

COUNTRY ROAD CONSTRUCTION AND MAINTENANCE.

In our issues of April 29th and May 13th, 1915, the subject of earth roads was effectively dealt with in the matter of drainage and general care, in extracts from sets of instructions prepared by Hiram Donkin, C.E., road commissioner and provincial engineer for Nova Scotia.

The following notes from the same source deal also with earth road construction and maintenance. The suggestions are simple and in the main inexpensive. They are based entirely on a thorough system of drainage, and if applied with common sense and judgment, according to the particular needs of each locality, better roads are sure to follow.

The wearing surface of a road must be, in effect, a roof; that is, the section in the middle must be the highest part, and the travelled roadway should be made, by consolidation, as impervious to water as possible, so that the rainfall or melting snow will flow freely and quickly into the gutters alongside. Probably the best shape for the cross-section of the earth road is an arc of a circle with a gradual fall from the centre to bottom of ditch of about 1 to 6, after the surface has been thoroughly rolled or compacted by traffic. Such a surface can be constructed and repaired with the road machine, and a roller can be used upon it to good advantage. If the crown is too great, the traffic will follow the middle of the road, and this will result in making ruts and ridges which retard the prompt shedding of the water into the side ditches. Too much crown is as detrimental as too little.

Where new roads are to be built, all stumps, roots, vegetable matter, rocks, etc., should be removed from the surface, and the holes should be filled in with suitable material carefully and thoroughly tamped. In forming a permanent embankment no perishable material should be used. If unsuitable material is discovered in the sub-grade it should be removed and replaced with good material, which should be tamped or rolled until smooth and compact. The longitudinal grade should be kept down to 3 or 4 per cent., if possible, and should under no circumstances, except in mountainous regions, exceed 5 per cent. After the road-bed has been brought to the required grade and crown, a roller should be used in consolidating the material. All ruts or depressions discovered during the rolling should be levelled off and re-rolled.

The width of the travelled way will depend upon the requirements of traffic. Sometimes 12 feet will suffice, but this can only be permitted where the soil is hard and very small ditches are required. The usual widths for the various classes of country traffic are 13, 18 and 24 feet. The right-of-way should be much wider than the travelled way, in order to provide for widening when traffic requires it.

In level countries where the natural drainage is poor, it is very desirable that roads should be elevated above the sub-grade or surrounding ground. For this purpose the required material may be secured by widening the side excavations or from cuttings on the line of the roadway by means of road machines, elevating graders, or modern dumping wagons. When the earth is brought up to the desired level it should be thoroughly mixed by harrowing, then trimmed with a road machine, and finally rolled with a road roller, the weight of which should be gradually increased by ballast, as the rolling progresses. During the rolling the surface should be sprinkled with water if the character of the soil requires such aid for its proper con-

solidation. The crown of the roadway should be carefully maintained during the rolling by the addition of earth as needed.

Treatment of Clay Roads.—On clay roads a thin layer of sand, gravel, or ashes will prevent the sticking of clay to the roller or to the wheels of vehicles. Clay soils, as a rule, absorb water quite freely and soften when saturated, but water does not pass through them readily. When used alone, clay is the least desirable of all road materials, but roads composed of clay may be treated with sand or small gravel, from which a hard and compact mass is formed, which is nearly impervious to water. Material of this character found in the natural state, commonly known as "hardpan," makes, when properly applied, a very solid and durable road. In soil composed of a mixture of sand, gravel, and clay, all that is necessary to make a fairly good road is to crown the surface, keep the ruts and holes filled, and the ditches open and free, with a good drag.

Importance of Rolling.—Earth is composed of small, irregular fragments which touch each other at points, leaving voids between. When the earth is broken up and pulverized these voids are almost equal in volume to the solid particles, and as a result the earth will absorb almost an equal volume of water. In the rebuilding or maintaining of earth roads it is, therefore, very desirable that these small, irregular particles be pressed and packed into as small a space as possible, in order that surplus water may not pass in and destroy the stability of the road. To this end rolling is very beneficial. The work of maintaining dirt roads will be much increased by lack of care in properly rolling the surface.

After the material has been placed on the surface, it should not be left for traffic to consolidate or for rains to wash off into the ditches, but should be carefully surfaced and then rolled. If loose earth is left in the middle of a road the narrow-tire wheels will cut in and knead it into uneven ridges and ruts, which hold water, and this ultimately results, if in the winter season, in a sticky, muddy surface, and in dry weather in covering the surface with dust. If, however, the surface be crowned with a road drag and properly rolled with a heavy roller it can be made sufficiently firm and smooth to sustain the traffic without deep rutting and to resist in a large measure the penetrating action of the water. Such work should be done while the soil is in a plastic state, when it will pack. The rolling not only consolidates the small particles of earth and leaves less space for water, but puts the road in proper shape for travel immediately. If there is anything more trying on man or beast than travelling over an unimproved road, it must be travelling over one which has just been worked by the slipshod methods followed in many places.

Filling Holes and Ruts.—With earth roads there is a pronounced tendency to rut, and when ruts begin to appear on the surface great care should be used in selecting new materials with which they should be immediately filled. Every hole or rut in the roadway, if not tamped full of some good material, like that of which the road is constructed, will become filled with water, and will be made deeper and wider by each passing wagon. A hole which could have been filled with a shovelful of material will soon need a cartful. The rut or hole to be repaired should be cleared of dust, mud, or water, and just sufficient good fresh earth placed in it to be even with the surrounding surface, after having been thoroughly consolidated with a pounder. Sod should not be placed on the surface, neither should the surface be ruined by throwing upon it the worn-out material from the gutters along-