

## The Fundamental Principles of Highway Construction

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The recent traffic counts made by the Bureau of Public Roads in Connecticut and Massachusetts show an average traffic of 1,140 tons of commodities per day of nine hours. Adding one-third, as a very conservative estimate, for the full day we have 1,520 gross tons daily, which includes the weight of the commodities and the carrying vehicles. From figures based on experiments conducted by the Iowa Experiment Station, assuming gasoline to cost 24 cents per gallon, the cost of fuel alone for moving this tonnage over an average dirt road would be \$26.44 per mile per day, assuming the impossible, that such traffic could be carried over a dirt road. The cost of fuel for moving the same tonnage over a paved road would be \$11.70, a difference of \$14.74 per day. On the basis of 300 days per year the actual saving on fuel alone for moving this tonnage would be \$4,422. Suppose the paved highway costs \$10,000 per mile. The average interest of 5 per cent would then be \$1,000 per year, which, deducted from the saving on fuel, would leave a balance which would retire the cost of the road in a little over 11 years.

Here are the astonishing figures of the cost of an improved highway, constructed at prices which are above what we believe will be the general average of such costs, and the

saving in fuel consumption alone on the commodity traffic, is sufficient to pay the cost of the construction, and the tremendous passenger traffic is carried, on this basis, free of cost.

With such facts as these before us, I think it must be agreed that highways, economically constructed with a view to accommodating the traffic are worth whatever they cost. In view of the actual financial return which their construction insures to the community and the large saving in the cost of transportation which follows the conversion of a bad road into a good one, the only question would seem to be whether we can afford not to build them.

And yet we find ourselves just now in a period of hesitation or reluctance on the part of the public to carry the responsibility of continuing the work of road improvement that has been well begun to its logical conclusion - the provision of an adequate system of highways for the ever increasing highway traffic. The suggestion is made in some quarters that we have gone far enough in building highways, and many other equally thoughtless comments and criticisms are more or less common. Having been convinced that improved roads are a good thing we are half inclined to halt in our efforts to secure them and thus not only fail to realize to the full the benefits they

will bring with them but actually lose much of the benefit of the expenditure already made by failing to connect up the sections of roads already improved into a serviceable system which will permit the traveler to go from origin to destination without being hindered by bad roads.

To build these highways that are well nigh universally desired there is need of labor, material, organization, contractors, engineers, transportation of material - all of which mean money. If we really want adequate highway service that money is absolutely essential. And yet it seems more than difficult to obtain from the public a general understanding of the tremendous effort that must be made in every State and in all the States to carry on the construction and maintenance of a sufficient mileage of highways to give adequate service.

Those in responsible charge of the road work in the States and Federal Government are making a serious effort to bring before the public a full statement of the need and a fair and complete disclosure of their activities in meeting the need. They are endeavoring to make perfectly plain the principles by which they are governed, and the reasons for the course of action they are following. And, all too frequently, this policy of openness and sincerity is taken advantage of, and the information so freely disclosed becomes the basis of attacks, unfair, unjust, and viciously destructive.

It is surprising that such attacks are credited by thinking people. The medical quack who would deny all the experiences, studies and research of the medical profession which, year by year, have developed into what is now the modern science of medicine and surgery would have no following among the thinking public. It is the same with the law. Society has secured for itself freedom of action, protection of life and property after long years during which principles were laid down one by one to form the structure we call the law; and we do not lightly abandon a single principle. So also the future of highway building in Kansas as well as every other State will prosper or fail to prosper to the extent that it follows or fails to follow and put into force and effect those principles which have been brought out of the experience of the past.

It has taken a long time and the road building efforts - successes and mistakes - of many States, to crystallize these principles, but they are now so clearly established that he who would deny them simply betrays his own lack of understanding of the definite progress which has been made in the science of highway administration, operation and financing.

It was for the purpose of encouraging the general adoption of these principles that the Federal Government in 1916, made its first appropriation for road building. The law is not an arbitrary set of rules and regulations, but rather a clear-cut delineation of the

principles which have proved successful in application over a period of 30 years. These principles have not only proved successful in the States where they have been in effect for the longest period; they have proved, in fact the only methods that will insure a continuity of successful administration of the highways and produce both new construction and continuous maintenance suited to the needs of any State.

One of these principles, clearly established by experience, is that the economic development of the country calls for roads of four classes. Whether they are recognized as such or not there are roads of the four classes in every State and these classes are: First, the interstate roads; second, the roads which are of importance to a whole State; third, the roads of county-wide importance; and fourth, the local roads or roads which serve only one small community. As I say, the development of the country has already brought into existence roads of the four classes, and it is a first principle of proper highway administration to recognize the difference that exists. The roads should be grouped in their proper classes and the duty of constructing and maintaining each class should be acknowledged and accepted by the proper governmental unit. It is not right to expect, as we not infrequently have expected, the county to bear the expense of a highway which is actually of greater importance to the State than the county.

The existence of roads of interstate importance has been recognized by the Federal Highway Act and provision has been made for the segregation of such roads into an integral system, not exceeding in mileage seven per cent of the total road mileage of the States, upon which funds appropriated by the Federal Government are to be spent in aid of construction.

The interstate and State systems will generally be coincident, although probably not co-extensive but there will generally be a clear line of demarcation between the State and county roads and the county and local roads.

There follows from the acceptance of such a classification the necessity for the establishment of an adequate State highway organization to take over the duty of building and maintaining the roads which are peculiarly the interest of the State, and this is another of the principles, developed through years of experience, that is recognized and given the force of law by the Federal Aid measure.

Now it is carrying the logic of the analysis only one step farther to set up as a third fundamental principle the idea that the roads, which are of importance to the State as a whole and which the State has provided an organization to administer, should be built and maintained with State funds derived from the citizens of the States at large. This principle also, has been adopted by the States which have recorded the greatest progress in highway development; but, in some States, it meets with resistance arising

out of the conception of local self-government and the limitation of local responsibility to the improvement of local conditions. There is actually no conflict with the institution of local self-government. On the contrary this principle recognizes what I take to be an axiom of political economy: That improvements which benefit equally more than one locality or governmental unit should not be held to be the obligation of any one locality. The counties and smaller units have a great responsibility. There is imposed upon them the burden of maintaining the 90 per cent of all roads which are solely of local benefit. It is not right to expect them to build the main roads of the State which lie within their borders when, as is often the case, such roads afford greater service to communities outside of the county borders than to the county itself. It is not fair to exhaust the credit of the counties by expecting them to pay for roads the income from which will return only in part, in small part, perhaps, to their citizens.

Let me illustrate my point by referring to a certain county I know of, which is situated in a valley surrounded by mountains. In order to obtain an outlet it bonded itself to the very limit and spent every cent of the money on a main line of highway. Its money spent and its credit exhausted, this county now finds itself with a road running through the center of it, but with no connection on either end, and there is no possibility of making these connections unless the State takes over the responsibility. The road is really

a part of the main highway in that part of the State and it is the State's duty to take it over, reimburse the county for the money spent and connect it with the adjoining counties. It is not fair to place this burden on the county. It is not fair.

This principle was not included in the original Federal Aid Road Act, but it is now embodied in the Federal Highway Act, and hereafter it will be required of every State as a condition precedent to the granting of aid by the Federal Government that the State shall provide State funds under the control of its highway department to pay the State's part of the cost of constructing the Federal-aid roads and to maintain them perpetually when completed.

When, in recognition of these established principles, the highways have been classified according to use and a State highway organization, provided with State funds, has been created to care for the construction of the State roads, when the individual counties have thus been freed of the burden of providing for the more expensive roads which are the concern of the entire State, the next problem is to determine the rate at which the improvement of all systems is to go forward, and in this there is involved directly the problem of financing the improvements.

But here let us say that there is this principle that may be set down as inevitable: That until a State has completed the backbone of its trunk line system with suitably paved or surfaced highways, the rate of construction should be independent of the source of the



revenue or the method of payment, and should be limited only by the physical handicaps imposed by the available supply of labor and materials. Only by accepting this principle can the ultimate cost of the highways and their service be reduced. For, in a State like Kansas, the use of the principle highways is so extensive that the people pay for adequate highways whether they have them or not, and they pay less if they have them than if they have not. As I have already shown the saving in fuel alone is sufficient in many cases to pay the entire cost of the improved road.

But I do not mean to say that all highways, even of the trunk line system, should be paved. The type of improvement required is clearly dependent upon the traffic, and if the traffic be known the kind of surfacing or pavement to be applied or whether to apply any surfacing at all will be a relatively simple matter to decide. It is merely a matter of balancing the aggregate saving in cost of operation, which is a product of the number of vehicles and the reduction in operating cost made possible by the various types of surface, against the costs of the several types of improvement. For any particular traffic density the economic type is that which can be paid for with the savings in operating cost accruing from the improvement. No road should be improved to an extent in excess of its earning capacity; but all roads should be developed to the highest degree consistent with the return in the form of traffic economies. Fortunately, we are not limited to any type of

improvement. Our problem is to provide economical transportation, and in doing so we must resort to every material and every practice that can be utilized to obtain the end desired.

Nor do I mean to imply that every highway should be brought at once to its final state of improvement. We must keep always in mind that the amount of construction possible in any State is necessarily restricted by the physical limits of labor and material available. But in a State as large as Kansas there are miles upon miles of road to be improved, and every mile in an unimproved condition entails a reducible expense to the traffic that uses it. The ideal solution would be to improve all such roads at once, raising each to the state of improvement justified by its traffic, but this it is physically impossible to do. What, then, is the better course to pursue? To confine all attention to a few roads each year, leaving all others in a totally unimproved condition, or to extend the mileage treated and develop a whole system progressively by stages? We have learned by experience that the stage-improvement plan is the better. It is the only plan that has been successful in such a large State as Kansas, and we have recognized the wisdom of it by advancing Federal Aid funds for improvements of this character. There will be certain roads of course, so important from the standpoint of traffic that they must be singled out for complete improvement at once, but generally speaking, the greater return will follow the simultaneous upbuilding of an entire system. In one State, with which I am very

familiar the application of this method has made it possible to improve 1,500 miles of secondary roads, surfaced with material available locally, which will last for a period of from five to ten years and which will greatly facilitate traffic during this period on the entire mileage improved. If the same resources had been applied to the construction of paved roads they would have produced only some 150 to 200 miles of pavement and the balance of the mileage would remain entirely unimproved.

I think there is no question that the improvement of the trunk line system should be carried into effect as rapidly as physical limitations will permit, and I have said that this should be done regardless of the methods of financing adopted; but I do not mean to imply that I regard the methods of financing as unimportant.

Let us consider briefly the principles of financing. In the first place, it seems to me that there are only three sources of revenue, and whatever money is needed must come from one or more of them. One is the road user, from whom revenue may be derived in the form of automobile license fees or a gasoline tax; the second is property - real or personal - on which a direct tax may be collected; and the third is income. Then there are just two methods of expending the money derived from these sources, either by the pay-as-you-go plan or the deferred payment plan, which means a bond issue. Now, it seems to me that it is entirely possible, by following certain well

known principles to finance a progressive program of highway improvement in this or any other State which will be acceptable to all parties.

The first of these principles which I would lay before you is this:

That the total cash expenditures, in each State, for highway purposes shall be considered as the annual highway budget.

You are building State roads and county roads and local roads, and the money to pay for all of them is derived finally from the same people. This being the case, unless you consider the financial needs of all classes of roads in preparing your highway budget, you are very apt to pile up an expense which it will be impossible to meet without excessive taxation. The business-like way to proceed is to recognize at the outset this first principle of successful financing which I have enunciated, set up a comprehensive budget which will cover the work for the year on all classes of roads and which will be adjusted to the peoples' ability to pay.

For the purpose of securing efficiency all expenditures on all systems should be correlated under engineering and economic supervision; and the order, character and extent of the improvements made upon the several systems should depend upon the relative future traffic requirements. The attainment of these objects implies the creation of a budgetary authority to supervise all highway expenditures in the State, and such an authority should, in my opinion, be created.

There is this fact also that we must constantly bear in mind: That the expenditure for highways is only a portion of the necessary public expenditure. We can not take all the income from public revenues and devote it to highways. There are educational institutions to be maintained and there are other public functions that require money for their proper performance; and it may therefore be taken as another fundamental principle that the annual highway budget should be adjusted to the relative needs for other public purposes. The revenues derived from various sources must be sufficient to cover all these needs, and the portion allotted to highway improvement must not be out of proportion to the relative need for highways. But in this connection it should be added that all revenue secured from motor vehicles or road users should be set aside for highway purposes.

Now, if the highway program, planned and administered as I have described entails an expenditure greater than can be met with current funds without diverting money from other necessary purposes, the only recourse is to issue bonds, for I will remind you again that to fail to prosecute the work of highway improvement as rapidly as physical limitations will permit is merely to shoulder the inescapable expense in the form of greater operating costs for vehicles, a form in which it will be greater than if it is assumed as a road construction cost.

Now, as to the problem of raising money, there is one very definite principle that will aid you in determining upon a wise policy. Concisely stated, it is this: That the cost of building and maintaining

an adequate system of highways should be distributed in equitable relation to the benefits derived.

I wish to develop this point very clearly and enumerate the various benefits derived because there is a tendency to saddle too much of the original cost of construction upon road users.

First and most important are the general benefits to society, such as the influence on education, recreation, health, the national defense, the postal service, living and distribution costs. In these, our general benefits, every man shares whether he rides in an automobile or not. Every one remembers the absolutely indispensable part played by the highways during the war. It is self-evident that the efficiency of the rural free delivery postal service is dependent absolutely upon the condition of the roads. No one is so out of touch with developments in modern educational methods as not to know that the progress of rural education depends upon the displacement of the one-room school-house by the centralized graded school and that this development in turn is dependent upon the improvement of the roads. The advantage of improved roads in making possible prompt medical attention in case of sickness is too well understood to be argued over. And so with the benefits that are derived by the farmer through increased participation in the facilities for recreation afforded by the town and the city and the general influence of the roads upon living and distribution costs. It is only necessary to mention these benefits for every one to realize how great an influence they have upon the lives of all of us.

A second important group is made up of the special benefits, such as those to agriculture, manufacturers, labor, railroads, waterways, mining and forestry. Without roads there could be no agricultural development at all. Without roads there would be practically no freight for railroads and ships to transport. The need for roads to develop and protect our forests is so well understood that, as a nation, we are expending large sums of money for that special purpose. The advantage to manufacturers is two-fold - the roads facilitate the acquisition of raw material and aid in the distribution of the manufactured product. It is not necessary to go further in the development of the argument. It needs but a little reflection to convince one that every branch of industry is benefited directly because roads are built and maintained, and it follows that the economic improvement of the roads must increase these benefits.

The benefit to property is well understood, and the benefit to the road user is direct and obvious.

All these benefits must be taken into consideration in making the assessment for the construction and maintenance of the roads. It is not fair to lay upon any one class a part of the cost disproportionate to the benefits it receives.

The wide variation in the present status of highway development in the several States prevents the adoption of a uniform policy for securing the funds necessary to the annual highway budget and expending these funds. Generally speaking, however, these principles may be enunciated.

(a) States in the initial stage of highway development should issue bonds to defer that portion of the annual charge for construction which would overburden either property or the road user.

(b) States where original construction programs are well under way, can, in the main, finance further expenditures for construction by bond issues devoted to deferring the cost of special projects.

(c) States where original construction is practically completed are concerned chiefly with maintenance and reconstruction and should depend on current funds, save in cases of emergency.

(d) The maintenance of interstate and State roads should be a charge against the road user.

(e) Roads serving a purely local purpose will generally require only light upkeep and this should properly be a charge against the adjacent property, which in this case is the first and often the only beneficiary.

(f) No road should ever be improved to an extent in excess of its earning capacity. The return to the public in the form of economic transportation is the sole measure of the worth of such improvements.