Home Course In Road Making

X.—The Macadam Road.

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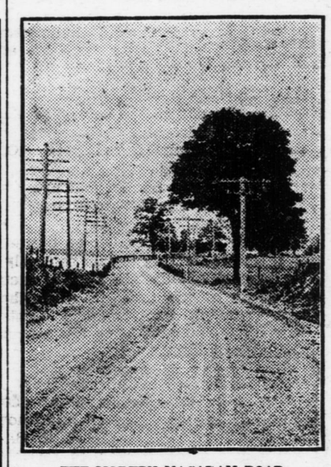
WHEN it is considered that a rise of one foot in a hundred increases by about twenty pounds the amount of force required to haul a load of one ton the question of grades is one not to be overlooked in road building. The character of the soil and natural drainage conditions have much to do with the cost of maintenance. Therefore too much consideration cannot be given to location. The main points to be dealt with are (1) directness, (2) grade, (3) natural drainage and (4) character of the soil.

The foundation to be built for any road should depend largely upon local conditions. Some soils of a gravelly nature make the best foundations and will be sufficient without treatment other than grading upon which to construct a macadam road.

Soils that are of a clayey nature or that contain pockets of quicksand, unstable earth or organic matter are treacherous and require special treatment. In such cases the unstable material should be removed and replaced with gravel or sand, and wherever practicable the earth subgrade should be thoroughly rolled, preferably with a steam roller, and made to conform in crown or camber to the surface of the finished road. Sandy subgrades may be improved by the use of a thin layer of clay or soil.



THE MODERN MACADAM ROAD.

There are two forms of drainage essential in road building, (1) surface drainage and (2) subdrainage. There are three essential points to be considered in connection with surface drainage. (1) The surface of the road should be of such a shape that water will quickly drain from it to the side ditches; (2) the side ditches should be adequate in size to carry, without overflow, the maximum rainfall, and they should be of such depth and grade that water will travel easily to low points on the road, and (3) from the low points there should be suitable outlets to convey the water to the natural drainage of the country.

Water should never be permitted to remain under a macadam road; consequently subdrainage must be resorted to at times. Water softens the foundation, allows the broken stone to be forced into it by the traffic, and in freezing it expands and dislodges the broken stone, destroying the bond. There are several ways of removing the subsurface water, (1) by raising the subgrade; (2) by side drains consisting of narrow trenches filled with broken stone, with a pipe five or six inches in diameter near the bottom. A drain of this type should have frequent side outlets. On hillsides a pipe or culvert is carried under the road at suitable points.

Another type of subdrain that is much used in Massachusetts is the "V" drain. It consists in shaping the subdrain in the form of a "V," the angle being at the center of the road. This is filled with coarse stone up to the foundation grade and has frequent side outlets. This type is rather expensive and very frequently can be dispensed with by raising the subgrade with suitable sand, gravel or clay.

Another type of drain practical for side hill locations is a subside drain, located on the upper side of the road to intercept and provide an outlet for surface and ground water before it reaches the road proper.

Great care should be used in properly grading a road.

The practice in America is generally to place the maximum grade at 5 per cent for important roads, as a horse can trot without difficulty up such a grade, and another important consideration in connection with grades is that a macadam surface can only be maintained at great cost on steep grades.

In fixing the grades the engineer should so adjust the cuts and fills as to make the least possible waste of material, and in this he must not overlook the fact that some materials shrink to a great extent when taken from the cuts and placed in the fills. This varies with the material, but averages about 15 per cent. The careful engineer will set his grade stakes not more than fifty feet apart, and in no case should they be over a hundred, and these will serve later for the macadam work. In grading ample material should be left to form the shoulders. Care should be used in properly sloping cuts and fills to avoid as far as possible settlement of material. A slope of not less than one and one-half to one should be used. Care should also be taken to have the gutter grades so fixed that there will be at least a fall of six inches in each hundred feet in order to provide surface drainage.

In general, any stone that is to be used in road building should be tested for hardness, toughness, resistance to wear and binding or cementing value. The specific gravity, weight per cubic foot and water absorbed are also determined. With such data as this in hand and a knowledge of the volume and character of traffic to which the road is subjected the engineer can make an intelligent selection of the best available material. While the diabases, diorites and basalts, all commonly known as traprock, in general meet the conditions where macadam roads are necessary, yet it is unwise to select a rock by species alone, as they all vary greatly.

There are two distinct types of broken stone road in use today, known as macadam and telford roads. The macadam road of today is so different from the type specified by Macadam that the relation is hardly recognizable. By the best practices used this road consists in a foundation course of two and one-half inch stone of varying thickness. This foundation should be thoroughly rolled with a steam roller and not more than a thickness of five or six inches rolled at a time. On top of this is placed a three or four inch layer of one and one-half inch stone, and after thoroughly rolling a layer of rock screenings below three-quarters of an inch in size is spread. This layer of screenings should be sufficient only to fill the surface voids of the wearing course and should not be applied all in one layer Each application of screenings should be rolled in before the next application is made. After the surface has been thoroughly filled with screenings the road should be well sprinkled with a watering cart and rolled with a steam roller until it is thoroughly bonded This rolling should continue until the surface ceases to wave in front of the roller.

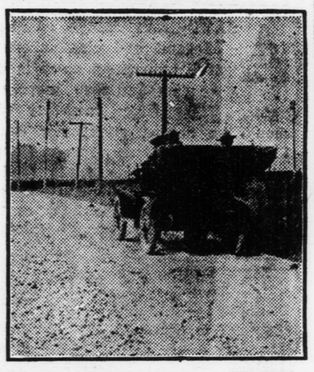
Stone should never be dumped on the road, and if specially devised spreading wagons are not used the stone should be dumped on boards and spread from them on to the road. The contractor should be required to place about a hundred tons of No. 2 stone and screenings at a convenient place for each mile of road built for the purpose of making future repairs.

The telford road of today varies only from the macadam road in that it has a hand paved foundation course, consisting of coarse stone eight or nine inches in its greatest dimensions. These stones are placed on edge in the subgrade by hand on their broadest bases and at right angles to the line of the road, and all irregular portions are broken off with hammers.

This type of road was first designed by a French engineer named Tresaguet forty years in advance of Telford. The roads built by Telford had flat subgrades, but those constructed by Tresaguet had cambered subgrades, which are supposed to have the effect of a keystone arch, and this is the form in which they are constructed today. It is rather an interesting fact that in France practically all of the broken stone roads are of the Macadam type, while in England they are largely of the Tresaguet or Telford type.

Experience has proved that the only way in which roads can be kept in good condition and at reasonable cost is by continuous and intelligent maintenance. It is a mistaken although unfortunately general impression that certain types of road are permanent. No permanent road has ever been constructed or ever can be.

Gutters, catch basins and culverts ought by all means to be kept clean, and small gullies in shoulders should be filled before they become too large. The loose stone which nearly always appears on the surface of a macadam road the first spring after it is built should be raked up and stacked for future use. Small holes and incipient



A POORLY CONSTRUCTED MACADAM ROAD.

ruts should be filled as soon as they appear with the same kind and size of stone as that used in the surface course.

If small defects are attended to when they first appear it will be unnecessary to resurface the road until it is worn entirely through to the foundation course. When the surface course is worn out it ought to be spiked up with a steam roller or scarifier and this followed by the spreading of a three inch layer of one and one-half inch rock. This is rolled, bonded with screenings and sprinkled in the same manner as the top course was originally constructed, after which the road will be as good as new.

Reinforced Concrete of Old Rome.

Although concrete has been used for many centuries, it is generally supposed that reinforced concrete is a modern invention. This, however, has been disproved, according to Popular Mechanics by the finding of bronze reinforcing rods in the concrete roof of an ancient Roman tomb, and in the discovery of reinforced concrete in the construction of one of the walls of the old palace of the Louvre, Paris.

The reinforced concrete in the latter dates back only 300 or 400 years, but created much comment because the walls were thought to consist entirely of ashlar and quarry stone. The discovery that the stone casing concealed a core composed in part of reinforced concrete was made while workmen were piercing the wall for an elevator installation.