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**SUMMARY REPORT ON STATE
HIGHWAY NEEDS IN INDIANA**

JULY, 1957

NO. 20

by

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**Joint
Highway
Research
Project**

PURDUE UNIVERSITY
LAFAYETTE INDIANA

Technical Paper

"Summary Report on State Highway
Needs in Indiana

TO: K. B. Woods, Director
Joint Highway Research Project

July 24, 1957

FROM: H. L. Michael, Assistant Director

File 3-3-20
Project C-36-54T

Attached is a technical paper entitled "Summary Report on State Highway Needs in Indiana" by D. O. Covault, H. L. Michael, and A. K. Branham of our staff. This paper was presented at the 43rd Annual Purdue Road School in April and has been submitted for publication in the Proceedings of that meeting.

This report is a summary of the needs of the state, county, and city highway and street systems as found from the State Highway Needs Study that has been in progress for the past two years. The final report on this project is now in preparation and will be ready for submission to the Board in a few months.

The report is presented for the record.

Respectfully submitted,

Harold L. Michael

Harold L. Michael, Assistant Director

HLM:bjk

Attachment

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"Summary Report on State Highway
Needs in Indiana"

by

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Joint Highway Research Project
Project C-36-54T
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Purdue University
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needs which cannot be evaluated directly in terms of money were investigated. The study found that the critical shortage of engineers and technicians in the State Highway Department of Indiana can be relieved by the development and use of more efficient equipment and through new techniques and procedures. Among them, the use of photogrammetry and electronic computers is typical. The inadequate information about county highways indicates that county highway administration urgently needs revision to meet current requirements for highway development. More efficient utilization of city streets through effective traffic engineering techniques and other operational procedures was also investigated. The final report will emphasize that everyone should have direct and immediate concern with highway safety because accidents are reducing the productive capacity of the nation and of each community. In addition, accidents add considerably to the cost of highway transportation.

Highway Needs

The highway needs problem in Indiana encompasses a complicated network of 98,000 miles of roads and streets. A mosaic of all rural roads and principal streets of Indiana is presented in Figure 1. These highways are used daily by nearly all of the 1.8 million vehicles registered of Indiana while out-of-state travelers also make heavy demands on them. These highways as a network are indispensable to Indiana's expanding economy.

In order to evaluate the needs of the highway systems, an engineering appraisal was made. Early in 1955 a complete inventory of the physical needs was made of those highways administered by the state and data from these facts served as the basis for evaluating the detailed needs on this

INDIANA'S HIGHWAY PROBLEM

FIGURE 1

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system. Figure 2 briefly shows some of the information compiled for each road section, each bridge, and each railroad crossing on the state administered system and examples of IBM cards on which the information was placed.

Time, financial, and staff limitations made it impossible, however, to inventory each mile of the 87,000 miles of county roads and city streets. Furthermore, the available records of construction and plans for county road and city street improvements were found to be inadequate. Data from two Indiana counties, as a sample of county conditions in Indiana, and a study of county road needs in adjoining states, as reported in their needs studies, provided the basis for the estimate of county highway needs in Indiana. The city street needs were determined by evaluating the network of streets in representative cities of each population class. An estimate of the cost of rebuilding or improving the streets to adequate standards was determined from various engineering studies of several cities of Indiana and from highway needs studies performed in adjacent or nearby states. Although the county road and city street needs are based on data which are not as objective as that for the State Highway System, the needs are based on the best available information and are assumed to be realistic and adequate.

FIGURE 2

A complete, mile-by-mile inventory of state bigway needs

Accident rate (per 100 million vehicle miles)	Capacity (per 100 million vehicle miles)	1955 traffic (vehicles per day)	Soil type	Surface type	Surface flexible pavement	Surface thickness (inches)	Total thick- ness of base (inches)	Year of major construction	Year of surface construction	Surface condition	Shoulder width (feet)	Curve	Grade	Right- of-way (feet)	Topography	Type of construction	Bridge number	Type of structure	Use as service	Class (feet)
261	2100	7000	Clayey loam	Concrete	Rigid	6.0	0.0	1937	1937	Good	11	Convex curves	3-6%	100	Hilly	Reconstruction 4-lane divided highway required	Unknown	Reinforced Con- crete slab	Stream crossing	28
261	3000	7000	Clayey loam	Concrete	Rigid	6.0	0.0	1937	1937	Good	11	Convex curves	0-3%	100	Hilly	4-lane divided highway required				
152	4850	1300	Clayey loam	Concrete	Rigid	9'-7"-9"	—	1934	1934	Fair	10	Convex curves	0-3%	80	Rolling	Widening & resurfacing	R-1-1224 R-1-1223 R-1-1227	Rain Can Gutter	Stream to Stream to Stream to	24 24 24
152	3500	2300	Clayey loam	Concrete	Rigid	9'-7"-9"	—	1935	1935	Fair	10	Convex curves	0-3%	80	Rolling	Widening & resurfacing	R-1-1226 R-1-1225 Unknown	Rain Can Gutter Rain Can Arch Rain Can Slab	Stream to Stream to Stream to	24 24 42 32

Description of Needs

The actual needs have been divided into three general categories:

1. Backlog or Immediate Needs.
2. Future Needs.
3. Maintenance Needs.

The "backlog or immediate needs" refers to those improvements required now for all highways, bridges, and railroad crossings which do not presently meet tolerable standards. The term refers specifically to the existing needs on Indiana's highways which have accumulated because of the ever-increasing gap between an inadequate and an adequate highway system.

"Future needs" are the improvements that are required because of deficiencies which accrue each year. Highways that now meet tolerable conditions may eventually become intolerable because of inevitable wearing out and obsolescence. Also included in the "future needs" are replacements and stop-gap improvements. Replacement needs are caused by premature obsolescence of a highway or bridge based on its average service life. For example, the destruction of a new bridge or the inadequacy of a relatively new section of highway caused by an unforeseen increase in vehicle travel may require replacement or improvement. Many urgently needed improvements must be delayed because of the large backlog of needs; therefore, some of these delayed projects must be improved in some manner to adequately serve traffic until they can be programmed for reconstruction. These temporary improvements are called stop-gap needs.

The "maintenance needs" refer to the general housekeeping and up-keep of highway facilities. These needs do not include the work

required for major betterments, such as the cost of surface treatments and other items which are classified as capital improvements in this study. Included in the maintenance needs, however, are the costs of administration and operation.

Program Period

In order to program the total highway needs so that the huge quantity of work might be completed in a reasonable time and also to efficiently use all available engineering and construction manpower, a program period of 15 years is proposed. The Federal Aid Highway Act of 1956 currently requires construction of the Interstate System within 15 years, thus giving additional emphasis to the adoption of a 15 year program. A shorter program period could be used, but the average annual expenditures necessary to eliminate the total needs for such a program would be greater, and, perhaps, beyond the revenue capacity of Indiana. A shorter program period, however, would provide earlier and greater benefits to the highway user in the form of more efficient operation of his vehicle, savings in time, reduction in the number of accidents and other benefits. The time required to complete the program is of importance, but it is also obvious that the highway system cannot be rebuilt overnight.

Summary of Needs

The estimates of cost of improving the various highway facilities were based on 1955 prices. Adjustments for possible future price trends were not attempted.

State System

With the exception of the toll road, very few miles of the presently designated 1, 100 mile Interstate System of Indiana meet approved design standards. Most of this system must be "built from scratch." Figure 3 indicates the extent of this system and the cross-hatched bands show the 936 miles which do not meet standards. None of this mileage, for example, meets the requirements for control of access. Many other structural and geometric features such as pavement, median and shoulder width do not meet approved standards. Nearly all of the existing four-lane divided highways of this system must, therefore, be relocated or rebuilt. The two-lane highways of the current system must be relocated and rebuilt because four-lane divided construction is a minimum for the entire system. Construction of this system to the proposed standards will require an estimated expenditure of \$452 million in rural areas and \$429 million in urban areas. The expressway system in Indianapolis alone will require about one-quarter of the total urban expenditures.

The deficiencies are also great on the rural primary and secondary systems and on the urban system. On the rural primary and secondary systems, over 2,800 miles need improvement now. About 200 miles currently need improvement because they have inadequate capacity; 2,400 miles have physical deficiencies; and the remaining 200 miles have a combination of physical and capacity deficiencies. Nearly 1,300 structures on these systems are also in need of replacement or widening. Figure 4 indicates the extent of the improvement required to eliminate needs. The cross-hatched bands indicate those highways which require reconstruction of

EXISTING & PROPOSED
INTERSTATE HIGHWAYS

FIGURE 3

IMMEDIATE NEEDS
ON THE
PRIMARY AND SECONDARY STATE SYSTEM
FIGURE 4

one type or another, and the solid black bands indicate where only resurfacing and widening is required. All sections of highway which are neither darkened or cross-hatched on Figure 4 meet tolerable or design standards. The total estimated cost of improvements on the rural state primary and secondary systems including the cost of structures, is \$485 million. The cost of reconstruction of highways and structures is nearly 85 per cent of the total cost and the remaining 15 per cent is for resurfacing and widening. It is also interesting to note that the cost of new structures is nearly 27 percent of the backlog of needs on these systems.

Over 450 miles of four-lane divided highways are now needed, as shown by Figure 5, on the rural State primary and secondary systems. It is obvious that the Interstate System will not satisfy all the requirements of four-lane divided construction.

The complex problem of the urban state highways must be handled boldly and decisively. The present needs are critical; congestion and delay are plaguing the major streets on the state system. Over 150 miles of by-passes are presently needed around large and small communities and expressway systems are needed in metropolitan areas such as Fort Wayne, South Bend, and Indianapolis. Many miles of urban thoroughfares need widening, rebuilding, and resurfacing. The total cost of the immediate needs for urban state highways exceeds \$210 million.

In those cases where it is necessary to abolish parking to obtain adequate capacity, off-street parking facilities must be provided. The cost of providing off-street parking facilities has not been included in the needs estimate for the urban state system. It is obvious that the

4 LANE DIVIDED HIGHWAYS NEEDED NOW
FOR PRIMARY AND SECONDARY SYSTEM

FIGURE 5

parking problem must be considered with the highway needs problem if an adequate and lasting solution is to be obtained.

The "future needs" of the state system will also be of considerable magnitude within the next fifteen years. Over 6,100 miles of the presently tolerable rural primary and secondary highways will become inadequate - 600 miles because of inadequate capacity, 5,000 miles because of physical deficiencies, and 500 miles because of a combination of capacity and physical deficiencies. It will also be necessary to reconstruct over 1,000 bridges.

The construction work required to eliminate "future needs" on the rural state system is indicated in Figure 6. The cross-hatched bands show that 2,550 miles must be reconstructed, including 1,150 miles of four-lane divided highways and 1,400 miles of two-lane highways. The necessary widening and resurfacing of an additional 3,600 miles is indicated by the dark bands. The total cost of this work on the State rural primary and secondary systems, including the structures, is estimated at \$814 million.

On the state urban system, over 200 miles of by-passes will be needed in the next 15 years and most of this mileage will require four-lane divided construction. The most complex problems, however, will remain on routes that pass directly through the cities. On a mileage basis, at least 49 percent of the future deficiencies will be caused by inadequate capacity, and 40 percent will be caused by physical inadequacies. It is estimated that \$272 million will be required to eliminate these deficiencies.

In addition to the construction necessary to eliminate the needs,

FUTURE NEEDS ON THE INDIANA STATE SYSTEM

FIGURE 6

it will be necessary to provide additional fund to adequately maintain the entire system. The maintenance costs will remain nearly constant from year to year even though improvement of the system is continuous. In many respects, improved pavements have lower maintenance costs; however this reduction will be offset by the higher costs caused by a greater number of miles of four-lane divided pavement and increased traffic. On the rural state primary, secondary and urban system an estimated \$354 million will be needed for maintenance in the next 15 years. Included in this estimate are the necessary administration and operational expenditures.

County Road System

Most counties have not established a highway classification system. It was necessary, therefore, for the sake of this study to classify their highways into primary, secondary, and local road systems. The greatest needs, on a cost per-mile basis, occur on the primary and secondary roads. These highways carry the larger volumes of traffic and consist of farm-to-market movement, milk and postal routes and other rural to urban movements. Nearly 21,000 miles of county roads were classified as primary and secondary roads while the remaining 55,000 miles were placed in the local road system.

In most of the counties tolerable road surfaces exist, as is indicated in Figure 7. The figure shows the 52 counties have 90-100 percent of their mileage surfaced at least with gravel or stone, 28 counties from 70-90 percent, and 12 counties have less than 70 percent. Although these figures indicate a rather high percentage of surfaced mileage when compared to some other states, the needs of the counties are of

considerable magnitude. Many bridges are narrow and inadequate and many roads are unable to carry heavy or even moderate loads. Many miles of road are narrow, poorly aligned, poorly drained, and have inadequate shoulders.

In order to eliminate the present needs and those that will accrue within the next 15 years, construction expenditures of \$372 million on the county primary and secondary systems and \$161 million on the local road system are estimated. An additional expenditure of \$458 million for maintenance is required on all county systems.

City Streets

The needs of state highways in urban areas are not included in this discussion of the needs of city streets because they were discussed in an earlier section of this paper.

It was necessary also to classify city streets into systems in many cities because they have not been adequately defined by the cities. The classification, exclusive of the state system, resulted in an estimated 2,600 miles of arterial streets and 8,600 miles of local streets. During the next 15 years nearly 1,000 miles of these arterial streets and 5,100 miles of local street system must be reconstructed or resurfaced to meet the demands of increased traffic. An estimated \$236 million is required for construction of arterial streets and \$207 million is required for construction of local streets to eliminate present and future needs. Maintenance needs of city streets will require an additional expenditure of about \$206 million in the 15 year period.

A summary of the annual average expenditures estimated for the state, county and city systems for a 15-year program is presented in Figure 8. Because of the uniqueness of the Interstate System and the high cost of construction of this system, the cost of the Interstate System has been separated from the cost of improving the other State Systems. The estimated annual cost of a 15-year program of eliminating the needs on the state primary, secondary and urban systems is \$156 million; the Interstate System, \$71 million; the county system, \$66 million; and the city street system, \$43 million. The estimated total average annual expenditure required for all systems for 15 years is \$336 million.

Fiscal Requirements

The ability of Indiana to bring its highways to adequacy depends greatly upon the money available to eliminate the large backlog of existing needs and those that will develop in the future. The amount of money available in the past and that which is available now is shown by Figure 9. This graph shows funds are available from three sources--the motor vehicle highway account, derived mainly from motor fuel taxes and license and registration fees; local funds, derived from property taxation; and Federal Aid. It can be observed that a total of \$108 million was available from these sources in 1955.

Although revenues have increased in recent years, the obsolescence of the highways and streets have increased at a faster rate. In addition, the highway construction dollar does not purchase as much today as it did formerly because of increases in the cost of labor and materials.

The passage of the Federal Aid Act of 1956 and a two-cent increase in motor fuel taxes at the state level have changed significantly the

ANNUAL AVERAGE COST FOR 15 YEAR PROGRAM
FIGURE 8

MAJOR SOURCES OF HIGHWAY REVENUE
FIGURE 9

availability of highway funds in Indiana. Estimates of revenues during the next 15 years were developed from growth trends and current revenue policies and are shown in Figure 10. It is estimated that the estimated annual highway income will reach a peak of \$280 million by 1967 but that it will be reduced to about \$250 million by 1971 due to completion of the Interstate Highway Program.

Superimposed on the estimated income curve of Figure 10 is the annual expenditures necessary to eliminate the needs in a 15-year program period. It can be observed that the yearly expenditures should increase until 1967 when \$388 million will be needed. It is obvious that the new fiscal policy will not meet all of the required needs. In fact, it is estimated that in the next 15 years about \$1.3 billion more will be needed than will be provided by current sources of revenue. Either new sources of revenue or increases in old sources are again needed to fill the gap.

Concluding Statement

In conclusion, it can be stated that the cost of improving Indiana's highway system is great. The cost of improving the Interstate System will require an expenditure of 22 percent of the total needs budget within the next 15 years. The construction of this system will undoubtedly create further demands for better highways. It is difficult to grasp the total impact of an adequate highway system on the general economy of the state, but an adequate system will undoubtedly bring many benefits to the highway user, industry, and agriculture.

Careful consideration should also be given to those needs which

ESTIMATED REVENUES & NEEDS
FIGURE 10

cannot readily be measured on a monetary basis. The supply of engineers and technicians, improved traffic operation, off-street parking facilities, classification of roads and streets, improved cost accounting, and a complex array of other problems remain to be solved. The next few years will require an expenditure of money for highways which has never been equalled in the past. It will be the responsibility of highway administrators, engineers, and others concerned with the economical and efficient development of the Indiana Highway System to see that this large sum of money is properly used.