HIGHWAY CONSTRUCTION*

The subject of highway construction has been so extensively discussed among laymen and engineers that it would seem to be difficult to raise any question that would be novel or interesting in a gathering of this kind, save for the fact that this Association is a gathering of laymen and experts, and probably the laymen would desire to gather data from the experts as his future guide in his official capacity, as to what pavement to use and what to reject, and on what basis his use or rejection should be made. The assumption of the laymen that road construction is a simple mechanical proposition, easy of achievement by an ordinary untrained intellect, while commonly accepted heretofore, has been somewhat gainsaid in the last few years as the scattered attempts in this country of road improvement have been a success or a failure in the ratio that a competent engineer has or has not been in control.

The sentiment of the country at large is in favor of good roads. The engineering part in this work has hardly been in proportion to the growth of the movement, and the result has been attempts on the part of one man or another to promote his own individual ideas of the work in total disregard of the peculiar requirements of his own locality. The extent of this country is so great, the supply of road material so diverse, the climatic conditions so varying, and the practice of road building so uncrystallized that it is impossible to give hard and fast rules for road construction for any given locality. One expert in roads will tell you that drainage is the sine qua non of road construction; but when it is conceded that one-third of this continent is arid or semi-arid, the problem of drainage ceases to be a factor. Another expert will declare that Teldford and MacAdam laid down the principales of road construction which cannot be properly departed from; yet if no material of MacAdam's standard can be found within 500 miles, the question of economy will put MacAdam into innocuous desuetude. Another expert has found a natural material in his section that is so applicable to the requirements of his locality that in his broad-minded philanthrophy no other material is of any account or any use.

The fact of the matter is that road construction in the United States has to be developed on its own peculiar standard, which standard will vary in every locality according to topography, climate, geological formation, density of population and particular requirements of that population. What is a good pavement in one section for climatic reasons may be a poor pavement in another, and what may be proper in one section may be too expensive in another under similar conditions.

The fundamental factors in road construction are as follows:

The earning power of the community.

The topography and climate of the section.

The available road material at hand.

The construction of the road itself.

As to the first it can be easily seen that in a district with land worth $20 per acre the paying capacity for road construction is much less than a country worth $100 per acre, the value of the land of course being based on its earning capacity, and yet it may be a correct assumption that $20 land might be worth $100 if it had good road communication. However, in the far future, when all roads are improved, this willcease to be a factor. At present, however, the taxable value of land is potent in the cause of road construction, as it might easily be seen that a rocky farm with no possible revenue cannot be benefited by any road construction at any time. The general community must here enter and announce the plea that intercommunication by good roads is the first law of civilization. If the rocky farm cannot pay for its road, the fertile farm beyond must have it means of communication, willy nilly.

In considering the topography and climate as functions of road construction, the question of temperature first enters in, as the line of frost penetration in the ground is a vital point in construction. Methods used in road building in a warm temperature will not be found adequate for a cold climate, and coupled with this also enters the question of aridity. Where there is no water there is no frost, so the warm area can really be extended so as to include the arid area. In the frost-ridden sections, roads have to be constructed of greater depth and of harder material to insure their stability. To offset this, however, in the extreme north the wear on the road itself is shortened by three or four months on account of snow.

Outside of the arid section drainage is paramount. This must be artificial in the flat country and properly graded in the mountain districts. That is to say, water must not be allowed to stand on a flat grade or wash out the pavement on a steep grade.

As to material to be used for roads the cost of transportation is the prime factor in the selection of material and methods of contruction. Road materials must be classed under two heads, natural material to be used as found, and artificial material consisting of natural material broken up to be used. Given a natural substance of average use in an average locality, it may be considered economically preferable to an imported material of higher character, but may not give such absolute good results.

Good gravel in a well-drained country without frost, properly laid and rolled, will give ideal results if properly cared for. If used in the frost limits its period of good use in the year may be extended by putting a layer of larger stone at the bottom. In some localities there are soft limestones and gravel. The limestone makes a good foundation, but does not wear well. Use the stone for the foundation and the gravel for a wearing surface and you will find good results. If no limestone exists, then burnt clay can be made available for the foundation. If there is no gravel it would then be better to import a hard, durable stone for the wearing medium on the limestone bed.

The slates, shales and silicates are also available for good road construction. The shales are somewhat affected by frost and require renewal, so it does not pay to import them. The silicates, however, are of different character. Take noviculate for instance. It is transported 200 to 300 miles with good economic results. Flint formations are also available, but they are rare.

Take the Mississippi Valley in general, however, and what shall be done with its roads? Good material for a wearing surface is rare and unsatisfactory, and it is probably best to lay down to the people of these communities that they must face the music and build their roads in good shape in approved methods, of selected material transported from a distance and pay their bills. Traveling through the State of Illinois for instance, what should be done? No local material and poor drainage, but plenty of rich land and rich farmers; so let them pay the bills for first-class roads.

In Alabama, for instance, with better material, not first class but available, it would be better at first to make a moderate outlay and then when the farmer gets rich, let him have the best there is. If there is gravel available let him use gravel for the present; if there is good shale let it be used, so that the present difficulty of transportation in wet weather may be eliminated.

In all these improvements, however, a trained mind should be used. It need not be an engineer's mind,

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