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For THE CANADIAN ENGINEER.

ROAD ENGINEERING.

BY W. H. BREITHAUPT, M. AM. SO. C. E.

(Concluded.)

The cost of road-making varies greatly in different localities, depending on the nature of the ground, on quality and accessibility of material, and on cost of labor and tools. For country gravel roads in Illinois the cost has been about nine hundred dollars per mile for a roadway 12 ft. wide with average depth of 10½ in. of gravel. The cost of gravel roads will vary from about 13 cents per square yard to as high as 50 cents and over. Broken stone roads will cost from about 30 cents per square yard (\$2,640 per mile of 16 ft. roadway) upwards, for roads constructed as described. Under favorable conditions the cost may be somewhat less than this. When stone has to be brought from a distance the cost is considerably increased.

Of earth roads and various other kinds of roads it is not the province of this paper to speak further, concerning itself, as it does, only with good roads as they are practicable in most localities. A properly made earth road may, however, be a very serviceable road for a large part of the year. It consists simply of a well-drained roadbed, as described, maintained as smooth as practicable. Frequent rolling will much benefit it. A plow should at no time be used on an earth roadway, as it breaks up the surface, which it will be difficult to get back to its former compactness.

In reconstruction of existing roads grades can often be eased, or eliminated, to great advantage. For improving them in general the same method is followed

as described for road construction. Drainage must be carefully rectified. An indifferent road, on being well drained, may serve as a good roadbed for a properly built one.

To get the best service out of any road, and the best returns for the money invested in its making, continuous maintenance is required. No road, however well built, or however carefully the materials for it have been selected, is proof against slight defects constantly developing. The economic course is to be at all times ready to promptly make good such defects, otherwise they soon become aggravated, and the road must be extensively repaired or rebuilt. Road maintenance consists of the removal of mud, excessive dust, and rubbish of any kind; the filling of ruts and depressions; the keeping clear of ditches, culverts, and the drainage system generally, so that drainage may be at all times uninterrupted; watering the surface in continued dry weather.

Mud is removed either with hoes or by means of road scrapers drawn by horses. All loose stones or gravel should be either raked into ruts or depressions or picked off the road and stored for use. No stone more than 2½ inches in greatest dimension should be allowed to remain on the road. The rake is one of the most useful tools in road making or maintenance. Ruts or depressions should be filled at once, and the regular transverse surface of the roadway should always be maintained. If the surface, where patching is required, is very hard, it should first be loosened with a pick, so that the new material will take hold. Gutters, ditches and culverts should be kept clear of weeds and rubbish at all seasons of the year. They should be especially gone over in the spring as soon as melting of the snow permits, and again before the fall rains. In long continued dry spells, watering is beneficial, not only as laying the dust, but as counteracting the extreme brittleness resulting from long drouth, and the consequent rapid wear of the roadway.

For all road maintenance material should be kept ready at hand. For gravel roads a few cubic yards of gravel, and for broken stone roads a like quantity of broken stone should be stored every eighth of a mile along a country highway. In towns such material should be kept as near by as is feasible, as it is required for filling ruts and depressions as fast as they appear. At least one laborer for every five miles is required for maintaining country roads. In towns there should be an organized maintenance force.

In repairing gravel roads it is best to apply the gravel in small quantities at a time, unless the surface has actually worn through. A layer of about two inches is generally best, in thicker layers the gravel is likely not to pack thoroughly, but to remain loose underneath, where it will then hold water. Six inches of gravel can be put on as cheaply in three layers as all in one, and a much better job will result.

The surfacing of broken stone roads will require to be renewed about once in four to six years. This should be done in as large sections as is convenient.