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## Relating Highway Planning to the Traffic Requirements

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It is not a new subject to the highway engineer -- this subject of highway planning in relation to traffic requirements. Reviewing his experience he is quite likely to fail to recall the time when it was not the one subject uppermost in his mind. It has held for him something of the deadly interest that we may imagine as gripping the soul of the -- let us say, coach of the Michigan football team as he ponders the reports of his scouts on the new plays of the Minnesota team. No less tricky and unexpected than the wiles of the football enemy has the highway engineer found to be the sudden shifts and double shifts of his own friendly rival the automotive engineer.

Looking backward over a reasonably long career the highway engineer is likely to recall the time when the big problem was the way those waterbound macadam roads gave up the ghost at the first whiff of a horseless carriage. That to him then -- in the early 1900's -- spelled traffic requirement, and the development of bituminous binders he still regards as no mean job of related highway planning.

Then later he will recall that there descended upon him a plague of -- not locusts, but -- solid-tired trucks that whacked the six-inch thickness of the bituminous macadam roads and stirred them to their very bottoms with blows five, six, seven times the load they would show on any wheel when put upon the scales. Why did they do it? Impact! Well, what can be done about it? Get busy

at Arlington and find out. Build a Bates Road and see about it. At Pittsburg, California, build another experimental road and measure the stresses in the road surface. Yes, that was traffic requirement again, and there was related highway planning too in the thick-edged concrete pavement that came as the response.

That was highway planning in the physical sense. Well the problems were a bit physical in those days; but he will recall too -- this highway engineer -- a matter of system planning when he first discovered that the people riding around in gas buggies wanted to go somewhere in the things instead of just staying around within walking-back-home distance. It was then that he made up his mind that if they were ever really going to get anywhere -- say, from Hartford, Connecticut to Worcester,

Massachusetts (Did you read that story of Hiram Maxim's?) -- he would have to confine his efforts pretty closely to the roads connecting the big towns, to the State highway systems and to the Federal-aid system. Limited systems, that was the answer, every cent to go into them until they were surfaced clear through. Yes, that was highway planning, and it was planning in strict relation to traffic requirements too.

As he broods further upon his experience the highway engineer is likely to be reminded that traffic requirements have always meant for him the minimum limit of what he had to do. He has had all the time another limit, too. It was his maximum, his ceiling they might call it in these days. It was what he could do and he got the word about that from Mr. John Q. Taxpayer.

It would have been a bit easier if he might just have yielded to the advice he received on occasion to make all the roads perfectly straight, and absolutely level, and three feet thick. That would have been planning, unquestionably. It might have been called bold, imaginative planning! But, would it have been really planning in relation to the traffic requirements; and would it have been possible, as measured by John's micrometer?

The highway engineer decided that it would be neither. He remembered that he had ahead of him -- only to get something over the end of those limited State and Federal-aid systems -- a job of some 300,000 miles of construction. He thought about the traffic pressing to get over those roads, and he asked himself: "What does the traffic want most?"

And the answer seemed to be: "Why, the traffic wants to get through from here to there and from there to the next place." So he made up his mind he would put it through, and he did.

He cut the surface widths to 16 -- well, better say, 15 feet. He left in place the old covered wooden bridges and the not-quite-so-old, uncovered tin bridges (because they would still do a while longer); and he spent just as little as he possibly could to pay reluctant and expectant farmers for new right of way. And what he saved in these ways he put into -- not fancy, but travelable surfaces. And, what did the road users think of it all, Why, they liked it. They called the roads "those fine new State Roads." And so, by keeping on in the same way, the highway engineer recalls that he finally did get those 300,000 odd

miles of the main roads improved, well -- better than he started out to make them -- in about 15 years, which was as fast as John would let him go.

And when at last he had got that far, and looked around him, what did he see? He saw twenty-two million passenger cars flying around all over the country, piling up four hundred and fifty billion passenger miles in a year; and he saw motor trucks and trailers pulling from Texas to Boston with several times the load they were supposed to be made for; and he said to himself, "Well, I've done something!"

And then he blinked his eyes; and when he opened them again -- there was another traffic requirement! When he looked last those touring cars were knocking

it off at 40; now here were these streamlined cousins of the west wind breezing along at 60. Well, what shall he do about that? Perhaps he had better just admit -- this highway engineer -- that the struggle to keep 10, 15, 25-year roads up to 5, 7-year vehicles is bound to be a losing one, unless he can get his friend, the automotive engineer to tell him in advance which way he is going to jump next.

Now, that is a somewhat personalized resume of the past of the relation of highway planning to traffic requirements.

The outstanding facts of the present are these. We have a main highway system on which a pioneer improvement is just about completed. As a whole, its worst faults, perhaps, are that its curves are too sharp



and its sight distances too short for 60-mile-an-hour speed. They were expected to serve 40-mile speed, which was what the laws allowed. Some of its surfaces need raising to higher type. That is the result of deliberate postponement in accordance with a stage construction policy. Its surfaces are generally a little narrow. Instead of 18 and 20, they should be 20 and 22 feet wide.

Its alignments are the result of gradual intercity and intertown growth on existing rights of way. They need to be straightened -- made more direct. Its rights of way are too narrow. That, too, is the result of a deliberate policy plus a philosophical acceptance of the alternative of interminable injunction suits. The rights of way need to be widened when they are made more direct;

and, now that the traffic has a road to move on, there is time to work out the property acquisitions.

We need more wide highways with separated lanes and fewer three and four-lane roads with undivided surfaces. But that need has not existed long. Ten years ago there were not, at most, more than 1,000 miles that needed more than two lanes. In 1930, Dean Johnson of the University of Maryland went along half the Atlantic Coast looking for highways that were congested, roads on which he could find those tell-tale queues on a Sunday afternoon; and he had to search for them.

And we must and will continue to eliminate grade crossings of railroads -- as long as the Federal Government foots the bill. Turn the responsibility back to the States,

while their laws remain as they now stand in reference to railroad participation in the cost, and the progress of elimination will come to an abrupt halt.

Then, too, we need, and need badly, the elimination of some highway-highway grade intersections. And we have reached the point where we shall have to have soon some roads of limited access -- freeways, they have been called.

One more need there is; and it raises a question as to which the highway engineer invites especially the sympathetic consideration of his automotive brother. It has to do with grades. A 5 percent grade is easy for passenger cars. It pulls many a semi-trailer combination down to a crawling 3 miles an hour. Collect a string of impatient

passenger car drivers behind one of these crawlers on a 5 percent grade and you have congestion of the kind that often breaks up in an accident. What shall we do about that situation?

We can reduce the grades. But for each percent below 5 the cost will be increased by tremendous increments. We can widen the surfaces on hills, as has been suggested. But before we do either, we should hear from the automotive engineers as to what they can do to raise the hill-climbing ability of the freight vehicles, and what they are likely to do in the next ten years or so. If the highway engineer can get a clear answer to those questions, he will know what to do about grades, even as he also knows quite well

what to do in a physical way about other recognized shortcomings of the highways in their present initially improved state.

But what really concerns the highway engineer much more than the problems of physical design are the problems of finances. What will we use for money?

Anyone will agree that it would be a fine thing to have a splendid lot of broad highways, each with at least four traffic lanes, the traffic moving in opposite directions separated by medial parkways, separated in grade from all other highways at intersections, with bordering roads to serve and control access from abutting property, and sidewalks for pedestrians wherever they are needed. Suppose we say we should like to have about 15,000 miles of such highways. That would be less than 5 percent of the

mileage of the State highway systems, but it would be nearly four times what the Germans have planned of similar design on their autobahnen. Well, the Bureau's division of design estimates that the cost of just that much would be approximately four billion dollars. That is just about the amount that has been spent in this country during the last 20 years by the Federal Government and the States together under the Federal-aid plan with all the recent outright emergency highway expenditures of the Federal Government included.

There -- to bring the question more close to home -- where shall we find the money to reduce 5 percent grades to 3 percent, or to widen 2-lane pavements on hills, so that trucks and trailers, if they cannot be

more adequately powered will no longer unduly strain the patience of reckless passenger car drivers. The passenger car drivers are likely to point the finger at the trucks. The real-estate owning public and some others are sure to vote for the owners of some kind of vehicles, any kind.

And here, may be as good a point as any to make the observation that, unless there is a marked change in the past trend, nothing is more certain than the probability that by whatever amount the permanent annual cost of highways is increased, by that amount at least are the tax levies of the road user going to have to be increased. The flight from the property tax has all the appearance of a rout.

Oh, there is no doubt that the financial problems are the more serious ones. In not one but several States today, but for

the fortuitous emergency aid of the Federal Government, both the construction of new roads and the betterment of those already improved would be at a complete standstill. In several, the available funds would be insufficient for maintenance alone. Where such conditions exist the cause is mainly that local property taxpayers, finding the burden of their taxes greater than they wished to stand, have unloaded the whole problem of the building and maintaining of all rural roads upon the State highway departments, with the parting advice to those holders of the bag to see whether the motor vehicle taxes won't do the job. How much more will these revenues provide for? That is the most serious question that we face today.

Twenty years ago we had the great growth of motor vehicle registration ahead



of us. There was no question then that we could count on greatly increased revenue from the motor vehicle -- just by the multiplication of its numbers. How much more of such growth can we count upon now? How much in percentage of the present total?

Twenty years ago there was an unstrained willingness of motor vehicle owners to pay more, and a little more in license fees, and the bonanza of the gasoline tax had not been discovered. Since then it has been pretty well worked. There are indubitable signs that a further increase in the rate of gasoline taxes, in some States at least, will meet with strong resistance. And how much additional revenue will be forthcoming from increased gasoline consumption? Certainly the increase cannot be of the order of the past; and while we are thinking of gasoline

taxes, it may be well to consider that the past rate increases and the past growth in consumption have coincided with a falling price of the commodity, so that in effect upon the consumer we have hardly had a tax at all or an increase in taxes. What is likely to be the attitude of the taxpayer if there is a reversal of the price trend?

It is time to give serious thought to this matter of finances for the further development of the highways because it is quite apparent that the willingness and ability of the public to pay the cost may at some not distant day reach its elastic limit, and because it is imperative that we shall not unknowingly create a larger and more expensive highway plant than we can keep up with the funds that the public will be willing

to pay year after year. There may be -- there probably is -- a difference between what the taxpayers will pay for a short period to build a new system of highways and what they will be willing to pay for an indefinite period to keep the system thus created. It is this latter cost to which the tax rates of the future must be scaled and it is that cost that must be considered the limit of further road improvement.

Already we have, in the existing improved highways, just as they are, an investment that it costs a very considerable sum to preserve. Without improving a single additional mile, without the least enlargement or betterment of the presently improved roads it will take a good part of the revenues produced by present taxes to maintain and rebuild as necessary the present plant.

We know that some additions are necessary and that some are imperatively required for the abatement of danger and intolerable congestion. We know that much more is desired -- on the main highways and on the secondary and feeder roads. In the recent extension of Federal aid to roads of the second class we see a new trend that has its spring in a long unsatisfied desire of those who have been kept waiting on the dirt roads for the main highways to be paved before they too should have the direct benefit of relief from the annoyances of mud and dust. And we see this move toward a further improvement of the lesser roads at the moment when the property tax source, so long the recognized support of such improvements, is apparently drying up.

So the big question is -- not how much more road improvement do we want, not

even how much do we think we need, but how much more will we be willing and able to pay for in the long grind of continuous upkeep.

It was mainly a recognition of the importance of that question that led the Bureau of Public Roads in 1935 to propose, and 40 States within the last year to endorse, the conduct of what are known as State-wide highway planning surveys. Anticipating the need there had been inserted in the Federal law a provision permitting up to 1-1/2 percent of the appropriations made for cooperative Federal and State road construction to be used for planning purposes. It is the fund thus provided that is now being used to pay for the extensive fact finding studies now under way in the 40 States.

The first aim of the surveys is to establish an accurate inventory of the

whole existing road plant. Up to this time we have never known with certainty even the total mileage of our highways. We have estimated it at approximately 3,000,000 miles, but there is reason to think the figure may be badly off or at least misleading.

By driving over every mile of public road that can be found on the ground, and measuring the miles with the odometers of the survey cars, we are now determining, with reasonable accuracy just how many miles we do have, and just what is the present condition of the entire mileage. What is the kind and condition of the surface on each section; what are the widths of the surfaces? What are the graded widths, the fenced widths?

And — very important, indeed, as indicative of the need of what may be called

the land-service group of roads -- what is the state of human settlement and industry along each of the roads? We are actually locating in the inventory, and will plot on the large-scale maps of every county that will for the first time result from this inventory, every rural home and farm house, every church and school, every mill and mine, and inn and store, and every place of every kind, in rural territory, where people live and work and which is therefore an origin and a destination of highway traffic.

On the main roads -- with modern traffic requirements in mind -- we are locating, in non-mountainous terrain, every curve of degree exceeding 6, which we count as the sharpest desirable, with practicable super-elevation, to give a reasonable factor of

safety for travel at 60 miles an hour.

In mountainous country, with speed of 40 miles per hour as the criterion, we are locating all curvature in excess of  $1\frac{1}{2}$  degrees. Similarly, and with the same traffic speeds in mind, we are locating all places on the main roads where, in non-mountainous country, the sight distance is less than 1,000 feet and, in the mountains, 650 feet. Where the sight distances are less than these criteria we are determining not only the length of the visible distance but the cause of the restriction, in order that there may be the possibility of integrating the cost and difficulty of correcting the existing limitations.

We are locating also, on the main roads, all grades that for a length of more than 500 feet exceed 5 percent in non-mountainous areas and 8 percent in the mountains.



Every bridge is being inspected and recorded with a description of its type and the best feasible indication of its age, condition and carrying capacity.

And, what will perhaps be of special interest, every railroad grade crossing is being noted, and a record made of its physical condition -- the angles and grades of the highway approach, and the sight distances along the track from various positions on the road. Then, to this information, there is added later, as planned, a record of the highway traffic over each crossing, and, with the aid of the railroads, a record of the rail traffic and of the accidents that have occurred in the recent past at each and the results in injury and death and property damage -- when all these facts are

available for every rural grade crossing, we should be able, as we have not been able heretofore, to measure the dimensions of the grade crossing problem and establish an order of priority in elimination consistent with factors of relative hazard and delay.

To the inventory phase of the surveys there are joined various counts and studies of the traffic moving over the roads. There have been traffic surveys before this but none like the ones that are now going on. No previous traffic surveys have attempted, as these do, to measure the traffic on the whole rural highway system. All or practically all of the previous counts have been confined to the State and Federal-aid highways. In a very important sense the most useful work that is being done in the current surveys is

that by which we hope to establish with reasonable approximation the relative service value of all of the large mileage of country roads that is not included in the main highways. We know that a large part of the whole rural road system must serve a disproportionately small part of the total vehicle-mileage of all road usage. Now we are going to determine the facts by actual measurement; so that we shall know quantitatively what part of the whole system lies below any given level of traffic importance.

By the simple counts of traffic we shall learn, at the other end of the scale what roads, in the whole highway system, regardless of present arbitrary administrative classification, are of maximum traffic importance. But, there is much more than the evidence of simple density that is being

obtained in these traffic studies.

By origin-and-destination counts of various kinds, we are piling up information indicative of the need of road relocation, both general and local; evidence of the values attached by road users to savings of time, distance, and vexatious delay, to be applied to the solution of the economic problems presented by relocation questions; and -- what may be especially important in deciding upon future tax measures -- the evidence of relative local and general interest and urban and rural interest in the several classes of roads.

By one form of weight study, conducted with loadometers at many points on the main highways and by estimates on the local roads, we are endeavoring to accomplish two ends: First, to possess the evidence needed for the

design of surfaces and subgrades of adequate load-supporting strength; and second, to determine the range of movement, within the whole highway system, of vehicles of various kinds, for consideration in arriving at equitable decisions upon taxes for the various kinds of vehicles. If vehicles are to be taxed according to the public road cost their operation entails, it will be useful to know what part of the whole highway system is used by those of the several weight classes in such numbers as to require a provision of road strength adequate to support them. Through these weight studies also, we shall be able to estimate the actual effectiveness of legal weight regulation as it is now prescribed and enforced, and something also of the proportions of the task of effective enforcement of any given limits.

By another form of weight study, employing carefully calibrated pit scales, we are weighing the wheel loads of vehicles of all descriptions and relating these weights to careful measurements of all significant dimensions of the same vehicles, their tires, the character of the loads they carry, and the nature of the service they perform, whether local or long-haul, private, contract, or common carrier. It is probably unnecessary to elaborate upon the purposes and the usefulness of such precise information, with regard to vehicles as they are actually used.

And, finally, in the traffic studies we are amassing a great deal of information concerning the kinds of commodities carried by trucks and the numbers of passengers by busses, the distances they are carried, and

the way the service is performed, whether by private or hired vehicles, which will have important bearing on questions of the coordination of highway transportation with other forms of transportation.

Then to the results of the inventory and traffic phases of the surveys we join those of the third phase -- the financial studies -- we add the clinching facts for purposes of planning the future road program.

The objects of the financial studies are these:

First, to determine the whole present tax burden for road and street purposes. No one knows what this is at present because (a few States excepted) there has never been an effort to assemble the records of all of the thousands of taxing jurisdictions involved, both urban and rural.

Second, to determine the actual incidence of these taxes -- the relative extents to which they are paid by city people and country people, by motor vehicle owners and other property owners, and the proportions in which they derive from the various geographical and governmental subdivisions; and

Third, to determine the purposes of all present expenditures by all road and street building agencies, whether for construction, maintenance, bond service, etc., whether for main or local rural roads or city streets, and what classes of people (rural, urban, etc.) are benefitted in what degree by such expenditures.

By such studies we aim to gauge the present size of the highway financial



structure and appraise the equity of its bearing upon various tax paying classes. But -- what is more important from the standpoint of future planning -- we are endeavoring also, by studies of the life history of roads of all classes, and their past cost trends, to approach an estimate of the normal life expectancy of various types of surfaces and parts of the road structure under varying traffic and climatic conditions, and the associated costs of construction and maintenance, from which to project the probable future annual cost of any determined road program. Or, to put it the other way round -- which perhaps amounts to the same thing: To determine what maximum highway investment may be made within the limits of probably available future annual road revenues, and in

what way the cost of such an investment should be distributed among the various beneficiaries.

We conceive these purposes of the surveys to be highway planning in relation to traffic requirements, as distinguished from that other, and, in our view reckless and indefensible kind of planning which aims at the impracticable attainment of the physical ideal without regard for the real needs of the traffic and the financial possibilities.