

OWING to the absence in many places of rock, gravel or other hard and durable substances, with which to build good roads, and by the reason of the excessive cost of such roads, where suitable material is scarce, a large part of our public highways will of necessity remain earth and clay roads.

When one considers the number of miles of this kind of road, in any township or county in the province of Ontario and compares it with the number of miles of surfaced road, it can easily be seen that it will be many years before even one-half of them are properly surfaced with either gravel or stone. For this reason it appears most important that we should give every consideration and thought to the construction and maintenance of the common earth and clay roads.

In our effort to construct a type of road that will carry the ever-increasing motor traffic between cities, we are apt to overlook this earth road problem, where large sums of money are being spent, more often with poor results, which, if handled properly, would result in better roads and more of them, for perhaps less cost.

Before spending too much time or money on the maintenance of a road, one should bear in mind that this earth road may be the foundation for a later improved one, with a surface of gravel, stone, concrete or other hard material. It is, therefore, important to first of all be quite sure that there is no question whatever regarding the correct location.

The chief factors to bear in mind in this respect are: easy grades, proper direction, good foundation and drainage. The common error in laying out a road, is made in the endeavor to secure the shortest route between two fixed points. For this purpose the road is often made to go over hills instead of around them.

Many of our roads were originally laid out following along boundary lines of farms and concession lines, regardless of grades. Here they have been allowed to remain, where a large amount of energy and material have been wasted in trying to travel and haul loads over them and in endeavoring to improve their deplorable condition.

In locating the route, one must also bear in mind that the road for the present will be constructed out of the materials over which it passes, so it will be well to carefully study the nature of the soils and avoid, where possible, any swamps, or morasses and soils adjacent to beds of streams, not only on account of the poor nature of the road-making qualities but also on account of the difficulty of draining.

A road can never be kept hard and smooth if the water from the surrounding land drains on to it. This can often be avoided by taking a little longer route on nearby higher ground at perhaps a little greater initial cost, but certainly at a much reduced expense for maintenance.

A road should be finally located so that when constructed the length and grades will be so balanced that a minimum amount of effort will be required to go from one end to the other.

After satisfying oneself that the location of the road cannot be improved upon, the next most important feature to study is drainage. Water is, without doubt, the most

destructive agent to any class of road, but much more so to an earth road, which is more susceptible to the action of water, more easily dissolved and moved by it, than any other surfaced road; for this reason, too much attention cannot be given to this problem. This is true in all climates, but more particularly in Canada, where heavy rains are prevalent during certain seasons of the year, and where the winter months are attended with severe frost and snowfalls.

Water must be kept away from the road and rain which falls on it must be made to run off as rapidly as possible.

Drainage may be divided into two sections: (1) Sub-drainage; (2) surface drainage. The former will undoubtedly be required, when the road runs through wet lands, over clayey soils, or where springs exist in the soil under the road.

Various forms of underdrains are laid, some of wood and some of stone, but at the present time there is no question but that the best results are obtained by the use of tiles, either porous or glazed, the latter being preferred, even if the cost is a little more, on account of their greater resistance to frost action. These tiles should vary from 3 ins. to 5 ins. in diameter and be placed about 3 ft. below the road surface, or just below frost level. They can be placed at once side of the road, or both sides if necessary, except in places where it may be necessary to carry off water under the centre of the road where springs or spongy places appear.

The pipes should have a fall of at least 2 ins. to every 100 ft. Previous to laying the tiles the bottom of the trench should be brought to a true grade and carefully levelled, so as to avoid any humps in the pipe line. In laying the tile, care must be taken to get the ends to fit closely to each other, and cover the joints with a strip of tarred paper. When filling in the trench, tamp the first few inches of material that is being replaced above and around the tile so as to prevent any possible displacement. Some people recommend filling over the pipes with gravel or small stones, but this is only necessary in certain soils of a stiff clayey nature. The object of subdrainage is to keep the ground supporting the road dry, by carrying off all ground water before it can penetrate the subgrade, also in the spring season, when the frost comes out of the ground, any water resulting from the thaw will be quickly drawn off. Roads which were at one time impassable for wheel traffic, on account of their muddy surface, have, after being properly subdrained, become most satisfactory highways during all seasons of the year.

Surface drainage should now be considered. By this we mean that the crown of the road must be made waterproof, or in such a condition as to shed water easily to open side drains or gutters, which also must be made to carry away quickly any water to the nearest natural outlet.

In constructing an earth road, the cross fall of the surface in level country must not be less than 1 in. in 12 ins.

On hills the camber should be greater, say, 1 in. in 9 ins., so that any water falling on the road will not be allowed to run down the wheel tracks lengthwise of the road and thus create deep ruts.

In many parts of the country one will find V-shaped ditches constructed across the surface of the road. These are more often found in hilly or rolling districts, and are generally spaced about 100 ft. apart and varying in depth from 6 ins. to 12 ins. These drains are not only dangerous, but very uncomfortable to travel over; also hard on

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