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SPECIAL ROADS RESERVED FOR MOTOR TRAFFIC

Thomas H. MacDonald,
Chief, U. S. Bureau of Public Roads.

In the United States the intermixture of motor and horse-drawn traffic presents no difficulties. Horse-drawn traffic is a negligible factor both in percentage and in volume; and substantially all roads must be regarded as roads for motor traffic.

A population of 113,000,000 supports, at present, more than 18,000,000 motor vehicles. For five years past the number has increased at a rate between two and three million vehicles a year and there is still no evidence of an early reduction in the annual increase. As the market for cars of the higher prices has approached saturation, price reductions, made possible by the standardization of manufacturing processes and quantity production, have extended the market, and it is apparent that the possibilities of cheap car production have still not been fully exploited.

The rate of motor vehicle ownership - nationally, almost one vehicle for each sixth person - is in some States, reduced to one for every third or fourth person, almost literally one for each family; and the probability of similar increases in other States is suggested by the fact that ownership is not confined to the wealthier and professional classes, but is literally within the reach of all classes.

The wide diffusion of motor vehicle ownership is reflected in the traffic on the roads. On main roads everywhere, horse-drawn traffic is a negligible percentage of the whole; and as the density of motor vehicle traffic increases the horse traffic dwindles - not in percentage only, but in numbers as well. So it has fallen out that when the motor truck traffic has increased to the point at which the presence of horse traffic would cause inconvenience there has been no horse traffic of sufficient proportions to constitute a hindrance. There is for this reason no appreciable demand for the restriction of the use of any roads to motor vehicle traffic only.

Although the traffic on all roads is thus so predominantly motorized that the needs of the motor traffic must be given primary consideration in the design of even the most lightly traveled road, it does not follow that all roads are, or have need to be, of the boulevard type. The primary consideration is the maintenance of a smooth and relatively dustless surface capable of supporting the vehicular loads, and affording satisfactory traction for motor vehicles. Strength to support the load is the primary requirement; surface wear is not a serious factor since the vehicles are predominantly rubber-tired.

These characteristics are obtained to varying degrees, consistent with the expenditure warranted by the volume of traffic, in a number of types of construction. At one end of the scale are the graded and drained earth roads which suffice to carry the traffic of the local roads and country by-ways. At the other are the expensive pavements of brick, concrete, and bituminous concrete which are required to support the heavy traffic of motor trucks and passenger automobiles which flows over the main highways. Between these limits traffic of intermediate density is served satisfactorily by surface-treated and bituminous macadam and the still less expensive surfaces of gravel and sand-clay or topsoil.

The paramount influence of the motor vehicle traffic upon the character of the highway construction is indicated by the relatively slight mileage of waterbound macadam type. Of the total of 128,347 miles of main roads which at the close of 1924 had been surfaced under the supervision of the State Highway departments, only 5,344 miles were improved with this type of surfacing. Formerly the standard type when traffic was largely horse-drawn and steel-tired, this historic method of road metalling is now found to be generally unsuitable because of its inability to resist the disintegrating action of the swift, pneumatic tired automobiles in the absence of a sufficient amount of steel-tired traffic to renew the supply of binding dust by abrasion.

That even in the case of the local roads on which the traffic is so infrequent as to justify only small expenditures for improvement, it is motor vehicle traffic which must be given primary consideration, evidenced by numerous efforts, some very promising, to develop cheap methods of rendering earth, sand-clay, topsoil and gravel roads relatively dustless

and mudless. For horse-drawn traffic of light volume untreated sand-clay, topsoil, and gravel roads, if well drained, and even the unsurfaced but drained earth roads would be entirely satisfactory.

Drainage would adequately prevent excessive softening of the surface and the formation of deep ruts, and for slow-moving, horse-drawn vehicles ordinary care and attention to the elementary principles of water removal and cheap surfacing would suffice to create a satisfactory surface condition. But more than this is required for motor vehicle traffic even when it is light. As the vehicles are wheel-driven it is essential not only to prevent the formation of deep mud but even to prevent the surface muddiness or slipperiness which reduces traction. And at the opposite extreme of weather condition, it is necessary to prevent the formation of dust.

To this end efforts have been made and practical methods have been developed in some cases to make the cheap roads suitable for motor vehicle traffic by surface treatment or admixture of bituminous materials, hydrated lime, Portland cement and other materials.

In the States of North Carolina and Massachusetts, and to a lesser degree in other sections of the country satisfactory results have been obtained by surfacing sandy roads with a course of the native sand mixed with asphalt in such a way as to produce a cheap approximation of a sheet asphalt surface.

In other sections, notably in the West and Middle West, the same need of accomodating light motor vehicle traffic has resulted in the development of oiled earth roads made by incorporating bituminous oils with the soil of the roadbed. The surface treatment of gravel roads with asphalt or tar is another expedient to the same end, as, also, are the experiments in the incorporation of Portland cement and hydrated lime. In reciting these instances, there is no intention to enter into a discussion of the methods of construction, but merely to develop the fact that motor traffic is the decisive factor in determining the character of even the most lightly traveled roads in the United States.

In recognition of the varying density of traffic the aim of American highway engineers is to develop a system of highways each part of which will be improved to a degree consistent with the traffic demands. In pursuing this object all types of construction, except the waterbound macadam type which will not resist motor vehicle traffic, have a proper field of usefulness. But the certainty of a rapid increase in traffic has been so thoroughly established that the cheaper and less durable forms are rarely built without making full provision for subsequent improvement in type by the use of the previous construction as a base.

This practice has crystallized into a well defined policy, known as the stage-construction principle, in accordance with which an unimproved road carrying, initially, a light traffic is improved in the first instance by grading and draining, and subsequently, as traffic grows by the addition, first, of a gravel or other cheap surface and, subsequently, by the superposition of a pavement to which the original cheap surface serves as a subbase. In each stage full provision is made for the requirements of the subsequent improvement. The grades and drainage structures originally constructed are designed to be adequate for, or readily convertible to the purposes of the ultimate improvement, which, also is contemplated and provided for in the initial surfacing.

In this way each stage in the improvement suffices to meet the demands of a growing traffic at several stages of the growth and each preliminary stage becomes the basis for the subsequent improvement. The cost of constructing and maintaining each stage, reduced to an annual basis and compared with the probable annual reduction in the operating cost of the motor vehicle traffic determines the economy and time of further improvement.

The progressive improvement contemplated by the stage-construction policy, however, relates principally to those characteristics of the road which are determined by the density or weight of the traffic. In those features which have a relation to the safety or the convenience of the traffic, whether light or heavy, even the cheaper forms of improvement, as constructed by the State highway departments, manifest the primary consideration which is given to motor vehicle traffic. Particularly is this consideration

evident in the care and attention given to the elimination of those inequalities of surface - to horse-drawn traffic inconsequential - which are likely to be a source of discomfort or danger to operators of motor vehicles.

Even the cheaper roads also are designed in width and grade and other features upon the assumption of motor vehicle traffic. Widths are predicated upon the space required for vehicles passing at automobile speed; grades are reduced, whenever practicable, to high-gear capacity; curves are super-elevated for motor vehicle speed and widened; sight obstructing foliage and other obstacles to view are removed at curves and highway intersections; danger and caution signs obviously intended primarily for the warning of motorists are erected at danger points, and railroad crossings are eliminated. These and other special features are obviously predicated in their intention and design upon the operation of motor vehicles rather than horse-drawn vehicles; and they are necessarily so designed because of the preponderance of the motor vehicle traffic, which on practically all roads is a majority, and on most roads is nearly the entire traffic. Because of this special attention that is given to the needs of motor traffic in the design of the ordinary highways and the practically negligible inconvenience of the slight intermixture of horse traffic, there is not the least demand for highways restricted to motor vehicle traffic only.

With one or two exceptions no such highways have ever been built or considered in the United States. The most conspicuous exception is the motor parkway on Long Island. Built in 1904 as the course for the first Vanderbilt Cup Race, this highway, 42½ miles in length has since been maintained by a private corporation as an exclusive motor road, the use of which is restricted to those who pay the company's tolls. This road was conceived and built at a time when the public roads were not adequate for motor travel and when the normal traffic consisted largely of vehicles drawn by horses that were still unaccustomed to motor vehicles. Under these conditions the road performed a useful service. It is still in active service and carries traffic safely at a maximum speed of 40 miles an hour over a course on which there are practically no cross roads.

But while the proportion and number of horse-drawn vehicles is so small that such vehicles no longer constitute a hindrance to the flow of motor traffic another problem is

emerging which promises to be more difficult of solution. This is the problem resulting from the intermixture of fast and slow-moving motor traffic. The most serious difficulty is presented by the slow-moving heavy motor truck, but the motorist whose conception of caution is extremely slow driving, is also a phase of the same problem.

Most of the main roads of the United States are two-way roads, eighteen or twenty feet wide. The passing of a slow-moving vehicle by a faster vehicle is easily possible on such roads and presents no difficulty until the traffic increases to the point where the frequency of vehicles proceeding in the opposite direction is so great as to cause the drivers of overtaking vehicles to hesitate to pass. When this condition obtains queues are rapidly formed headed by the slow-moving vehicle; and, as the difficulty and danger of passing becomes greater as the length of the queue increases, there is the tendency for the speed of all vehicles using the highway to be reduced to the speed of the slowest. In this way the number of vehicles which may safely pass over a highway in a unit of time may be reduced by half as pointed out by the highway commissioner of Connecticut.

This condition has already been reached on many of the important inter-city highways. How general it may become is still a matter of speculation. But the motor vehicle registration statistics provide cold comfort for those who are inclined to be optimistic. On December 31, 1934 the registered passenger cars numbered 15,460,649. At the same date there were 2,131,332 registered motor trucks; making a total of 17,591,981 vehicles of which the motor trucks constituted 13.8 per cent. But, whereas, for the four years preceding, the passenger cars have increased at the average annual rate of 16.5 per cent, the motor truck registration has grown at the average rate of 26 per cent a year. In the year ending December 31, 1924, the increase of trucks was 37.2 per cent.

Fortunately the majority of the trucks present no problem which is essentially different from the problem of the passenger car. Fully 90 per cent of them have a carrying capacity of less than two tons, and practically all of these are equipped with pneumatic tires and are capable of travel at average passenger-car speed. But the 10 per cent

of heavier vehicles, equipped in the main with solid rubber tires and built to operate at relatively slow speed, increase in practically the same ratio as the lighter trucks; and, although their numbers are not great, they are used principally on the main inter-city roads where the volume of other traffic is greatest, and where the presence of even a few slow-moving vehicles tends to cause congestion.

The questions raised by these heavy and slow-moving motor trucks, as indicated by my confreres, are of two principal classes. There is first the question of the economy of building highways capable of supporting their loads; and second the question of what is to be done to avoid the congestion resulting from their intermixture with other faster-moving traffic on the highways.

Omitting consideration of the cost of the highways the justification of their use in preference to freight vehicles of smaller capacity is that the cost of operation per ton-mile is reduced as the tonnage carried by a single vehicle is increased. If, therefore, there is assurance of a volume of freight to be transported which will enable the larger vehicle to be operated under full load, the vehicular cost of transportation is reduced by the use of the larger vehicle.

But the cost of the highway can not be omitted from the consideration. The heavier vehicles require heavier and more expensive roads to support them. Roughly, the additional highway expense may be estimated at \$10,000 a mile for construction in the United States; and if this expense is assumed and the road built adequately to support the heavier vehicle the cost of maintenance is not appreciably increased since, with rubber-tired vehicles, the surface wear is negligible.

Obviously, therefore, the economy of transporting highway freight in heavy trucks must be determined by the ability of the heavier vehicle to reduce the cost of operation by an amount per ton-mile which applied to the total ton-mileage of this character will more than compensate for the increased highway cost. With respect to any particular road this is determined by the number of heavy vehicles using the road. Estimating the annual operating saving which results from the transportation of commodities over any mile of road in heavy rather than light trucks it will be economical to permit the operation of the heavy vehicles and to assume the additional

highway expense only if the annual operating saving exceeds the annual interest and retirement charges on the additional expense.

Theoretically the saving of a sufficient amount of vehicular operating expense to compensate for the increased cost of highway service may be assumed to constitute a sufficient warrant for the construction of the more expensive highways whether or not the operators of the heavy vehicles are required to yield of their savings to the public treasury the full amount of the additional cost. For, theoretically, it may be assumed that the saving which redounds, initially, to the individual vehicle operator ultimately benefits the entire community.

On the basis of the heavier demand which they make upon the public treasury to provide highways suitable for their operations and their assumed superior ability to pay, the owners of heavy trucks in the United States are required to pay larger license fees for their vehicles than the owners of passenger cars and light trucks. The scale of fees in relation to the capacity of the trucks differs in the several States. For the country as a whole it is estimated that the trucks of 3 tons gross weight and over, pay license fees which, on the average, are 6 times as great as the fees paid by lighter trucks.

At the close of the year 1924 there were approximately 425,000 trucks of the heavier class which paid an average annual license fee of \$64.50 and 1,706,332 trucks of the lighter class which paid an average fee of \$10.24. If the excess of the larger over the smaller average fee be taken as the measure of the additional highway expense warranted for the accomodation of the heavier trucks, it follows that in 1924 the expenditure of \$23,000,000, would have been justified for the special purpose of making a certain mileage of highways suitable for heavy truck use. If the additional cost of providing for heavy truck traffic be taken at \$10,000 per mile and this cost be amortized at 5 per cent over a period of 20 years the license fees paid in 1924 by the heavy trucks in excess of the fees that would have been paid by the same number of light trucks would be sufficient to pay the annual extra charges on approximately 30,000 miles of highway. At the close of the year 1924 there were not more than 46,000 miles of highway in the United States which had been paved by the State highway departments and were adequate for the support of heavy trucks. It appears, therefore, that the excess of

license fees paid by the heavy trucks in the United States as a whole in 1924 was not sufficient to pay the extra cost of the highways which had been built for their accomodation.

The above disparity between expense and payment would be considerably reduced if, to the excess of license fees paid by the heavy trucks, there were added the gasoline taxes they pay in excess of those which would be paid by a like number of light trucks. But, considering all taxes paid by the heavy vehicles, there is no doubt that the total for the entire United States is still less than the amount which their reduced operating cost would enable them to pay without undue hardship. Of this there is ample evidence in the fact that in a number of States the owners of the heavy trucks willingly pay taxes greatly in excess of the average.

After a careful consideration of all the evidence, one is forced to the conclusion that conditions now obtain on many roads in the United States under which the operation of heavy motor trucks is truly economical, giving full weight to the greater cost of the highways. There is evidence, moreover, that the number of such roads will increase; and, on the contrary, no evidence at all that the operation of the heavy trucks will be voluntarily abandoned by their operators.

Recognizing these facts, and believing that the economical utilization of the existing improved highways demands an increase in the speed of vehicle operation which is prevented by the intermixture of heavy truck traffic, the highway commissioner of Connecticut suggests three possible solutions:

1. That the capacity of the trucks be limited to two tons in order that the trucks as well as the passenger cars may be required to conform to a minimum speed limit considerably higher than the prevailing average speed.
2. That truck operation be restricted to parts of the day when the passenger car traffic is at a minimum, and that the minimum speed limit be enforced at times when only passenger car traffic is permitted to move.
3. That special motor truck roads be built, or, as an alternate solution, that existing two-lane roads be widened to four lanes.

The first two of these suggestions he sets aside as restrictions of the free operation of freight-carrying vehicles in accordance with economic laws. The third he believes to be

the best solution, and to be feasible and economical. He limits its application, however, to those highways which have a peak load of at least 2,000 vehicles an hour or to those on which, because of the presence of many slow-moving vehicles, the speed of traffic is greatly reduced. Moreover, he would not advocate such a measure until all obstructions and bottle necks have been eliminated, until all improved roads in the immediate vicinity are receiving their full share of traffic, and until data are in hand which indicate the absolute necessity of the enlargement of highway facilities.

There can be no question of the soundness of this proposal. As may be judged from the fact that its application is suggested only for roads carrying more than 2,000 vehicles in the peak hour the conditions requiring such treatment are not yet general, although the continued rapid increase in truck and passenger car registration in all sections suggests that the problem may soon have to be dealt with in the vicinity of a number of cities.

At present, however, conditions may be said to have reached a critical stage in only three limited regions: The first adjacent to New York and between that city and Philadelphia, the third city in size in the Republic, which lies 90 miles south of the metropolis; the second between Chicago, the second city in order of population and the city of Detroit, the center of the motor vehicle industry; and the third between Los Angeles and San Francisco in California.

The 36-foot highway now under construction between New York and New Haven, Connecticut embodies the principles defined in the report of the highway commissioner of Connecticut. Designed to relieve congestion on the existing Boston Post Road in the section west of New Haven it will provide four traffic lanes, the two outer ones being reserved for slow-moving traffic and the inner ones for fast moving vehicles. Every effort is being made to do away with dangerous turns and crossings wherever possible.

The plan of the 13-mile highway between the vehicular-tunnel entrance to New York and the neighboring cities of Jersey City, Newark, and Elizabeth is described in the report of the State highway engineer of New Jersey under whose supervision it is being constructed. This is the first section of

what will in all probability be similarly designed highway, 90 miles in length, between New York and Philadelphia.

The so called super highway plans of Wayne County, Michigan, in which the city of Detroit is located, are but the beginning of the improvement which eventually will extend from that city to Chicago to be constructed by extension outward from each city as the need becomes imperative. The Detroit plans include provisions for the building of radial and circular belt line highways within a 15-mile radius of the city hall. The main belt line highways will intersect the radial highways at intervals of three miles. Each class will have a right-of-way width of 204 feet. At one-mile intervals between the main belt lines there will be secondary belts built on a right-of-way of 120 feet; and at the half mile intervals a third class of belt highway with a right-of-way of 86 feet will be built.

On the main radial and belt-line-highways there will be a center strip 86 feet wide reserved for rapid transit rail facilities, on each side of which there will be a 20-foot high-speed highway for traffic moving in one direction only. Outside of these express roadways there will be a five-foot planting or safety zone, then a 20-foot roadway for motor parking and local traffic, and then on each side a 15-foot sidewalk area.

At intersections of the 204-foot super highways there will be three levels. The local traffic will be carried at the same elevation as the adjacent property. One super highway will be elevated to the necessary height above the local intersection, the other will be depressed. At no point will there be interference with high-speed traffic at intersections; but at suitable intervals there will be entrances from the local roadways to the express highways which will permit a vehicle to leave the local or slow-speed roadway and merge with the high-speed traffic without danger or inconvenience.

The California condition differs somewhat from those previously referred to in that the congestion results to a greater degree from a very great density of motor vehicle ownership in the State as a whole rather than from the activity in the vicinity of cities. Already in this State there is one motor vehicle for every 3 inhabitants. Coupled with this condition there is an advanced development of

inter-city passenger bus transportation, especially between Los Angeles and San Francisco, and a heavy tourist traffic between the same cities. Congestion in this case results chiefly from the intermixture of the heavy through traffic which moves at high speed and a dense slower-moving, local traffic.

The California plans, therefore, although still in the formative stage, will be designed to separate the through and local traffic. One suggestion, which has received considerable support, contemplates the acquisition of a 100-foot right of way between Los Angeles and San Francisco as nearly as possible free of curvature. The central 30 feet would be devoted to the through motorway on which speed as high as 50 miles an hour will be permitted.

All local traffic will be barred from this trunk-line motor way, and will be cared for on two other highways, one on each side of the main line, each 20 feet wide, separated by a 15-foot parkway from the central way, and each carrying one-way traffic only. Cross roads will be carried under or over the motorway. Traffic desiring to turn from such cross roads in the direction of the through highway will be admitted to the local highways, but at the points of such connection there will be no access to or egress from the motor way. Motorists coming into the paralleling local-traffic highways will be compelled to drive several miles on them until they come to one of the regular sidings at which traffic will be enabled to get on and off the high-speed motor way. At these sidings the motor way will be widened to 50 feet, the added space being taken from the 15-foot parkways. Motorists desiring to enter the motor way at these points will be required to increase speed on the siding to the minimum which will be permitted on the through road - not less than 30 miles an hour. Those desiring to leave the motor way will, on the same sidings, reduce speed to the normal State limits. Left-hand turns on entering or leaving the motor way will not be permitted.

In cities the motor way will be fenced and access to or exit from it will not be permitted. Motor busses and freight trucks will stop at stations in the larger cities to take on passengers and freight, but motorists will not be allowed to drive onto the motor way within the city limits. Such motorists will be compelled to follow the parallel local-

traffic highways until they reach the nearest siding outside the city. Similarly traffic on the motor way bound for an intermediate town will have to leave the high-speed artery at the point of exit nearest to the town.

While it is recognized that curves can not be entirely eliminated the trunk line as proposed will be nearly straight, and unavoidable curves will be long, wider than the straight sections, and banked heavily so as to permit travel at undiminished speed.

Those are so far the only situations in which a condition of constant congestion must be dealt with. A similar condition occurs on many other main roads on Saturday and Sunday during the summer. This condition, however, is due neither to the presence of large numbers of trucks nor to a mixture of heavy long-distance and local traffic. It fortunately occurs at a time when truck traffic is at a minimum, and is due mainly to the efflux from the cities of motorists seeking recreation and pleasure. Congestion results under these circumstances principally from the slow driving of those who mistake slow speed for caution, and can be eliminated by the enforcement of suitable minimum speed regulations on the peak days only.

To all highway congestion in the vicinity of the cities, whatever the principal cause, this habit of driving for pleasure is a contributing factor. Such use of the motor vehicle, which is due mainly to its novelty, may be expected to be self-limiting. The more experienced motorists use their cars in this way far less than those who have only recently acquired them. As congestion increases, with its attendant delays and annoyances, and as the novelty appeal of driving wears off, such use of the motor vehicles may be expected to decline. The decline may be hastened, perhaps, by encouraging those in search of pleasure and recreation to find it at State-controlled bathing beaches, golf courses, tennis courts and parks located at suitable points within easy reach of the cities rather than in driving on the main highways. Such a plan is now under consideration by the State Roads Commission of Maryland for the relief of peak congestion on the main roads near the city of Baltimore.

The only other condition which thus far has seemed to require special treatment is the intermixture of through highway traffic with street traffic in the cities along the route. In most instances the main State roads now enter the cities and through traffic must, perforce, pass through the city streets to reach the continuation of the highway at the opposite side of the city. This situation has already become intolerable in a number of places, not only because of the further congestion of the already over-crowded city streets but also because of the difficulty which strangers experience in finding their way to the proper highway exit. The remedy in this case is being found in the construction of belt-line or by pass highways encircling the cities.