

Highway Transport - A Field for Engineers

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Among the miscellaneous odds and ends which the dying nineteenth century bequeathed to its heir and successor were two small bodies of engineers. Comparatively unimportant among the many more pretentious gifts with which the lusty infant was endowed, these two groups of men were destined to grow in numbers and in influence, as the young century passed from infancy to youth and at a man's estate to occupy a very considerable portion of the young man's time and attention.

One of these groups has made the automobile one of the greatest economic forces in our modern civilization; the other has built and is rapidly extending the roads, without which the automobile would have been as the railroad without a track.

Where these two groups of engineers set to work we find the beginning point of a new cycle in highway transportation. In 1900 they found the highways, where a century of coach-building and road-mending had left them only a trifle more useful and influential in the life of the people than they had been a hundred years previously; and in twenty-one years, together, they have so altered and changed the character of highway travel that whereas, formerly it was looked upon as a hardship, it now, is regarded as a pleasure; and there stands to the credit of the highways more than double the passenger-mileage carried by the railways, to say nothing of the growing importance of the highway haulage of commodities.

The men who have brought about these changes have hitherto worked, each group within its separate field. They have developed as highway engineers and as automotive engineers. There has been something of a race between them - and a near collision. In their eagerness to develop the full possibilities of the motor vehicle and the road there has been not a little misunderstanding between the highway engineers on the one hand, who felt that their roads were being destroyed by new and heavier vehicles, and the automotive engineers on the other, who believed that their progress was being retarded by a lack of foresight on the part of the highway engineers. Echoes of the controversy linger even now, when, a fuller understanding of the mutuality of their aims and purposes has taught them that their common business is not to produce motor vehicles only, or build roads, but rather to provide better highway transportation, by the economic adjustment of the motor vehicle to the highway and the highway to the motor vehicle. Out of this better understanding springs the new conception of highway transport engineering.

It is this conception that is in the minds of the representatives of the motor-vehicle producers and the highway engineering profession who have associated themselves with representatives of the educational institutions in a committee formed at the call of the U. S. Commissioner of Education, and known as the Highway and Highway Transport Educational Committee. Their purpose is nothing less than the development of a new profession, with several branches, each having to do with one phase of highway transport, yet so inter related as to require for successful practice in each branch a fundamental knowledge of the whole field.

The branches, more or less clearly delineated are: (1) The designing and building of motor vehicles; (2) The designing and building of roads; (3) The operation and care of motor vehicles; (4) The management and control of highway traffic.

To prepare the necessary men for any of these branches radical changes are needed in the courses of instruction offered by the technical schools; as, for example, the partial breaking down of the old classification of engineers into civil, mechanical, and electrical groups. Highway transport engineering requires knowledge of principles and applications in each group. Thus the motor vehicle designer of the future will have in mind not only the mechanical principles of gas engine design and power transmission, but also the effect of the vehicle on the road and of the road on the vehicle. He will have in mind the development of a vehicle which will reduce the whole cost of highway transportation, not merely the cost of vehicle operation. In the distribution of the load within the vehicle, in the tire equipment, the spring characteristics, the ratio of sprung to unsprung weight, the power and speed requirements, over all dimensions of the vehicle, the capacity of bodies, he will deal with principles derived from the practice of the road building branch.

Similarly the highway designer will be required to understand the principles of vehicle design and to build the roads as tracks for vehicles of known characteristics. A knowledge of the effect of grades and of various types of surface on gasoline consumption, and the effect of vehicles of various designs upon the roads will enable him to design roads with a view to providing cheaper transportation.

and not simply cheaper road construction. At present ideas of grade, surface and alignment, are still influenced by the practice of the period when the horse-drawn vehicle was the only or predominant factor in highway traffic. A fuller knowledge of the requirements of the motor vehicle will lead to substantial changes in some of these ideas. The new problems connected with grade development will serve very well to illustrate the interdependence of the two branches of designers upon each other. Because of the change from horse-drawn vehicles to motor vehicles the highway designer, who has in mind economy of transportation rather than the narrow conception of cheap highway construction, is forced to take into account the different characteristics of the newer vehicle. For example, he finds that he must consider the ability of the motor vehicle to coast down hill and surmount succeeding elevations by virtue of the momentum it attains. So, therefore, in laying out his grades he will take a leaf from the book of his predecessor, the railroad engineer, and consider them on the basis of a virtual rather than an actual profile. His problem is made more difficult than the corresponding railroad problem because of the varying factors of surface resistance introduced by the various types of surfaces, and the wide range of vehicular weights. The vehicle designer on his part has the problem of altering the design of the vehicle so as to permit coasting with a greater degree of safety.

The design of vehicles and roads are the parent branches of the new profession. The other branches have only recently been developed and their limits are not clearly defined. Of the two the branch which deals with the care and operation of the vehicle is the

more readily defined and understood. Representatives of this branch of the profession are now employed by large transportation companies which operate fleets of trucks or passenger buses over the roads. Seven hundred and seventy-three of these companies are reported as operating with 4000 vehicles in the State of California alone. Sixty-three companies in Connecticut specialize in passenger bus service over the improved State roads. Similar reports from other States indicate that the business of highway transportation both of passengers and freight or express has become more than an experiment and in innovation and is rapidly settling down to a solid business basis. In this business there is need for the transport engineer not only to supervise the care and repair of the vehicles and to institute economical methods of operation, but also to adjust the vehicles to the character of the traffic engaged in and to plan schedules, and routes which will give the best and most profitable service to the greatest number of clients in the territory served. As typical of the problems dealt with by the engineer there is, for example, the question of deciding upon the size or capacity of the vehicles to be used. For collection and delivery of express parcels in cities questions of economy demand a truck of different type and capacity from the one that is used for inter-city haulage with few or no intermediate stops.

To haul heavy materials, such as stone, ore, machinery, etc. requires a different body and often a different chassis than it would be possible and economical to use for the transportation of lighter and bulkier materials. Then too, there is the study of the production of the territory served - and this is one of the most interesting and

important of the fields which are only now being developed - in order to determine the character of service which the company should equip itself to render. Such a study involves an investigation of the quantity and character of the output of manufacturing plants in the territory served, and the development of economical and efficient transportation service to meet the peculiar needs of each plant.

The fourth branch is one which has not yet been developed, but one which is certain to be developed. Because it has not yet become a definitely recognized function of the highway transport engineer it is somewhat difficult to define. I refer to the form of public service - the necessity of which is becoming increasingly evident - dealing with the management and control of highway traffic, and the adjustment of highway service to the traffic. One of the first duties of engineers engaging in this branch of the profession will be to study the existing highway traffic and probable changes and developments with a view to adjusting the location, type and width of the roads to be built to the traffic that is to be served. To do this it will not be sufficient merely to count the existing traffic, because, as is well known, changes in the character of the roads, invariably result in material changes in the distribution of traffic. What is needed is a careful survey of the potential sources of traffic carried out in much the same way that the engineer attached to the haulage company studies his territory. By such a survey of the contributing industries and the points of origin and destination of pleasure traffic it will be possible to define with sufficient accuracy the natural lines of traffic, and prescribe the type and width of such roads

which will be justified by the probable traffic. The work is the exact counterpart of that which is undertaken by a railroad in anticipation of the construction of a new line. To ascertain the facts necessary for such an adjustment of the highways to the traffic is a much more difficult matter than the corresponding problem of the railroads, but it must be undertaken if we are to develop truly economical highway transportation.

After the roads are constructed this branch of the profession is the one which will regulate their use. By observation of the traffic it will point out places which need special treatment in order to remove dangerous conditions. It will recommend for enactment by the legislature such requirements in regard to speed, size of vehicles, number of trailers and other matters affecting the use and convenience of the highways.

As indicative of the character of work that will be done by this branch readers of Professional Engineer will be interested in a paper prepared by Dean A. N. Johnson of the University of Maryland, published in Public Roads for July, 1921, entitled "The Traffic Census and its Use in Deciding Road Width". Mr. Johnson takes for his subject the single phase of determining the width of road required for traffic of various intensities. One of the interesting facts developed by this study is that a larger number of vehicles can be passed by a given point at a speed of 15 miles per hour than at 30 miles per hour.