

PROBLEMS AFFECTING DESIGN AND CONSTRUCTION OF HIGHWAYS*

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It has been said by a well-known railroad executive that the railroad of the future may find it more economical to tear up short-line tracks and develop motor truck transportation in their place. Although the supplying of tonnage is the freight traffic manager's problem, it is also a problem which should engage the serious attention of the engineering department, from the viewpoint that every means should be employed to reduce the cost of supplying tonnage to the main lines, just as careful attention is given in location and construction, to reducing grades and curvature to the minimum. It is claimed that, considered as a unit, few branch lines pay expenses, but as gatherers of freight and passengers to increase density of main-line traffic, they are sources of profit. As, however, traffic gathered by them is turned over to the main lines with a deficit attached, which has to be overcome during the main-line movement before any profit is made, it might be a decided advantage if this traffic could be delivered to the trunk line by means of the motor truck or tractor, without this bill of expense attached.

May Eliminate One Handling

Since it is a fact that it is now necessary to truck products of all kinds, and especially farm products, to the short branch line, and load them into cars, a serious investigation of the matter may disclose that one handling might be obviated and considerable expense saved if the tracks were removed from many branch lines and the grade used for an improved motor road, which could be entered from every intersecting highway. Such an arrangement would mean increased facilities at main-line points for freight handling, but with the present rapid improvement of country and interurban highways, it would relieve the railroads of the burden of maintaining freight stations, water systems, coaling stations, track and other structures, and the inevitable overhead expense during seasons when traffic is light.

It is inconceivable that trunk highways paralleling trunk lines of railroads will ever seriously affect the tonnage carried by the railroads, but it is quite conceivable that with the extensive building of hard, smooth, all-year highways, the tonnage of branch line roads will be very seriously affected, and in my opinion this problem should from now on engage the attention and induce careful investigation by the engineering departments of railroads, whose managers are looking to the future and the economical handling and transportation of freight.

There are, at present, approximately 6,000,000 passenger motor cars in the United States. Conservative estimates place the passenger mileage of automobiles in the United States at 45,000,000,000 per annum. Commercial motor cars increased from 60,000 in 1912 to approximately 600,000 in 1918. The mileage for all kinds of commercial motor cars is now estimated at 5,000,000,000 ton-miles per year. It is estimated there will be in use at the end of the next 10 years 20,000,000 passenger and 5,000,000 commercial motor cars. Surely the above figures should cause railroad officials more than casual concern and lead to consideration of the matter of short-line hauls from the highway viewpoint.

Same Principles of Design

Highway engineering to-day differs little from railway engineering. The same fundamental principles are involved in the original design of both—viz.: Alignment, grades, curves, drainage of subgrade, bridges, superelevation of curves, etc. There must also be traffic regulations and signals, danger signs, distance and direction markers, etc. Particular attention is being given to grades and curves, especially on the New Jersey state highway system, where, except in very hilly country, 5 per cent. grades and 6 deg. curves are the maximum.

*From an address before the New York Chapter of the American Association of Engineers.

The advent of the swiftly moving motor vehicle soon demonstrated that the earth and macadam pavements were unsuitable and uneconomical for that class of traffic, therefore the most durable types such as concrete, stone block, asphalt and brick pavements are now being laid. Light foundations and inadequate drainage are the most fruitful causes of pavement failure, as they are in track construction. Systems should be provided for thorough drainage of the sub-foundation, such as lateral drains under the pavement, leading to longitudinal drains; the construction of storm sewers on a grade in long, level sections; and the construction of side ditches and gutters. In the preparation of sub-foundation, all areas of permanent saturation are removed and replaced with coarse sand or broken stone placed directly beneath the pavement. Experience is developing the fact that concrete provides the most durable and lasting foundation under heavy traffic. It is being used in rapidly increasing amount as a pavement and as a foundation for other types of pavement.

Widths, Thicknesses, Curves, etc.

On country and interurban highways, graded widths from gutter to gutter are not less than 30 ft. and the hard pavement not less than 18 ft., widening to 24 to 30 ft. where several roads converge, or when approaching large cities. All curves exceeding 3 degs. are superelevated, as in railroad practice, in accordance with a formula devised for the purpose and based on a speed of 30 miles per hour, though some of our banked curves have been driven at 60 miles per hour, presumably because the driver liked the sensation of rounding a curve at high speed without the effort of resisting the overturning force.

Laws of most eastern states permit gross loads of from 24,000 to 30,000 lbs. on trucks, therefore bridges are being designed for 20-ton loads, assuming 75% of the load as being on the rear axle.

Rapid increase in use of motor vehicles makes pertinent the question as to whether we are building pavements sufficiently wide and foundations sufficiently heavy. The first is a matter of local finances; the second is one which can be determined only by experience and observation, extended over a period of years. On our most heavily traveled route, that between Newark and Trenton, we are laying a concrete pavement 8 ins. thick at the sides and 10½ ins. at the centre. On all other routes the pavement is being laid 6 ins. at the sides and 8¾ ins. at the centre. It is believed these will suffice for 15 or 20 years.

Public Service Conditions Changing

A comprehensive system of marking the highways with danger, distance and direction markers is being installed to enable the motorist to travel from place to place with convenience and safety, if he will but observe the traffic regulations and ordinary courtesy to others.

Highway and highway transportation engineering offer a broad, promising field to young engineers in the future. There are objections to employment in public service, the principal one being uncertain tenure of office, due to changing political administrations, but it is within the power of the engineers of this continent, by united and persistent effort, by educational propaganda, the exercise of tact, good judgment and constant adherence to the high ideals which actuate 99% of our engineers, to so mould public opinion that within a very few years the civil engineer may attain the social and economic status which is rightfully his, especially in the administration of public business and affairs. To most engineers, the idea of mixing or entering into politics is repugnant, but the present political system and the appointment and election of misfits and unfits will continue until the people of this great nation are educated to demand trained, experienced, practical men for the conduct of public affairs.

W. B. Redfern, 84 Close Ave., Toronto (Telephone Adelaide 2938), desires a copy of the November 9th, 1911, issue of *The Canadian Engineer*. Some subscriber may be able to oblige.