

MODERN HIGHWAY PROBLEMS*

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HIGHWAY engineering is going to become one of the most important branches of engineering science. It is not only on the technical side that highway engineering has become important, but on the administrative side of human life. Very few men have ever crossed the Firth-of-Forth bridge, but I venture to say there are very few men who have not used a highway. Our grandfathers, and also most of our fathers, had to build their own roads, and consequently when it comes to road-building to-day, most people think it is a "family" affair, and that they are all able to do it. That is one of our modern highway problems.

It is unnecessary to say here what is at the bottom of modern highway problems. It is unnecessary to give statistics and figures indicating the changes that have occurred in motor traffic during the last ten years, and in respect to motor trucks in the last 3½ years. There is adequate machinery for motor vehicle registration throughout the United States and Canada, and this provides approximately correct figures which show absolutely what is the source of all of our modern highway problems and troubles.

Growth of Motor Traffic

Fifteen years ago automobile traffic on our highways was negligible; 3½ years ago motor trucking on our highways was negligible; to-day the business presents an entirely new set of problems for the highway engineer.

There are two aspects to the question. First, there is the administrative side and its importance. In the United States we have passed this problem and I believe that we have in a measure solved it. Twenty-seven years ago we had no state highway departments; twenty-four years ago we had only two state highway departments; to-day we have forty-eight state highway departments in active operation. The reason for that fact is just this: The growth of this new motor traffic, and the increased radius of its operation, made it absolutely imperative that the poor towns and poor counties should not stand in the way of road development and construction. Further, that towns and counties, rich and poor, should do their construction systematically in a manner articulate with that of their neighbors, and that roads should be built uniformly good across the country.

We had many poor towns and counties, and for years they stood in the way of highway development. The growth of our state-aided system is the direct solution of that problem of administration. Three years ago another advance step was taken when the federal government officially stepped in and continued the process of development. We found that where the state-aid systems solved the problem of the poor towns, there was nothing to equalize the differences between state and state excepting the federal government, and three years ago the federal government assumed its place along with the states, and to-day we have without doubt the biggest program of highway construction that has ever been undertaken in the history of mankind.

Large Program for 1920

It has been estimated by the Bureau of Public Roads that during the present year funds amounting to \$633,000,000 will be available for road construction in the United States. That is one year's program, but we do not expect to use all that in one year. It took ten years to build the Panama canal, and the funds available for our roads next year would build that canal twice over. That will give some idea of the extent and importance of this subject in the minds of the people of the United States.

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The solution, so far as we have gone in the United States, is of interest to the engineers of Canada and the Canadian government, for the reason that you have paid us the high compliment of coming to the United States for a study of the federal aid laws, and there is on your statute books to-day a law formulated in principle on our Federal-Aid Act of 1916, and I had the honor of having had a hand in some of the early details of that Act and in preparing rules and regulations giving force to that Act, and you have adopted rules similar to ours in the states, because your law is based largely on ours.

Uniform Laws for Controlling Vehicles

The next obvious step to be taken by us will be the solution of the administrative problems of modern highway building. Shall there be federal highways, planned, built and maintained by the federal government exclusive of the states? Personally, I am of the opinion that the United States will be able to hold the states well in line in respect to their different highway systems.

The injection of the federal government into the highway situation not only solves the question of modern construction to meet modern traffic, but it paves the way directly for the next step to come; and I think that most administrative officials interested in such matters recognize fully that the next step to take is the passing of more or less uniform laws for the control of motor vehicles; for registration and licensing of automobiles; for the construction and maintenance of highways; and, for the general uniform control of the highway situation.

The conclusion of this part of the matter is this: That the gradual development (first by the state and then the federal government) that we have seen in the United States seems to be adequate, and, so far as we know, is the only adequate solution to meet modern highway conditions. However, I leave that for your consideration and for your encouragement, inasmuch as you are to-day just entering that final stage of the matter.

Problems of Modern Traffic

Now I wish to turn to the technical problems that modern traffic present to us and to give passing mention of this most important matter.

In the first place, our general cross-section design has been tremendously influenced by modern traffic. The weight and quantity of traffic has so increased that where we used to build, to take a typical example, 5 or 6 ins. of concrete on a concrete road—I know many in the province of Quebec as well as Ontario are familiar with that construction—we now use 6 ins. on the sides and 8 ins. in the centre, or what we call 6-8 construction. A great many are built 7-9, and in New Jersey we are building 8-10, averaging 9 ins. thick, or an increase of practically 50% over our former designs of 3½ years ago.

This is because of a very interesting fact. We have come to recognize that there is in railway work a detail which also affects our designs as highway engineers, and that is the question of impact. The bridge engineer is familiar with impact as well as is the railway and other engineers, but the highway engineer never bothered about it until the failures that occurred of some of our highest types of roads, two winters ago, brought us face to face with the fact that impact destroyed our roads.

A month or so ago one of our men got up at a meeting and said that a true cylinder rolling over a true plane should cause no impact, but unfortunately we cannot build our roads as a true plane and our auto and truck wheels are not true cylinders, so that we do, as a matter of fact, develop impact. It starts its work at the slightest imperfection in a hard-surfaced road. It is exactly as if a man working with a sledge attacked the road at that point, and a man with a sledge can cut his way right across a 6-in. road. We have had concrete roads and brick roads, and brick roads on concrete base, and all kinds of road construction, go to pieces almost promiscuously due to impact. This question of impact is one we are facing in cross-section design, and because of