matters come under the principle of good engineering. The second is the selection of the men, teams and machinery to do the work, and, most important of all is this division, the selection of an experienced and competent foreman. These matters are embodied in the principle of organization. The third principle is the planning of how the work is to be carried out, at which point the work will be started, in which sequence it will be followed up, and whether or not the work will be continuous. These matters are included in the principle of system. The three principles, good engineering, good organization, and the systematic carrying out of the work are the vital elements in road construction.

First, the engineering side of construction. What bearing has engineering on proper road construction? Three essential requisites for construction of a good road are drainage, grade and alignment. Drainage, drainage, and more drainage, is the slogan of all road builders.

*Abstract of paper read before the Manitoba Good Roads Association.

In rolling country or open soil the drainage may not be a difficult question, but in a level country with heavy soil it often becomes a most difficult problem. Here skillful engineering is required to obtain proper grades for the drainage ditches and to locate offtakes which will carry the water away from the road ditches to natural watercourses so that the road may dry quickly after rains or in the spring. The question of grade is also one requiring careful consideration. Not only grade reduction on steep hills, but also the grade through rolling and through level country. In level country the road will be constructed of material from the ditch. Very rarely is a country so level that the quantity of earth taken out of a ditch is the same at every point in the ditch. Some places there will be more earth than is required for the building of the road at that point and at other places not sufficient. Careful thought must be given to the disposal of this earth, whether it should be hauled from places of heavy cut to places of light cut or whether some of it should be wasted and earth borrowed at the light cuts. In rolling country, where little ditching is necessary, the grade must be so planned that the cut from the hills must just balance the fills up to an economical length of haul, which length of haul must be determined. In grade reduction on hills the problem is to establish the most economical grade. This grade will vary with the relation of the cost of the grade reduction to the amount and nature of the traffic. It will be dependent on the direction of heavy traffic, the type of road, or perhaps be governed by a ruling grade on some other portion of the road.

A proper alignment of the road is necessary, both for appearance and economy. In level country a well-aligned road grade and ditch has an appearance in keeping with a neat farmyard and farm buildings. On side hill work a change in alignment may make a considerable change in the grade of the road or in the cost of construction. In rolling country it is often found more economical to build a road around a hill than to build over the hill and thus reduce a heavy grade to a level or nearly level grade.

The shape of the road is also an important question to be decided. It must be wide enough to conveniently accommodate the traffic which will make use of it, but no wider than is necessary or the expense of maintenance will be too high. The width of the road will vary according to the class and amount of traffic. In general, an eighteen-foot road is the minimum width on which two lines of traffic can comfortably pass, especially if some of this traffic is fast moving. On roads where the traffic is light and slow moving a sixteen-foot road may suffice.

The location and size of ditches must also be given consideration. The ditches must be so planned and constructed that the road will be safe for traffic. The location, size and shape of the ditch will vary with the class of road, with the nature of the soil and with the topography of the country. The crown of the road must be such that any water falling on it can quickly find its way to the ditch. But the crown must be no more than is necessary to serve this purpose. The amount of crown will vary with the type of road, with the grade of the road and with the character of the soil.

From these considerations it is apparent that engineering plays a very important and essential part in road construction.

The part which the organization has in road-making is also very important. It is useless to plan proper drains, grades, road sections and alignment unless the construc-