

five inches of concrete and reinforce it with small steel members closely spaced. I believe in the use of transverse joints at less than 30 foot intervals. These should be carefully dowelled. I also believe that a center joint is necessary, with adequate design for the transfer of load across the joint. While these joints add to the initial cost, they reduce the maintenance and repair bills. Therefore, it will be well to use them.

It is not the purpose of the paper to talk of details of construction, and I shall leave you here with the new rug on the old floor, and with the bills for it hanging over your heads.

## WIDENING AND REPAVING OR RESURFACING STATE HIGHWAY ROUTES THROUGH CITIES

By John W. Wheeler, Member, Indiana State Highway Commission, Indianapolis

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In the conception of the law creating a state highway commission, we had in mind expediting travel between centers of population, such as county seats and neighboring cities of the larger class. We wanted to go, for instance, from Logansport to Delphi. We did not see that in these short fifteen years our highway system would become the main transportation system of Indiana, and, linked up with similar roads in other states, would provide the principal transportation system of the nation.

A few years ago when we in Lake County wanted to come to Indianapolis, we boarded a train to make the trip. Of late, however, we think only of driving, and after riding along over smooth pavement for miles and miles, we wonder why we should bump through Lebanon. The original law did not permit the state highway commission to make improvements in cities of over 2,500 population. Later this was raised to 3,500. Last year, when the law was again rewritten and enacted, it was considered making it possible to go through all cities on state highway routes, but because the special session of the 1932 legislature had taken half of the money from the highway commission, it was felt that the commission should not take over additional mileage with this handicap. So, as far as the statute of the state is concerned, the commission is unable to make improvements in cities of over 3,500 population.

With the enactment of the National Reconstruction Act, \$400,000,000 was set aside and given to the Bureau of Public Roads to be spent by the state highway commissions, as its agents, under the following regulations: At least 25% had to be spent on the federal system of highway routes outside of the cities. At least 25% had to be spent on the routes of state highways through the cities and on the federal system.

As much as 25% could be spent on feeder roads, which did not necessarily have to be on either the federal or the state system.

We saw an opportunity here to do something for the cities which all along had received the small end of the benefits of the state highway commission. Instead of stopping at the minimum of 25%, we chose to spend 48%, totalling in round numbers \$4,800,000 in the cities. Since there was no provision in the statute for going into cities, you can readily realize that we were handicapped in not having one scratch of a pen in the shape of surveys or plans for city work. We chose to go into 60 cities with 140 projects, each necessitating surveys, plans, and estimates. This has taken time and we have been roundly criticised by the authorities in Washington for being slow; however, we feel that our decision was just, and that much more benefit will come from the money expended by following the method that we have chosen.

It appears at this time that C.W.A. work will keep the unemployed busy until early spring at least, and by that time, we should have the major portion of our N.R.A. money under contract.

When this federal law, which permitted us to go into the cities, was enacted, a hurried survey was made by the commissioners themselves, accompanied by their engineers, and the above number of projects was selected as being the most worthy. We endeavored to divide up the benefits among as many cities as possible and to cover the state as evenly as possible geographically. After conferring with the Bureau of Public Roads, we decided that city streets on the federal routes, which apparently had a good base under them, should be resurfaced, and that those which did not have a good base under them should be torn out and reconstructed with modern pavement. If the curb was inadequate or badly broken, we decided to build new curb.

#### STREET RAILWAY DIFFICULTIES

As these survey notes came in from the various city projects, our troubles began to multiply. The greatest obstacle that the state highway commission encountered in trying to improve city streets was the existence of city street railways. We told the railway companies that, if they would rehabilitate their tracks and properties, we were confident that the Bureau of Public Roads would be willing that we pave the surface. In practically every case, the railway company plead no funds, so that part of the project was thereby halted. It will be very difficult for the state highway commission to turn out good paving or resurfacing work within the cities where street railway properties cannot be rehabilitated at this time. We will merely have to make our improvement up to the end of the tie and leave the dilapidated street railway in its present condi-

tion. This will have, as you can readily realize, a very sad effect on the appearance of the work that we plan to do.

Another great difficulty is to devise a proper resurface material which can be applied thin enough to resurface an old brick street, for instance, and join up with a street car track. We will take the case of a street car track that is in operation, and in so far as the railway is concerned, is satisfactory. The top of the rail is now approximately level with the top of the old worn brick pavement that joins it. How to put a proper resurface on this brick pavement, and still meet the top of the rail, is a problem causing us a great deal of trouble. If we feather-edge the resurface material, it will break away in the thinner section and leave a bad appearance. If we raise the brick header from the rail over to the end of the tie so that it will be possible to put a two-inch resurface up against this header, we have then depressed our railway track below the surface of the new pavement and formed a gutter in the middle of the street, down which water will have to run to an intersection, or perhaps until the street railway turns and allows the water to follow the rail on to a side street. Either one of these methods will prove unsatisfactory. Where the street railway is in a position to raise its tracks the needed amount, the whole program will be materially helped.

In other cases, we find projects where it will be necessary to construct storm sewers so that our new street or our resurfaced street can be drained. This runs into big money. Every time that we have to build one of these sewers out of the estimate that we had originally made for the street, it is bound to shorten the pavement project. We must remember then that when this \$4,800,000 is gone, there is no way to add to it under our statute, and unless the Bureau of Public Roads grants more money for city improvement, this improvement will have to be final until such time as our legislature puts the state highway routes through the cities into the state highway system.

#### PAVEMENT TYPES

We might discuss what kind of streets and what kind of resurfacing the cities will probably receive. As I mentioned before, wherever the base is adequate but the surface is rough, resurface has been recommended. An average thickness would be  $2\frac{1}{2}$  inches. This will probably consist of hot or cold binder with a wearing surface of either hot- or cold-mix asphalt or rock asphalt. A great drive has been made by the patented pavement manufacturers, and under the federal regulations, I believe, it is possible to specify patented pavements under their trade names as alternates to the above-mentioned resurfacing materials. This may or may not be done, depending on the decision of the highway commission. Where a project for new construction is endorsed by the

Bureau of Public Roads, it will probably be built out of concrete, because all of these projects are on state highway routes through cities where the amount of traffic is heavy; and from our experience over a term of years, when alternate types of new pavement are called for, we have found cement concrete pavement to be the lowest priced. This price might, however, change to such an extent that some other material would be low.

We now find that the \$4,800,000 that we have allotted to city projects will only scratch the surface of the needed street improvements on the routes of the federal system through the cities of Indiana. But with this start, we wish to give the people an example of the kind of work the state highway commission could build in the cities if these city streets were a part of the highway system. We hope that the nature of our work will be such as to invite a sound discussion as to whether or not the next session of the legislature should or should not take these city routes into the state highway system.

#### ALLOCATION OF MOTOR VEHICLE REVENUES

Here at the Purdue Road School it seems to me is a very proper place to discuss the revenue of the state highway commission. Prior to the special session of 1932, the state highway commission received 75% of the revenue from the gas tax, and all of the motor vehicle tax. At that session, half of the total gas tax and half of the total motor vehicle tax were allotted to the counties, cities, and towns. When a revenue is cut directly in two, any executive must become at least mildly apprehensive of taking on additional expense, and that is the reason that the law enacted at the regular session of the 1933 legislature did not place the city streets in the state highway system.

The question that confronts us now is: "Who is to carry on and finish the highway system?" If it be the counties, cities, and towns, all well and good, and the division should remain as it is; but if the people feel that the state highway commission should improve and maintain these routes through the cities, then it will be necessary that part of this money, at least, be returned to the highway commission. As revenues now stand, the highway commission can construct a limited mileage each year in filling gaps, widening existing pavements that are overloaded, and maintaining the entire system in as good or better condition than ever before. But that is all, and if more mileage outside the cities and the routes of state highways through the cities should be added, additional revenue must come to the highway commission.

I wish to quote a recent editorial, written by Professor Ben H. Petty, expressing his opinion of the future development of Indiana highways. The article reads as follows:

*“Future of Roads in Indiana?—*The Editor believes it would be good policy for the State Highway Commission to double or treble its present road mileage within the next ten years, arriving at a maximum of about 25,000 miles. This could be done at the rate of, say, 1,500 miles per year with a proportionate additional allocation of gasoline tax and license fees to the State Highway Commission for the necessary improvement and maintenance of this mileage. This *gradual* absorption of the more heavily travelled county roads, on which much of the county maintenance money is expended, would not interfere with the efficient functioning of the State Highway Commission. We believe that all roads in the State of Indiana, on which traffic justifies a surface better than an ordinary untreated gravel or stone surface, belong in the state highway system. The remaining 52,000 miles of county roads would be largely local farm roads and should be maintained by county road authorities.”

These last two suggestions that I have placed before you—namely, the inclusion of the city streets in the state highway system, and Professor Petty’s viewpoints on enlarging the state highway system—are purely matters for the electorate of Indiana to decide, and I leave them with you for discussion.

## DESIGN AND CONSTRUCTION OF CEMENT-BOUND MACADAM PAVEMENTS

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My knowledge of cement-bound macadam pavements is limited to one job of actual construction and to considerable study of theory and methods. When it was decided to build a cement-bound macadam road at Fort Sheridan, it was necessary for the officers charged with this work to study the methods of construction. I can not pose as an expert on the theory of this type of construction. However, from the practical viewpoint, I believe I can now build this type of road so that it will pass any state highway inspector. I say this because, through the school of bitter experience, I learned about all the errors of constructing cement-bound macadam roads. So, through the errors committed on the Fort Sheridan road, I feel that I can come before you gentlemen and tell you how to construct this revived type of cement-bound macadam.

You will note that I have used the expression “revived type.” In order to explain that expression, I must go back a few years and delve into the history of cement-bound macadam to see just when and where the first-known section of this type of road was constructed.