are convinced that this phase of the question is important and worth all of the interest on the bonds In Missouri this interest item will be $2 80 a car a year, for the thirty-five year period before the last of the bonds are retired.

THE PAY-AS-YOU-GO PLAN OF HIGHWAY FINANCING[1]

J T DONAGHEY

Whether highway finances are provided by direct property tax, the sale of bonds, or from motor vehicle revenues, the funds made available should be expended with but one thought in mind—that of furnishing the greatest degree of highway service to the motoring public.

Highway service should include not alone the construction of a limited system of primary roads with a so-called high type surface, but must take into consideration the traffic needs of the entire state. Such traffic needs should be carefully diagnosed well in advance of formulating any plan of highway financing

The various resources of the state must be thoroughly analyzed before deciding upon the fairest and most economical plan for highway financing

No plan will be thoroughly successful and satisfactory that does not include, in a fair measure, the needs of both local and inter-city traffic It must be remembered that the smaller cities and the villages, especially in agricultural states, have been built up largely through the support of the local people These people patronize the stores, theatres, garages, and other places of business in such towns three hundred and sixty-five days in the year, and must be considered in any fair plan of highway improvement

The people who contribute most to building up a community or a state are not the motor gypsies who roam from state to state, but the home people who have given so generously of their brain and energy year after year to help build up the community, and it is these people who should receive first consideration when planning increased highway service

Nearly every family now owns one or more motor vehicles and they naturally desire reasonable highway service The large majority of owners are willing to pay their fair share of the necessary cost, providing the roads that best serve their needs are included in a plan financed with their money. There is no longer any argument as to who must foot the

[1] This paper was arranged for by the Committee on Highway Finance in order to stimulate discussion of this important topic The opinions and conclusions are those of the author, and have not been endorsed by the committee

bill for highway improvement It has become a well established policy in all states that the majority of highway funds shall be provided by those who use the roads, either in the form of license fees or a tax on motor fuel There are two principal reasons why this method of financing highway improvements has become so popular First, it is only fair that those who use and thereby destroy the road surfaces should pay the bill, and second, it is the most painless method of securing large sums of money for highway improvement

The subject assigned me to discuss is the pay-as-you-go plan of highway financing I throughly believe in this policy and will explain the principal reasons why I believe in it

First, the pay-as-you-go plan prevents waste through unnecessary and extravagant expenditures, which too often occur when large sums of money are made available by the authorization of bonds for public improvements

Second, the pay-as-you-go plan as compared to serial bonds, retired from one to twenty years after sale in twenty equal installments, will provide 47 per cent more miles of road with the same amount of money at like cost per mile

Third, it is not sound business policy to bond for pavements that cannot be expected to serve traffic well beyond the end of the bonding period without resurfacing

Each year brings new traffic problems and there will undoubtedly be as much or more demand for further highway service ten years hence as we find today Present conditions in my own state, Wisconsin, are a fair example of what may be expected in other states We have about 2800 miles of concrete and 200 miles of other high type surfaces—the latter mostly bituminous macadam At present day prices these 3000 miles of so-called high type road would cost more than $100,000,000 Wisconsin also has 30,000 miles of good gravel surfaces that would cost at least another $100,000,000 Our total road mileage is nearly 80,000 Therefore over 40 per cent of Wisconsin's rural highways are surfaced with materials that will at least keep traffic out of the mud and of which 3000 miles are modern pavements Even with this extensive highway service rendered throughout the whole state, there is an apparent demand for another $100,000,000 to build an additional 3000 miles of hard surfaced roads

There is a question in the minds of many whether this demand is coming from the real users of the roads who pay the highway service bill, or from those interests that will benefit financially by the expenditure of additional millions If such demand is from the motor vehicle owners and they are convinced that the roads they use daily, both local and intercity, will be improved, then the plan will win On the other hand, if this apparent demand is promoted mainly by those interests that will gain financially by such expenditures, the plan will fail

In discussing the first reason in favor of the pay-as-you-go plan we find a growing tendency towards extravagant ideas when large sums of money are at the disposal of highway officials Too often we see old surfaces removed at a large expense that would provide a substantial foundation or base for a new wearing surface With $100,000,000 or more at the disposal of those in charge of highway expenditures, there is a tendency to think in large terms and when an improvement is contemplated it is easy for the engineer to believe it economy to tear out the old surface and build the last word in pavement, even though the old surface would make a suitable foundation for a new wearing surface that could be constructed for one-half the cost and which would give equal highway service

Few people realize the annual cost of owning a modern pavement If they did there would be less enthusiasm over large bond issues for new pavements There appear frequent articles in highway publications by reputable engineers and economists showing how the excessive maintenance costs of low type surfaces make it necessary to replace them with modern pavements Invariably they omit the one most important item in their calculations—that of the annual depreciation of the new pavement A modern rural highway will cost about $35,000 per mile in the average state, and the 20-foot pavement or slab alone costs about $25,000 per mile Where traffic is heavy enough to warrant the construction of a modern pavement, the most optimistic will not place the life of such pavement or slab at more than twenty-five years Assuming that a twenty-five year life is approximately correct, the annual depreciation of the surface will be $1000 per mile The annual interest charges are not less than $1500 per mile, and the maintenance cost over a twenty-five year period will be another $500 per mile per year, resulting in a total annual cost to the public of $3000 for owning a modern highway

Under the pay-as-you-go plan the officials will of necessity make the funds available provide as great an amount of highway service as possible Old surfaces are utilized wherever possible as a base for new wearing surfaces, thereby giving twice the highway service with the funds expended If it costs $3000 per mile annually to own a modern pavement, the officials are justified in expending an amount well within such sum for the maintenance of the old surface each year if, by so doing, satisfactory highway service is rendered

The second reason for favoring the pay-as-you-go plan is the fact that nearly 50 per cent more miles of pavement can be built over a twenty year period with a given sum of money than can be secured under a twenty year bonding plan

At $35,000 per mile, $100,000,000 will build about 2800 miles of pavement To retire $100,000,000 in $4\frac{1}{2}$ per cent serial bonds within a twenty year period, one twentieth each year, will require a total of $147,250,000 or in other words, the total interest charges will be $47,250,000 This enormous sum will build 1350 additional miles of pavement at the same cost per mile

No state can plan and expend $100,000,000 in one year The shortest time that can be reasonably expected is five years, and in all probability it will take seven years before the funds are all expended It takes time to make the necessary surveys and plans and iron out all the difficulties encountered in a large highway program Spread over a seven year period the average per year would be 400 miles A reasonably steady mileage per year is better for everyone concerned—the highway department, the public, contractors, material dealers and transportation companies Too large an annual mileage of construction attracts "hay-wire" contractors, taxes the capacity of material delivery, and undoubtedly costs more per mile than where a uniform mileage is built year after year

The average state now has a registration of from 500,000 to 600,000 motor vehicles The registrations show an increase of from 5 per cent to 15 per cent over each previous year I am assuming that a state requires additional funds in the amount of $100,000,000 to furnish necessary highway service for a future period of years Starting with a registration of 600,000 and assuming again that the registration will increase only 5 per cent over each previous year, a revenue of but $20 00 per car each year for a seven year period is all that would be required to produce the $100,000,000 If the pay-as-you-go plan is adopted, the state can build and fully pay for the 2800 miles of pavement within a seven year period. Future revenues can then be used to furnish further highway service which we know will be demanded and necessary

A hundred million dollars is a tidy sum of money to be responsible for Those in charge of its expenditure have a grave responsibility They naturally desire to give the state a dollar's worth of highway service for every dollar expended In the majority of states, many miles of different types of surfacing now exist on the principal routes Serious consideration must be given these roads before entirely discarding them and losing to the state the investment in such surfaces Every state has adopted some form of primary or state trunk system that probably serves the interests of the greatest number of people within such state, and which is maintained in whole or in part with state funds

I believe that where there is a necessity for and a demand from the motor vehicle owners for an appreciable increase in highway service, those who are responsible to the people for the expenditure of highway funds should make a careful study of the entire situation and determine the amount of funds required and the manner in which such funds, when available, should be expended

First Every state highway department has certain expenditures which include general administration, traffic direction and regulation, traffic studies and other overhead costs which we will assume constitute item number one

Second Determine the number of miles of such system that can be maintained in a manner that will serve traffic reasonably well for the next five years or more, at a cost well within the annual cost of owning a modern pavement As before stated, I maintain that such cost is not less than $3000 per mile The total of this estimated maintenance cost plus the estimated cost of maintaining the new pavements built each year is item number two

Third Determine the number of miles of present surfaces on such system that cannot be maintained within the annual cost of owning a new pavement but that are suitable to provide a substantial base or foundation for a new wearing surface Generally, where such conditions prevail a satisfactory new wearing surface can be provided at about one-half the cost of a new pavement The estimated cost of such resurfacing is item number three

Fourth Determine the minimum number of miles of new pavement required on such system within a ten year period, the type best suited to traffic, soil and material conditions and the estimated cost thereof Include the cost of widening and removing bottlenecks near large cities The total of this estimate is item number four

Fifth Determine the drainage structures whose replacement is imperative within a ten year period, also the grade separations that should be made and the estimated cost of both This is item number five

Sixth Determine the local highway service that should be supplied during the same period in addition to that provided through the improvements on the primary system This will be item number six

The total of these six items is the minimum that the state should expend for highway service during the next ten years Estimate the average annual registration for this period, and then determine the amount each vehicle must bear to meet the annual bill for adequate highway service over this period of years

When motor vehicle owners are satisfied that their individual needs are being considered and that the particular roads in which they are interested will receive their fair share of highway service, they will urge their lawmakers to enact laws that will make reasonably adequate highway service possible, knowing full well that it is better to pay a *good road tax* than a *bad road tax* and better yet, to *pay-as-you-go*

The great majority of municipalities are heavily bonded,—many of them to the legal limit or nearly so. In those latter cases the imperative improvements must be financed on the pay-as-you-go plan by a direct property tax

Until five years ago Milwaukee, a city of 700,000 population, financed their major improvements by long term bonds About this time the city officials found they were fast approaching their bonding limit A new plan was inaugurated by the present administration whereby all new improvements are financed practically on a pay-as-you-go plan, and in addition to financing the new improvements enough funds are set aside annually to retire all outstanding bonds within a thirty year period

It is true their taxes are higher under this plan but they will be less in the long run than if the old method were followed Many municipalities have arrived at the same conclusion and are taking steps to stop the bonding craze by the inauguration of a pay-as-you-go plan of financing necessary public improvements

One outstanding feature that is always in evidence where the pay-as-you-go plan of highway financing is in operation is that the inter-city roads are considered the most important, the principal local market roads second, and but little thought is given to the so-called through routes Any state that has its main centers of population connected with roads that furnish adequate highway service for the people of such centers, certainly has an adequate system of through or inter-state roads

The percentage of through or inter-state traffic on the heaviest traveled roads in the country is lower than is generally supposed. The recent traffic surveys in Ohio and other states prove this to be true The Ohio report shows that the Cleveland-Toledo-Detroit road, which carries the heaviest and most destructive traffic of any road in the state, has but 22 per cent of inter-state traffic and that the inter-city traffic is much more destructive to the road surface than is the through or inter-state traffic The same report shows that the National Pike (U. S Route 40) carries but 18 per cent of inter-state traffic In this instance nearly all the inter-state traffic is light or comparatively non-destructive

The several intensive traffic studies recently made prove beyond a doubt that the big problem is to provide inter-city highway service If this form of traffic is adequately served the inter-state traffic is automatically well served The inter-city and local road users are with us always, while the inter-state travelers may use the road but one a year or less

A few years ago I stopped off at a logging station in northern Wisconsin to meet a farmer who had a local road problem on which he desired advice There was no hotel within many miles and the farmer invited me to take dinner with his family Upon arrival at the farm it was evident that the good wife was somewhat fussed However, she prepared a very good and wholesome meal As we sat down at the dinner table the good wife apologized for the meal The husband immediately took her to task and this was his line of reasoning—"Mother, don't apologize I have to eat this stuff three times a day for three hundred and sixty-five days in the year It hasn't killed me yet and I guess this fellow can stand it for one meal " The moral is that if the inter-city roads furnish adequate highway service for the inter-city and local motorists three hundred and sixty-five days in the year, they are good enough to serve the small percentage of inter-state motorists who use them occasionally There is entirely too much ado about through travel and through routes If highway expenditures are planned to conserve the investment we now have in highways in each state, and to furnish reasonable highway service to the motorists on the roads they use daily from city to city and from farm to market, we will soon have a well served and well satisfied motor public who will be willing to pay the bill foı adequate highway service on the modern pay-as-you-go plan

DISCUSSION

ON

METHODS FOR FINANCING HIGHWAY SYSTEMS

PROFESSOR T R AGG *Iowa State College*· There are a number of States that have proceeded along the bond issue method, and a number of States that follow the pay-as-you-go plan I want to emphasize this point It should be possible with proper study of road improvement in those respective States to decide whether all of those who proceeded on the bond plan can be upheld on a basis of things that have happened in the States where it has been applied I believe that facts can be obtained from some of the States that will have some bearing upon this problem and that will assist a State that is considering bonding to determine whether it should accept that scheme or not I think there are two sides to the question and that there are some States that should not consider bond issues I am equally convinced that there are other States that will never get themselves out of the rut until they do adopt the bond issue method Incidentally I believe that the pay-as-you-go plan is a misnomer The scheme that we term the pay-as-you-go plan is not a pay-as-you-go plan, but a pay-BEFORE-you-go plan, and the only true pay-AS-you-go plan is the bond plan

Attention should be directed to the fact that Mr Donaghey in this paper disregards entirely the effect of road improvement on vehicle operating costs, and his whole argument falls down when that is added In Bulletin 91 on "Operating Cost Statistics of Automobiles and Trucks" the Engineering Experient Station of the Iowa State College reports that the saving in cost to the car user by running on a high type paved road instead of intermediate type roads such as surface treated gravel or macadam amounts to 0 99 cents per mile On a road having a traffic of 500 cars per day, this saving to the car users would amount to $1804 per mile per year In considering the improvement of a given road if this sum was found to be greater than the additional yearly cost of the higher type road, taking into account maintenance cost, interest on investment and salvage value at the end of the economic life of the surface, it would be found to be sound economics to change to the paved surface For middle western conditions a pavement would cost from $500 to $1000 more per year than the intermediate type surface, but since the saving to the car users by reason of the change would amount to $1804, the improvement would be amply justified On the other hand under traffic conditions so light that the vehicle saving would not be so great as the difference in road cost it would not pay to make the change For a more extensive discussion on this point reference is made to the report of the Committee on Economic Theory of Highway Improvement in the Fourth Annual Proceedings of the Highway Research Board

MR B E GRAY, *State Road Commission of West Virginia:* The two papers presented show diametrically opposite views, the reason being that most of us look at our particular State as the criterion I think that the bond issue plan and the pay-as-you-go plan are supplemental to one another and not competitive The pay-as-you-go plan assumes that you have some sort of a highway system already in existence from which revenues may be obtained However, in a state where there are no through connections completed, the annual construction of short mileages between centers of populations does not bring any marked increase in revenues, because the unimproved gaps limit the traffic flow Under such conditions, it is desirable to have a bond issue, thereby making available immediately, funds in sufficient amount to permit early completion of through routes After such roads have been built, traffic increases rapidly, greater revenues are obtained, lower maintenance costs are had because of higher type surfaces, until the point is reached where additional bond issues do not produce proportionally greater revenues When this condition obtains, the pay-as-you-go plan is in order

MR E M FLEMING, *Portland Cement Association:* I spent some time with the Illinois Highway Department during the time they were spending large sums of money building concrete roads across the prairies of Illinois To me at times it seemed as if we were putting concrete in places where the traffic might not justify it for some years, but I have thought also that in parts of Illinois there are practically no road building material Gravel or crushed stone for macadam or gravel roads would have to be shipped long distances, and probably it was cheaper and more satisfactory to the State at large or the largest part of the State to build concrete than it was to build low type roads Illinois had nothing to start on Wisconsin and Indiana having gravel could afford to start with gravel roads I lived in Iindiana a year and three quarters, and traveled over a good bit of that State which has been famous for its gravel roads It occurred to me that where they are committed to the pay-as-you-go plan that this is all right if they go fast enough I think it boils down to the fact that the best plan depends upon the conditions in the State It may be all right for Wisconsin and Indiana to pay as they go, but certainly in Illinois the bond issue system is the best