

Engineering Department

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Underdrainage.

Many, if not most, country highways could be considerably improved by thorough subdrainage. Most roads need underdraining, even though water does not stand in the side ditches. Most people appear to think that the sole object of tile-drainage is to remove the surface water, but this is only a small part of the object of the underdrainage of roads.

The most important object of underdrainage is to lower the water level in the soil. The action of the sun and the breeze will finally dry the surface of the road, but if the foundation is soft and spongy, the wheels wear ruts and horses' feet make depressions between the ruts. The first shower fills these depressions with water and the road is soon a mass of mud. A good road cannot be maintained without a good foundation, and an undrained soil is a poor foundation. A dry subsoil can support any load. A friend of the writer, an intelligent man and a close observer, claims that even in a dry time the easiest digging on or around a farm is just under surface of a road having no underdrainage. His theory is, that except in the road, vegetation is continually pumping the water up from the subsoil and giving it out into the air, while in the road the compact surface prevents evaporation of the water in the subsoil. Therefore, the road needs underdrainage more than the field.

A second object of underdrainage is to dry the ground quickly after being frozen. When the frost comes out of the ground in the spring, it thaws quite as much from the bottom as from the top. If the land is underdrained, the water when released by thawing from below will be immediately carried away. This is particularly important in road drainage, since the foundation of the road will then remain solid and the road itself will not be cut up like untiled roads.

A third, and sometimes a very important object of subdrainage, is to remove what may be called the underflow. In some places where the ground is comparatively dry when it freezes in the fall, it will be very wet in the spring when the frost comes out, surprisingly so considering the dryness before freezing. The explanation is that after the ground freezes, water rises slowly in the soil by hydrostatic pressure of the water in higher places; and, if it is not drawn off by underdrainage, it saturates the subsoil and rises as the frost goes out, so that ground, which was comparatively dry when it froze, is practically saturated when it thaws.

The underdrainage of a road not only removes the water, but prevents, or greatly reduces, the destructive effect of frost. Frost is destructive only where there is

moisture. The upheaving action of frost is due to presence of water. Water expands on freezing and loosens the soil; when thawing takes place, the ground is left spongy and wet, and the roads "break up." If the roads are kept dry they will not break up. Underdrainage helps to keep them dry.

It is the universal observation that roads in low places which are tiled, dry out sooner than the untiled roads on the high land. The tiled roads never get so bad as those not tiled. There is no way in which road taxes can be spent to better advantage than in tiling the roads.

All roads, except those on pure sand, can be materially improved by tile drainage. In each community this is universally the opinion of the farmers who have had the best success in draining their own farms. The cost of tile drainage is not great, the improvement is permanent with no expense for maintenance, and the benefit is immediate and certain. Further, tile drainage is the very best preparation for a gravel or a stone road. Gravel or broken stone placed upon an undrained foundation is almost sure to sink gradually, whatever its thickness; whereas a thinner layer upon an underdrained roadbed will give much better service. Roads tiled without gravel are frequently better than roads graveled without tile.

Crowning.

A very notable defect of most country roads is the flat or even concave surface; others present the opposite extreme, and are so rounded up as to be dangerously high in the centre, making it difficult for vehicles to turn out in passing. Roads must be crowned sufficiently to shed the water from the centre to the open drains at the side, otherwise water will stand in the road, soak into it, soften and cause rapid wear and decay; but a crown higher than is necessary to properly drain the surface is also objectionable.

The amount of crown must be sufficient in the newly-constructed road to provide for wear and settlement. It should be greater in the softer and rougher varieties of pavement than in those which are hard and smooth; a gravel road, or a broken stone road, must have a greater crown than a brick pavement. The amount of crown needed on a gravel road or one of broken stone varies with each of these classes according to the quality of gravel or stone, the nature of the subsoil and the care taken by rolling to provide against settlement. The amount of crown for newly built gravel roads should be one inch of rise to the foot of width from the edge of the ditch to the centre of the road, and this should be increased in the construction of roads on hills according to the steepness of the grade.

The amount of crown should not be more than sufficient to provide for surface drainage. A steeper crown than is necessary tends to confine traffic to the centre of the road, and in turning out, the weight of the load is thrown on one pair of wheels in such a way as to rut the side of the road. The shape of the crown is a matter on which expert road-makers differ, but with the class of material available for roads in Ontario, and the method and plans of construction, a form as nearly circular as possible will be found most serviceable, and most easily obtained.

Suggestions on Making and Repairing Roads.

The following instruction to pathmasters accompanied the statute labor lists last year in the township of Ops.

GRADING.

A properly graded road is uniform throughout, being slightly rounded and elevated in the centre, with sides sloping gently to shed the water. As straight roads look better than crooked ones, and are always shorter, care should be taken to stake the road the desired width before grading; about 16 feet between the ditches being preferred, that is, 8 feet from the centre on each side. Fresh graded roads should be harrowed and rolled to make them smooth and solid.

DITCHES.

The depth of the side ditches depends on the height of the grading, the quantity of water to be carried off, etc., but in all cases the outer sides should be sloped as well as the inner ones, to prevent caving in.

STONING.

When a road-bed of stone is required, it is always best to put the large stone in the bottom, filling up the cavities with the small stone as a base for gravel or earth. Stone should be spread and covered as soon as possible to guard against accidents.

SPRINGY ROADS.

When a roadway is very soft and springy, tile-draining is necessary before a dry road can be secured.

GRAVEL PITS.

When taking gravel from any pit, pathmasters and others should not pass the limits of the pit, otherwise they become personally liable for any damage to the adjoining lands.

GRAVELING.

A road should be graveled as soon as possible after stoning or grading to prevent displacing stone, or making deep ruts.

Every load should be spread about six feet wide as it is delivered, and any large pebbles in the gravel should be raked forward and put under the next load.

CULVERT.

Ordinary culverts should be at least eighteen feet long, and somewhat longer at road junctions. They should be close-fitting at top and sides, and the cross-timber placed so as not to impede the flow of water.