

Read by C. F. Rogers.

## HIGHWAY NEEDS AND PROBLEMS

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As we enter the year 1950 there is much public debate whether we are beginning the second half or ending the first half of the twentieth century. It is really a matter of little consequence, whether it be one or the other, because the true significance of dated periods is not found in the passage of time alone but in the events of the periods.

That this is indeed a crucial moment in world affairs, perhaps in the very life of the human race, is deeply impressed upon the consciousness of all of us; and, as individuals, we are burdened with a sense of our impotence to alter the course of world shaking events.

Compared with these cosmic affairs, the highway needs and problems I am here to discuss lie more fully within our powers of comprehension and control. That there is some want of effectiveness in our dealings with them, in the nation, State and community, results less from any actual insufficiency of our organized ability to cope with them than from the lack of a common understanding of the extent of the needs and the nature of the problems. And this, in turn, results from the fact that in highway affairs, as in others of both greater and lesser moment, the first half of the twentieth century has

been a period of change, swift beyond our power of immediate appreciation and responsive adjustment of thought and action.

As we approach or enter the second half of the century our highway needs are far greater than they were at its beginning, but not beyond the measure of our ability to meet them. And the associated problems, if, as I believe, they are not vastly more difficult than those we have previously encountered and conquered, are nevertheless new and different problems, for which we must and will find new and different solutions.

If, in 1900, when the total annual outlay of public money for all our roads and streets was a few hundred millions of dollars, it had been possible for anyone to prophecy that the annual expenditure for those purposes would grow in 50 years to more than 3 billion dollars, that prophet would very likely have been without honor anywhere - in his own or any other country. If, in that same year, at the end or the beginning of a century, anyone had been mad enough to predict that horseless carriages and wagons would in 50 years, or in any space of time, drive Dobbin clear away from our streets and highways, that person would most certainly have been treated with the derision with which, by custom, we greet all those who are wise beyond their time.

Yet, in 50 years we have wrought what in 1900 would have been thought a highway transport miracle. Our great automotive industry has developed and produced, and we have acquired automobiles and trucks to the present number of more than 43 million. There are enough

automobiles in use to move our entire population in a single trip of one vast caravan. Our varied industries, none more effectively than the industries here represented, have profitably adopted the motor truck for the transportation of an ever increasing volume of their production. And a system of rural roads and highways which, in 1900, was notable only for the obstacles it placed in the way of a reluctant and occasional travel, has been built up to serve with some convenience an annual transport movement of more than 200 billion vehicle-miles.

As we look back upon these fifty years past we can conclude that the accomplishment of this highway transportation miracle has been made possible by these things, mainly: The ingenuity and commercial genius of the automotive industry; a great hunger of our people for the new freedom of movement which the motor vehicle afforded; a clear recognition of the more urgent highway needs; a truly remarkable readiness to venture the means to meet the needs; and a practical solution of the problems encountered as the needs were met.

We can and do take justifiable pride in the accomplishments of fifty years past. Our hunger for the still increasing facility of automotive locomotion remains unsated. If our alertness to emergent highway needs retains its past sureness, if we continue our earlier success in the resolution of problems that appear, and if we remain in the future as ready as in the past to suit the essential means to the ends we desire, we shall not lose the sense of satisfaction we have enjoyed in our highways.

These are big IFS.

Highway needs are increasing and changing in place and character. There is some failure to recognize and appreciate the extent and the implications of the altered needs.

The greater and altered needs have raised new problems. We may be becoming a little tired of solving problems, more ready to persist in old answers to new questions.

The meeting of greater needs and the solution of more difficult problems call for greater means. The means already provided are great; the requirement is greater still in aggregate sum, if less in proportion to the ends to be achieved. Facing a fast-multiplying public need, there are signs that we are becoming frightened by the bigness of the effort required to meet the need.

If I correctly read your minds at this moment, you are thinking that these are somewhat metaphysical observations in which I am indulging - possibly correct, but definitely abstract. You expected to hear from me some report of a more particular, less abstract nature.

To get down to something more concrete, let us think for a moment about concrete itself. The greatest need of the early years of our roadbuilding was to get all-weather, dustless surfaces as quickly as possible over a limited, but still extensive mileage of main intercity highways. The first problems that occupied attention were largely physical problems.

What materials would make good surfaces that would hold up under the weight and volume of traffic as we then knew it? The two principal answers at which we arrived were bituminous surfaces and concrete. We

were in a hurry to get the roads surfaced. We did not overlook the foundations. That is a charge that is made by persons unfamiliar with the problems and needs of that time. The Bureau of Public Roads began its studies of subgrade soils as early as 1918, and precious little pavement had been laid by that time. We simply had neither the time nor the means to build up the foundations as rapidly as we needed the surfaces.

Concrete seemed to be an admirable solution. We said it would probably bridge over some weakness of the foundation. How then could we get concrete pavements down faster? We vied for records of daily square yardage laid. With high production in mind, workability became a by-word - quick workability. Machines were developed that would mix and lay "workable" concrete quickly. We know now; indeed it was well known then that the relatively plastic mixes we compounded would not make the best and most durable concrete.

Was it a mistake to do what we did? I think not. The great need of the time was for the rapid extension of surfacing. The big problem was how to meet that need. The problem was solved. The need was met; and we still have in service a large mileage of concrete pavements quickly laid in this way on unprepared subgrades.

This reference to concrete is not intended to be discriminatory. There was the same problem in reference to other materials, and it was solved in a similar way. I have used concrete as an example only to illustrate the thought that the paramount need of the pioneer period of our road building was for the rapid surfacing of a limited

mileage of intercity roads, and that the problems that were associated with that need were largely physical problems which were solved in accordance with the need.

The highway needs of this country now are no longer defined in terms of the relatively simple linking-up of surfaces on a limited mileage of primary rural roads. Physical problems are no longer the weightiest problems, though physical problems remain and require new solution according with the altered needs of the time. The physical composition and placement of concrete, for example, still pose problems to which, as I believe you will agree, we must find new answers somewhat different from the old.

But, today, we are faced with highway needs incomparably greater in magnitude than those with which we dealt in earlier years. A traffic which then we could accommodate reasonably well on roads and streets of long accepted dimensions has since doubled, and redoubled, and doubled again. Where in the rural areas it was once pretty well concentrated on a comparatively small mileage of main intercity roads, it has since spread out, and its service has become a problem on a much larger mileage of secondary roads, and perhaps tertiary roads. A while ago I gave the figure representing the present annual flow of traffic over the rural roads at 200 billion vehicle-miles. That is a usage distributed, not uniformly to be sure, over three million miles of rural roads. The more significant fact is that there is a jam of traffic of the same magnitude - 200 billion vehicle miles annually, - on our city streets. And the streets through which this movement is attempting to push its way are 300,000, not 3,000,000 miles.

The picture I am laying before you is one of greatly increased need of improvement required on a very large part of our entire system of 3,300,000 miles of rural roads and city streets. On the primary rural roads, where need of improvement was first felt, larger needs remain. On city streets, once believed to present no serious problems, stupendous problems have arisen; and out on the secondary and lesser rural roads improvement needs today compare with those with which we were concerned on the primary roads two decades ago. All of which is attributable to great increase in the volume of traffic demanding to be served everywhere.

It is in this present ubiquity of need that we find one of the principal distinctions between our highway situation of today and that of two decades since. But there is another important distinction. On substantial segments of our highway system, especially on the primary rural roads and city streets, the growth of traffic has reached magnitudes that exceed the capacity of the existing facilities. So we find ourselves simultaneously confronted with two kinds of need which it had been better, or at least far pleasanter, had we been able to deal with them separately and in different times.

Unfortunately we cannot now, as formerly, postpone attention to a large part of the highway system while we concentrate upon the greater needs of a small part. Yet these greater needs of the smaller part alone are so great that they cannot possibly be met immediately as they should be, but, practically, only over a somewhat extended period.

The problems of this present situation, as I have said, are not largely physical problems. To the extent that they are physical in nature, they concern rather the geometry of design than the strength and characteristics of materials. The greater problems are problems of finance, of taxation and revenue; of administration, of the essential working together of many agencies of government to accomplish the necessary balanced attention to widespread, but variously measured needs.

Such are the big problems. There are some minor ones; and some that are rather in the nature of annoyances, which divert needed attention from the prosecution of the larger and more important work in hand. One of these is the problem of overloaded trucks.

We are confronted with a task of highway modernization, vital to the accommodation of great volumes of traffic. In our cities we have expensive new arteries to construct; and failure to construct them as soon as possible will prolong a condition of traffic congestion that is fast becoming unbearable. On the main rural roads near the cities a situation almost as critical exists. Elsewhere, on the main roads deficiencies are rife, deficiencies of curvature, gradient, sight distance, width, and others. At the same time there is demand and need for the improvement of secondary and feeder roads, overlong delayed.

Statewide studies in State after State have catalogued these deficiencies and estimated their cost. In every case the conclusion is reached that improvements needed at once can be actually completed, because of financial limitations, only over an extended period, running usually to 15 or 20 years.



The recently completed study of the national system of interstate highways established that the present deficiencies on the 37,300 miles included in that important but very restricted skeletal system will require an expenditure of more than 11 billion dollars for their correction. At a \$500-million annual rate of construction this task will require more than 20 years, and only the very courageous suggest the feasibility of a faster rate.

With such tremendous needs to be met and such necessity to spread the accomplishment over a somewhat extended period, it is imperative that every mile that is without deficiency be preserved in its surfaces and structures as well as possible in order that avoidable burdens of reconstruction shall not be piled on unavoidable burdens of new construction.

There are many miles of those concrete pavements we spoke of earlier; yes, and as much of other types of surfacing, laid in earlier years on unprepared subgrades, and not in the best of condition, which, nevertheless, we must try to hold in service as long as possible. Many of such roads we can cheaply widen and otherwise better, while we devote as much as possible of our available revenue to the more expensive provision of modern facilities where they are most urgently required.

And, spoiling the one chance we have of working to a reasonably acceptable solution of these greater and unavoidable problems, we have with us the overloaded truck.

Contrary to law, and in spite of any effort of law enforcement thus far deemed feasible, we have the overloaded truck. The laws of the States prescribe limits of vehicle weight that are consistent with the strength of the greater part of our mileage of existing road surfacing. These limits are exceeded by a steadily increasing, if still small, percentage of the total of truck operation. The overloads are not minor and unintentional accidents. They represent the deliberate practice of operators, and they run up to excesses that no conceivable liberalization of law can ever sanction. The more serious of these excesses appear in the axle loads of vehicles, although excessive gross loads and combinations of loads on groups of axles threaten our older bridges almost as seriously as the overloaded axles damage the surfaces. The worst of the consequences, from the highway standpoint, is the greater difficulty the practice imposes upon the effort to hold old roads in service until new roads can be built.

Those who follow these law-defying practices justify their actions on grounds of economy, the reduction of haulage costs, which they say they accomplish. I think there is not the slightest doubt that the cost of the road damage they cause and the economic loss, greater still, which results from the shortened life of our existing roads and bridges, adds up to totals far exceeding any vehicle operating savings that can be thus effected.

Such savings as there are, therefore, are the savings and the gains of individuals made at the expense of greater losses by the public at large.

It is most deplorable, in my estimation, that much of the road-damaging overloading of vehicles occurs as an incident of construction operations, many of them public construction operations, and some of them road construction. It would seem possible to stop the practice, in so far as it occurs in connection with public work, by the insertion of a provision in construction contracts requiring conformity to law in the loading of vehicles.

As for the greater part of the illegal operation, apparently a solution of the difficulty will only be found in the imposition of legal penalties with such certainty and in such amounts as to convert the individual profits now garnered into losses, and yield to the public treasuries a revenue compensatory of the damage caused.

I know there is room for honest doubt as to the reason or necessity for particular legal limits of vehicle size and weight. Such doubt cannot, of course, justify the current violation of law. Nor do the most harmful excesses of operation fall within the limits of any reasonable doubt.

In the hope that it will help to remove such doubt as exists in regard to appropriate axle-load limitation, a test is being arranged to be carried out shortly under the auspices of a number of cooperating State highway departments. A reinforced concrete road of 9-7-9-7-9-inch cross section, 24 feet wide, in Southern Maryland, which has withstood weathering effects and relatively light traffic with practically no visible damage since it was built in 1941, will be subjected on opposite lanes to a controlled traffic of vehicles of two magnitudes of axle loading.

All of the road's real traffic will be diverted from it in a section more than a mile long. On opposite lanes of this section, in one-half of its length, two-axle trucks having 18,000- and 22,400-pound rear axle loads will be operated respectively and continuously, back and forth, day and night, for about six months. On the other half of the road section, the opposing lanes will be similarly tested under operation of 3-axle trucks having tandem load totals of 32,000 and 44,800 pounds, respectively.

It is a fair test. If the road is good for the lighter axle loading, which conforms to the majority of State laws, it will not crack on the more lightly loaded side. If the heavier single and tandem axle loading is excessive, the side so loaded will progressively crack under the accelerated loading.

This test is being arranged by the Interregional Council on Highway Transportation, a group of officials of eastern States recently organized at Columbus, Ohio.

What I have said about the present indefensible practice of overloading I wish to distinguish clearly from what I shall now say about the loads and dimensions of vehicles for which our new highways and bridges should be designed. Maximum economy of transportation is a goal toward which all must strive. Highway transportation has some reasonable place within the whole field of transportation. If we can, we ought to try by objective means to discover what that reasonable place may be. And within that proper sphere, whatever is conducive to the greater economy of highway transportation is certainly to be desired.

Determination of the optimum maximum size and weight of vehicles is an economic problem that should have our most earnest study. It is a problem that is under study by a committee of the Highway Research Board on which I am glad to serve as a colleague of representatives of the automotive and allied industries, of truck and bus operators and other road users, and of the State highway departments.

The essence of the problem is the determination of the largest sizes and weights of vehicles that can be effectively used for the transport of persons and goods on public highways; and which so used, make possible, by reason of their greater capacity and reduced operating cost per unit of payload, transportation of lowest cost to the public, when the total of vehicle operating costs is combined with the total of associated highway cost, for both of which the public pays.

This is a real problem, as worthy as any arising out of our highway needs. The investigations planned have recently produced their first published results in the form of scientifically determined direct costs of operation of vehicles of a range of gross weight from 20 to 140 thousand pounds in the presence of various highway conditions.

This is only a beginning. The studies will be continued, going exhaustively into the question of the demand for transportation in vehicular units of various magnitudes, into the load factors, overhead, terminal, and other costs associated with operation over a range of vehicle size; and finally, by means of careful planned road tests into the question of the designs and costs of roads required by vehicle operation throughout the whole range of vehicle size studied.

The planned studies are expensive. They require the marshalling of a large group cooperation drawn from the two sides of the highway transport industry. They cannot be much hurried. I feel that the possible results are greatly to be desired for guidance of the future design of highways and bridges, and equally for the determination of economically sound operating practice. I am most hopeful that the investigations can be carried through with reasonable expedition to these ends.

Speaking from the highway point of view, I consider this determination of the optimum road-load relation one of the most vital of our problems. We can build roads and bridges for any size and weight of vehicle. We will build them, I am sure, for the largest size and the greatest weight of vehicle that can be shown to be in the public interest as an agency of truly economical transportation.