ROADS AND PAVEMENTS

SOME NOTES ON THE DRAINAGE OF COUNTRY ROADS.*

The most important principle involved in road building is that of thorough and proper drainage. The soil upon which the road bed is placed must eventually bear the loads passing over the road. The intensity of the pressure is, of course, not nearly so great on the soil as on the wearing surface of the road, since the severe wheel pressure becomes distributed over a much larger area, the distribution depending on the thickness, character and condition of the roadway materials. But, whatever the distribution, the load is finally transmitted to the soil.

Fig. 1—Deep Side Ditch for Longitudinal Drainage.

The ability of the earth to sustain a load depends largely upon the absence of moisture in it. Most soils can be so compacted as to form a good firm foundation as long as they are kept dry, but on the entrance of water they become soft and incoherent and largely lose their sustaining power. In cold climates there is the additional damage due to freezing, but frost has no disturbing effect on dry material. Therefore, it is the entrance of water which is to be guarded against in every possible way.

Drainage consists of two kinds: surface and under drainage. Surface drainage is accomplished by using more or less impervious material for the road surface and by having the surface of such form, that water falling upon it will quickly run into the gutters or ditches. The great majority of our improved country roads have a cross section which may be said to be formed of two sloping planes with their intersection slightly rounded along the center line of the road. The side slopes toward the ditches vary from ⅜-in. to 1-in. to the linear foot. For plain macadam roads having a surfaced width of 12 to 16-ft., ¾ to ½-in. to the foot is very commonly used. The earth shoulders from the stone to the ditch are usually given a slope of 1-in. to 1½-in. to the foot, which has been found to be very satisfactory. Very little has yet been done to determine the most suitable side slope for various grades. The formula $H = \frac{W(100-4P)}{5{,}000}$ for the crown of a roadway, where H equals the crown in feet, W equals the width of road in feet from shoulder to shoulder, and P equals the per cent. of grade of the road, has probably been used more than any other in this country, but it is by no means perfect, and further investigations are needed on this subject.

The ditches and cross drains must be of ample size to care for the largest storm flow, and since the rainfall varies very largely throughout the United States, ranging all the way from over 100-ins. to a minimum of less than 3-ins. per annum, it is at once plain why the practice is so varied as to the size, shape, and grade of ditches and culverts. Wherever practicable, however, the grade of the bottom of a ditch should not be less than 6-ins. to the 100-ft. On our country roads the gutters, or side ditches, are as a rule unpaved, except on steep grades where the velocity and volume of the run-off are sufficient to produce appreciable scour or erosion.

Cross drains or culverts are constructed of wood, earthenware, iron and cement pipes, and concrete, both plain and reinforced. Wood as a material for cross drains is rapidly going out of use and should be discarded entirely. For the smaller waterways terra cotta and cement pipes serve fairly well in the warmer climates. In the extremely cold sections the terra cotta and plain cement pipes are very often broken by becoming clogged in time of a thaw which is followed by a sudden, hard freeze. Iron and reinforced concrete do not seem to be injured in this way, and the latter should be used for the construction of all of the larger culverts.

All culverts which are built with any of these materials should have their ends protected by concrete construction, in order to prevent the washing away of materials adjacent to the ends or of the culvert itself. An illustration of the washing away of a corrugated iron pipe culvert is included, which shows its failure, due to the lack of being provided with concrete ends.

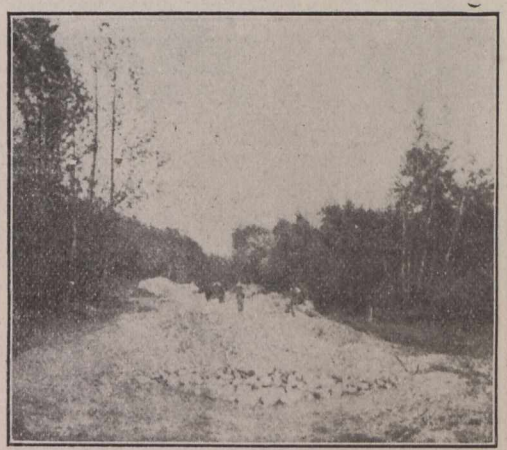

Fig. 2—V-Shaped Drain Construction.

Under-drainage involves the removal of the ground water to a sufficient depth to prevent it from injuring the road, and this depth should be varied according to the climate and the character of the soil, never being less than 2-ft. below the elevation of the road surface. The general method of removing the ground water is by drain tile from 4 to 12-ins. in diameter, laid on a true grade, and not less than 3-ft. below the crown of the road. There may be a line of such tile on both sides of the road, a single line on one side, or a single line down the middle of the road. When the direction of flow of the ground water is found to be strongly from

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