

# Economic Evaluation of Two Indiana Bypasses

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THIS paper has been developed from before-and-after studies conducted on two Indiana bypasses. The before part of the studies was made prior to the completion of the bypasses while the after part was conducted about 6 mo. after the opening of the facilities to traffic. The cities chosen for the studies, although differing in size, location, and traffic pattern, are similar to many others which are presently considering means of relieving local traffic congestion.

The effects of the bypasses on traffic, accidents, land use, land value, and business in each of these two communities are presented and compared. The methods used to obtain and evaluate the necessary information are also briefly discussed and the factors causing a demand for bypasses in Indiana are presented.

It is shown that these two bypasses have had significant, similar, and largely beneficial effects. The bypasses effectively routed through traffic around both cities, but eased congestion in the business district of only one of them. The bypasses accelerated the urban development of the rural areas through which they passed and within a few months increased the land value of that area by 50 percent. The majority of businessmen believed the bypasses were beneficial and had not had detrimental effects on their business. A few fringe-area businesses which were primarily dependent on transient trade did suffer considerably. On the detrimental side, the severity of accidents on the bypasses, with more injuries and fatalities, more than off-set the reduction in accidents which occurred within the cities.

It is concluded that a bypass facility should be constructed only after a thorough analysis of all local factors and that some method, such as limited access, should be employed to control development along the route so as to insure safer facilities and maximum economic return to the state and to the users of the facility.

● THE highway system of the United States, currently including about 3 million mi. of rural roads and more than 300,000 mi. of streets, was not projected or developed at one time, but has evolved over a long period to meet the increasing demands for adequate motor transportation.

More than 70-billion dollars have been expended by all levels of government since 1900 for a highway system that is considered by many to be inadequate for the currently estimated 500 billion vehicle-miles of annual travel by more than 52 million motor vehicles. Nearly all of this expenditure has been made since 1921. Annual expenditures for roads and streets have increased from about 375

million dollars in 1906 to an estimated 4.25 billion dollars in 1952.

The total rural mileage increased from an estimated 2.15 million mi. in 1904 to slightly more than 3 million mi. in 1952. Nearly 90 percent of this increase in rural mileage occurred prior to 1921. About 55 percent of the total rural mileage of today has some type of improved surface.

Available statistical records do not provide an accurate measure of the changes which have occurred in total and surfaced mileages of town and city streets during the past 50 years. While substantial improvements have been made, it is generally indicated that since 1921 the rate of improvement of city streets has not been as great as that for rural roads.

Most of the obstructive deficiencies existed on the rural roads when the Federal

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Highway Act of 1921 was passed. City streets were considered to be relatively ample in their traffic capacity. But during the 1930's when automobile traffic in the cities became more intolerable, and as the problems of congestion, vehicle-operating costs, accidents, and other measures of the inadequacy of the arterial streets became more evident, greater emphasis was given to urban remedial measures. Among the methods used to relieve this situation were the use of appropriate signs and signals, improvement of parking conditions, installation of one-way streets, and the development of parkways, expressways, freeways, and circumferential routes in or near the cities.

Although state highway funds were used in the 1920's and 1930's to relieve urban congestion, the most significant impetus to the extension, improvement, and development of the modern highway system in this country in general, and of the advanced type of parkways, freeways, and urban expressways in particular, was provided by the Federal Aid Highway Act of 1944 which authorized separate funds for construction within metropolitan areas. Each succeeding act has included a similar provision. The 1952 act provided supplementary funds by permitting the use of defense-access-road funds for the construction or improvement of a circumferential highway around a city, or a radial intracity route upon receiving proper certification as being essential for civilian or military defense.

Improved methods of administration, finance, and engineering have led to greater efficiency in developing the highway system. There are, however, certain serious deficiencies in this development. The failure to provide adequate rights-of-way has been a basic fault in highway practice. The failure to protect that right-of-way by control of access, by regulation of location and type of roadside use, by set-back lines and other devices has resulted in costly highways. Many states have the legal authority to protect the highway by the use of these methods, but in some cases it has not been used effectively.

This general description of the highway situation is applicable at both the national

and the state levels. By January 1, 1952, the State Highway Commission of Indiana was responsible for a highway system of 10,616 mi. in various stages of improvement. The counties were responsible for more than 74,000 mi. of local roads and streets and the cities were responsible for more than 10,000 mi. of streets. It is only reasonable to assume that in Indiana the expenditures, vehicle-miles of travel, and motor-vehicle registrations represent their proportional share of the nation's respective totals.

The communities of Indiana are typical of those scattered throughout the United States. They began to feel the effects of traffic congestion in the 1930's. The State Highway Commission of Indiana began as early as 1923 to cooperate with the small communities in an attempt to solve the traffic problem. A legislative act in 1937 extended the service to all cities except Indianapolis, and in 1945 routes through Indianapolis were included. Bypasses have been constructed in Indiana as a means of diverting traffic around a community and as distributors of traffic to the arterials of the community.

The diversion of through traffic to a bypass facility is of benefit to through traffic and to local traffic. City streets, divested of through traffic, provide increased capacity for local traffic. Among the specific benefits claimed are: increased activity of business, increased value of property, more effective use of land, convenience of parking, increased safety and convenience to the pedestrian, reduction of traffic conflicts, expeditious movement of through traffic, reduction of operating costs, and simplification of local traffic control.

Common practice in highway administration requires that an engineering and economic study should be made of any proposed major highway facility to determine the need and the cost of the improvement and to establish the direct economic benefits to the motorist. Such an analysis is often used to justify the cost on the basis that the savings to be affected in terms of reduced maintenance costs, savings in vehicle-miles, and time will equal the cost of the service and amortize the cost of the improvement over a period of years. This method is

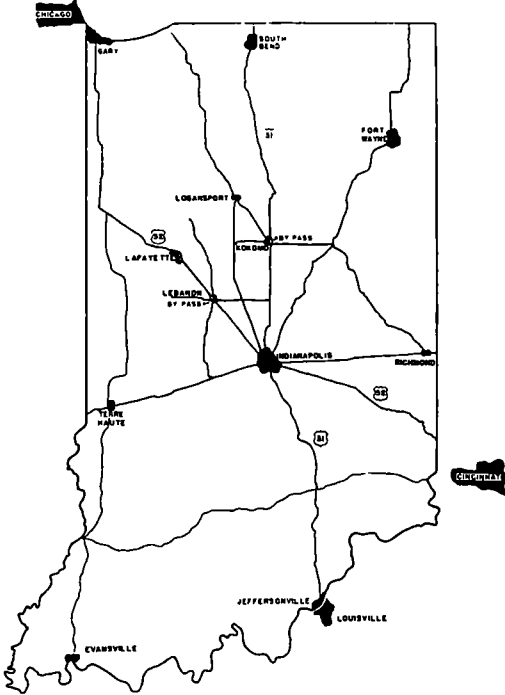


Figure 1. Principal highways connecting bypass areas with other parts of Indiana.

essential to insure proper investment of public funds and should result in benefit to the greatest number of people. These studies of direct benefits are often a standard procedure, but studies of the indirect effects upon a community have not received adequate consideration.

In 1950 the State Highway Commission of Indiana through the facilities and in cooperation with the Joint Highway Research Project of Purdue University developed a study to determine the benefits of a bypass to traffic and the effect upon business, land use, land value, and accidents. Commodity and passenger movements were also to be investigated. The bypasses, then in the process of construction at Lebanon and Kokomo, provided an opportunity to make a study of the problem before and after the facilities were opened to traffic. The facility at Kokomo was scheduled for traffic use within 60 days while the facility at Lebanon was scheduled for use within one year.

Kokomo is a rather typical Indiana city of about 35,000 population. Lebanon is a static community of less than 10,000 population. Highway transportation has

become of real importance to each community.

The location of these cities with respect to the highway system of Indiana is shown in Figure 1. There were about 14,000 external trips at Lebanon and 25,000 external trips at Kokomo on a typical week day in 1951. The heaviest traffic at Lebanon is on US 52, which serves as a collector of traffic from Cincinnati and Louisville via Indianapolis to Chicago and other midwest areas. The heaviest traffic at Kokomo is on US 31 and US 35. The former route serves through traffic from Louisville via Indianapolis to the industrial cities of north-central Indiana and western Michigan. The latter route serves the industrial section of southwestern Ohio and the heavily industrialized region of northwestern Indiana.

The locations of the bypasses at Kokomo and Lebanon are shown in Figures 2 and 3. It may be observed that the bypass at Kokomo is on the outskirts of the city while the bypass at Lebanon is some distance from the city. Each bypass route

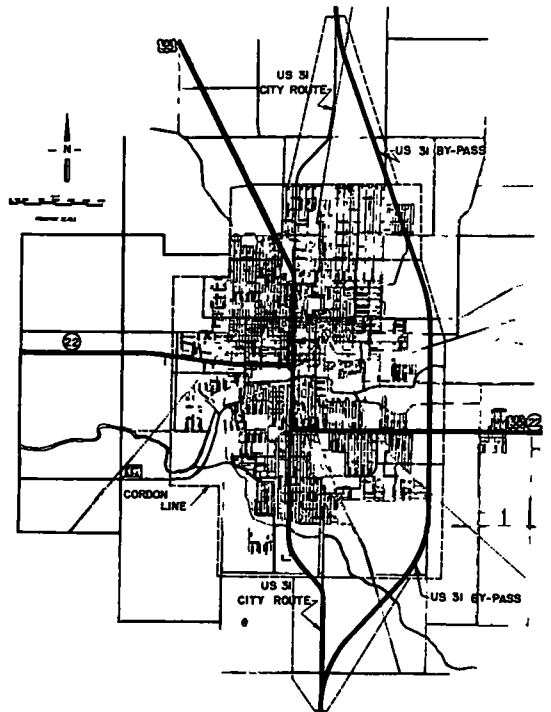


Figure 2. Kokomo Bypass and other state routes.

is slightly longer than the corresponding city route.

#### METHODS USED TO COLLECT DATA

The data used for an enumeration of the actual effects of the bypasses on (1) traffic, (2) accidents, (3) land use, (4) land value, and (5) business in each of the two communities were collected by several methods. The basic traffic data were obtained by two external-type, origin-and-destination surveys in each area. One of the surveys (before) was conducted prior to the completion of each bypass, and the second (after) approximately 6 mo. after the opening of each bypass to traffic. Each survey was of the roadside-interviewing type.

The before surveys included the roadside interviewing of occupants of vehicles as they crossed a cordon line which enclosed the developed area of each city. The standard questions of origin, destination, and trip purpose were asked; and when applicable additional information on number of persons, place of vehicle registration, commodity carried, and purpose of trip stop was obtained. These surveys, in conjunction with volume counts, travel-time runs, and other traffic studies, provided information relative to the traffic patterns and characteristics before the bypasses were opened.

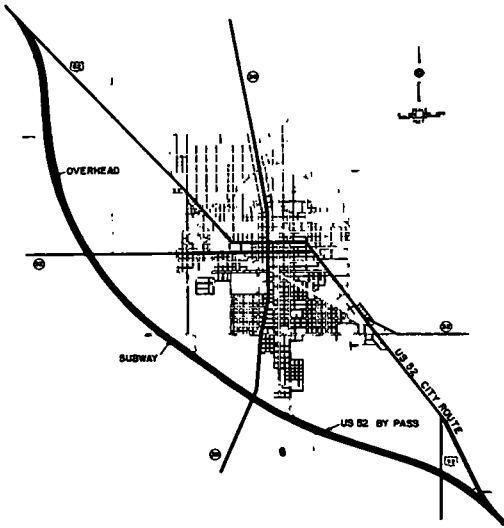


Figure 3. Lebanon Bypass and other state routes.

The after surveys, also of the roadside interviewing type, were conducted only within the bypass areas. Each bypass was enclosed with a cordon and traffic was interviewed as it departed from the bypass area. Data similar to those obtained during the before study were acquired and supplemented by asking each driver where he entered the bypass area. The data from these after studies were, after analysis, compared with a similar analysis of the before data to determine the changes in traffic patterns and the uses of the bypasses.

Accident data were collected from official accident records on file with enforcement agencies. The recorded accidents which occurred in each area during a full 6-mo. period prior to the opening of the bypasses were compared with those which occurred during a similar 6-mo. period after the opening of each bypass.

Land use in the area of each bypass was determined for three periods for the two bypasses. An estimate of the land use of the areas during a period approximately 10 yr. prior to the construction of the bypass was obtained from aerial photographs applicable to that period. The land use prior to any initial preparations for location of the bypasses in their present locations and the land use 6 mo. after opening of the bypasses were obtained from previous land-use surveys and field-reconnaissance notes.

The value of land in each bypass area was determined for periods (1) several years prior to the planning of the bypass, (2) prior to actual construction of the bypass, and (3) after opening of the bypass. These data were obtained primarily from several qualified real-estate dealers in each area. The actual sale and resale prices of tracts of land, as determined from their records or memory, for these various periods were collected during this phase of the study.

The effects on business in each city were determined from a survey of businesses located on or near the old routes. This survey was actually an opinion survey since all reported factual information of earnings of business, for example, income-tax records in Indiana, is confidential information. Each proprietor contacted was asked a series of questions



a very short period, cause the congestion on this street to be worse than it was before the construction of the bypass. In Lebanon, however, the relief to congestion on the old route was very great and will be effective for many years. This comparison would indicate that although a bypass will effectively divert through traffic, the reduction of congestion on the old route will be quite small unless

volumes, without allowance for increased traffic during the life of the bypass. A similar computation indicated a benefit-cost ratio of 2.61 for the Lebanon Bypass.

The bypasses also serve as new distributor facilities for local traffic destined to or from the cities. This local traffic is also shown in Figures 4 and 5 for the two cities. The major movement of traffic on the Kokomo Bypass is,

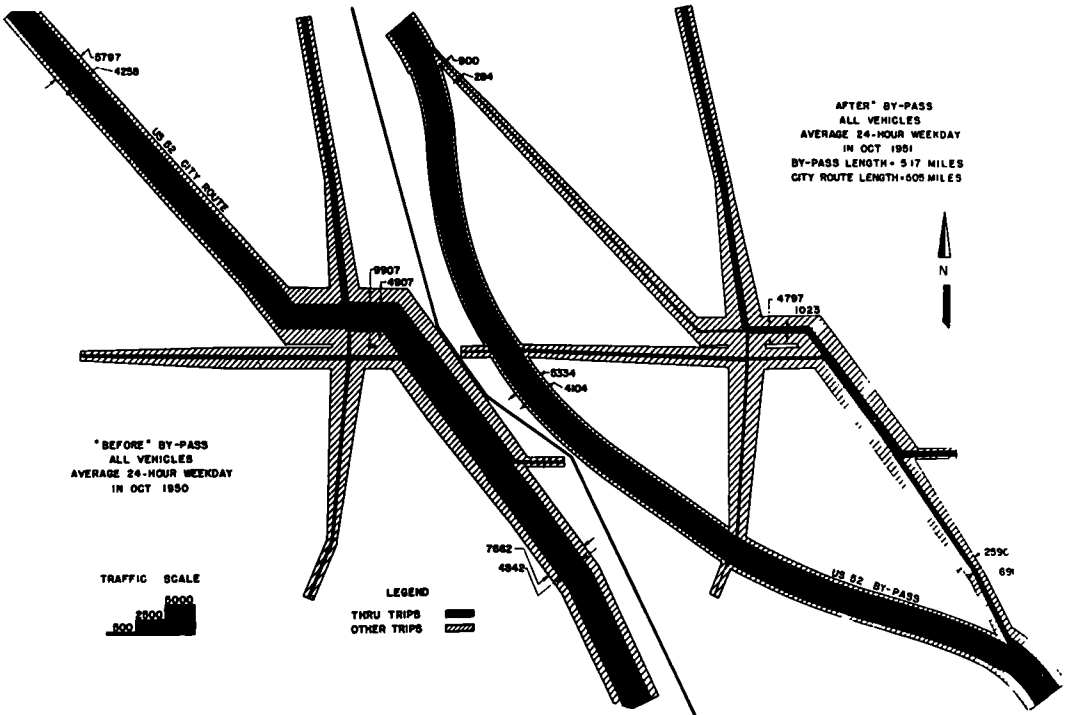


Figure 5. Traffic volumes for Lebanon before and after bypass.

the through traffic is a major portion of the total traffic on that route. If the through traffic is a minor portion of the total traffic, a bypass will have little effect on relieving congestion on the old route.

The savings, however, which accrue to through traffic, especially heavy trucks, in the form of lower operating costs and time saved may be of such economic value that a bypass would be justifiable even though it offered little solution to the downtown congestion problems. The savings to through motorists at Kokomo, for example, were of sufficient value to give a benefit-cost ratio for the bypass of 1.65 computed for 1951 through traffic

in fact, by this type of trip. This movement is perhaps larger than normal in Kokomo because of a shortage of north-south streets. In both cities, however, this type of movement is primarily dependent on two important factors: (1) the amount of traffic destined for the city from outside the city and (2) the proximity of the bypass to the developed sections of the city.

Kokomo, because of its size, has many more trips than Lebanon whose origins or destinations are within the city. This naturally increases the use of the bypass at Kokomo by this type of trip. An equally important factor is the proximity of the bypass to the city. At Kokomo the by-

pass touches the edge of large developed sections of the city while at Lebanon the bypass is surrounded almost entirely by farm land. The use of the bypass at Kokomo by strictly local trips (those with both origin and destination within the city) illustrates this point (see Fig. 6). At Kokomo an important part of the total bypass traffic is composed of such trips (17.8 percent), while at Lebanon this movement is almost negligible (3.1 percent). Of all such local trips which used the bypasses, more than 90 percent had both termini of their trip within 1 mi. of the bypass. Lebanon had few such trips

from both bypasses. A comparison of the travel times before and after are indicated in Figure 7. Less time was also required to travel on the old route through Lebanon after the bypass than before. The local drivers in Lebanon, even though they might not have used the bypass, also

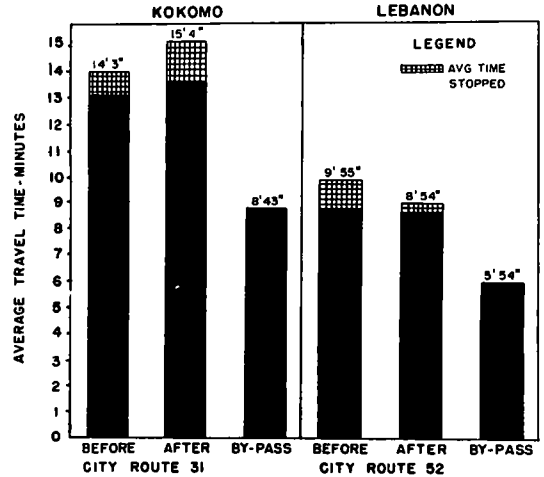


Figure 7. Average travel time.

received a benefit from the bypass in the form of this ease of movement on the city route. In Kokomo, however, it actually required a slightly longer time to travel through the city on the old route after the bypass was constructed than it did before. This is also shown by Figure 7. As has already been noted, the decrease in actual volume on the old route was quite small and congestion was still present during many hours of the day. Moreover, it is generally recognized that local traffic desires to travel slower in downtown areas than through traffic, and perhaps, after the "push" from through traffic was removed by diverting it to the bypass, the local traffic assumed a more-desired, "window-shopping" speed.

Wise foresight on the part of the planners of both bypasses has provided sufficient right-of-way for dual-laning whenever the use of the facilities warrants such improvement. Traffic increases that are presently occurring will necessitate the actual construction of the separated dual lanes within a very few years. This type of planning has affected every citizen of Indiana, since it provided eco-

#### NOTE

TOTAL LOCAL TRIPS THAT  
USED BY-PASS = 1304  
LOCAL TRIPS REPRESENT  
17.8% OF TOTAL USAGE

#### DISTANCE SCALE

1 MILE

#### TRAFFIC SCALE

100  
200  
300  
400

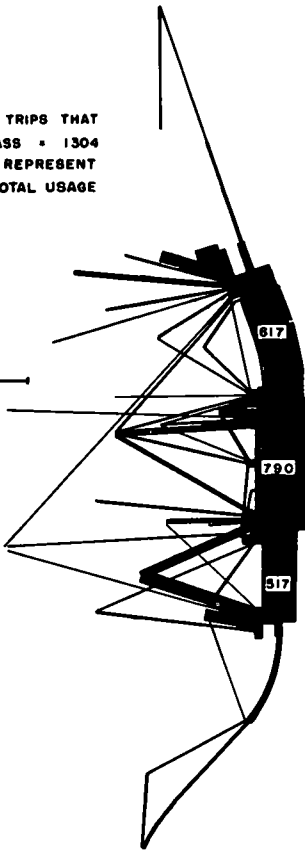


Figure 6. Local trip usage of bypass with location of termini for passenger cars and trucks.

that used the bypass, simply because there was an absence of popular origins and destinations that close to the bypass.

A considerable savings in travel time (4 to 5 min.) resulted for through traffic

nomically the right-of-way necessary for required construction.

Neither of the two bypasses, however, was constructed with limited-access provisions. The benefits which now actually are accruing, to particularly the through motorist in the form of the reduced operating costs and trip time, must be assured for the full life of the

### Effect on Accidents

A tabulation of the accident data for both bypasses for periods of before and after is shown in Table 2. The accidents on the former routes through the cities were less in number after the bypasses than before them. The accidents which occurred on the bypasses in similar

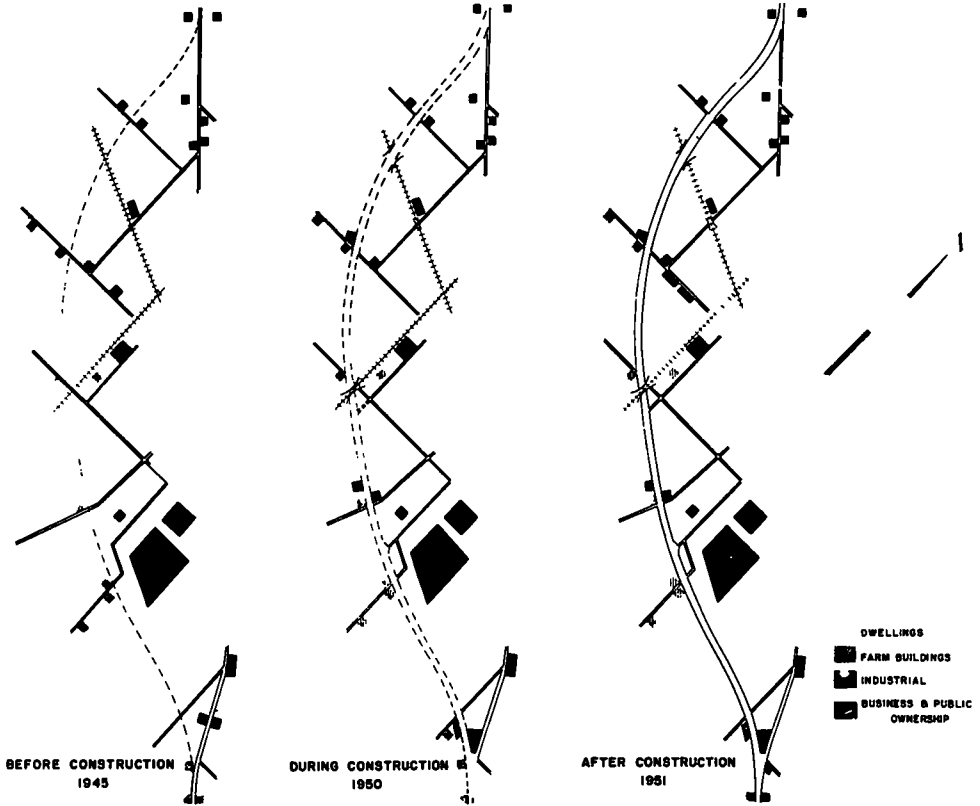


Figure 8. Land use of bypass area for Lebanon.

bypasses if the full benefits are to be realized. In computing the benefit-cost ratio, the total cost of the facilities was averaged over the expected life of the bypasses, and the benefits were computed on the basis of existing costs and conditions. In order to receive these benefits, the relative ease of movement that now exists on these bypasses must be maintained for the life of the facilities. Experience indicates that careful control of access might do much to maintain this ease of movement as development of the bypass areas continues.

periods, however, reduce the encouragement indicated by such statistics. The number of accidents which occurred on the bypasses, when compared to the decrease in number of those which occurred on the old route, can be considered favorably with accident trends in other cities. Due to increased speeds on the open highway, however, the accidents which did occur on the bypasses were probably much more severe than if they had occurred on the old routes. The number of deaths, two on the Kokomo bypass and one on the Lebanon bypass within the first 6 mo. of



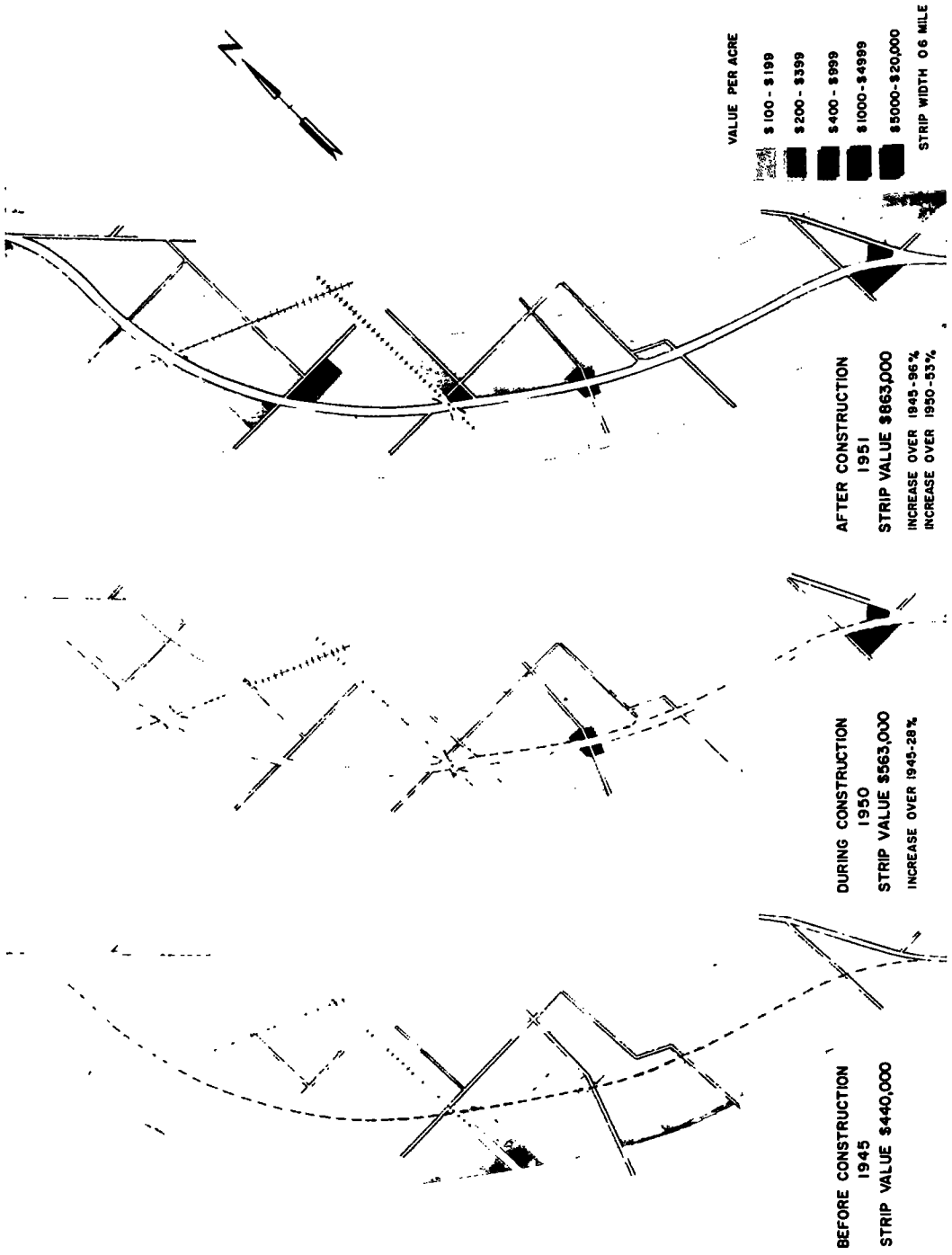


Figure 9. Land evaluation of bypass area for Lebanon.

TABLE 2  
ACCIDENT COMPARISON ON STATE ROUTES  
Before and After Bypasses

	Lebanon		On Bypass	Total After
	In City			
	Before	After		
Number of accidents	44	29	27	58
Number killed	0	0	1	1
Number injured	8	3	11	14
Average damage	\$184	\$166	Severe*	--

All data for 6-month periods.

	Kokomo		On Bypass	Total After
	Before	After		
	Number of accidents	205		
Number killed	0	0	2	2
Number injured	23	23	9	32
Average damage	\$128	\$134	Severe*	--

All data are for 6-month periods

\*Estimated damages were not available but police authorities stated many vehicles were demolished

on the new facilities. The land use of the bypass area at Lebanon for 1945, 1950, and 1951 is shown in Figure 8. This is very similar to the development which occurred at Kokomo. At both locations, development of the areas, which was only normally active prior to the bypasses, increased appreciably and is continuing rapidly. For example, three service stations, two restaurants, one motel, and one farm-equipment store were under construction before the Lebanon bypass was opened to traffic. At Kokomo, within 6 mo. of the opening of the bypass, four businesses were in operation at one intersection, and a residential area, whose only outlet is to the bypass, contained five new residences.

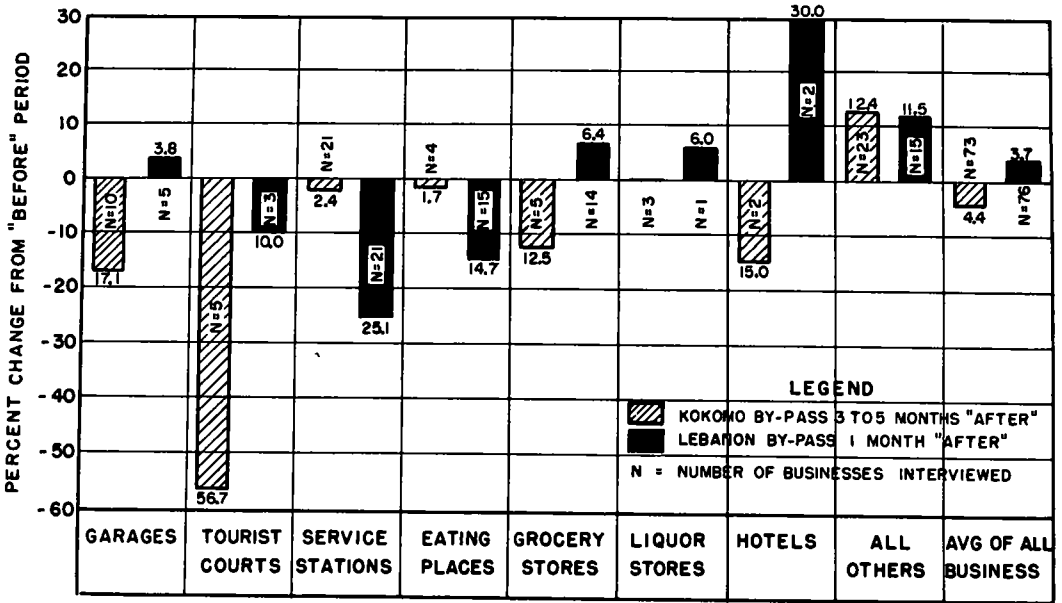


Figure 10. Gross-business comparisons of similar periods before and after bypass.

operation, certainly offset any economic benefits that resulted from the decrease in accidents on the city routes.

Effect on Land Use

Before 1945 the areas through which the two bypasses now pass were almost entirely farm land. As soon, however, as planning for the bypasses began, interested individuals began developing the land to fit the needs of the travelers

This rapid development of the area again emphasizes the problem of access control. Unlimited access increases the frictional movements between bypass users and can only result in a curtailment of the ease of movement for them. In the absence of any limited-access provisions, the Kokomo Planning Commission is attempting to control the development and the access points by the use of an intelligent zoning ordinance and a required platting procedure.

### Effect on Land Value

The effect on land value, as expected, has been influenced by the development of the bypass areas. Not only does this hold true for those areas actually under development, but it also extends into all areas that border or are near the bypasses. A chart showing land values of the area along the Lebanon Bypass is shown for three different periods in Figure 9. The Kokomo effects were very similar. There the land without improvements was worth approximately \$500 per acre during the period before the bypass was located. During the construction of the bypass, various parcels of land were offered for sale at about \$750 per acre. As the bypass neared completion, the asking price for this same land, spurred up by some fabulous prices actually paid for choice locations, was increased to \$1,000 per acre. Various real-estate men believed that this amount would be obtained if the area were zoned for business purposes. Since only limited areas are, however, zoned for business, these men believed that the average selling price of all land along the bypass would be about \$750 per acre. They attributed the increase of from \$500 to \$750 per acre solely to the presence of the bypass and not to general increases in land values.

### Effect on Business

The survey of effects of business was limited in both cities to those businesses which were located on or within a few blocks of the original route through the city. It was believed that the greatest adverse effect would certainly occur among this group. Some of the business men felt that the bypass had taken business away from them. Others felt that although the bypass had caused them to lose the business of through traffic, it had resulted in more local business for them. A few thought the bypass actually had helped them. The information as to the reported effect on gross earnings between periods both before and after the bypasses is summarized in Figure 10.

Some types of businesses reported

overall decreases which they attributed to the bypasses. Some tourist homes, hotels, gasoline stations, restaurants, garages, and groceries reported a decrease in business during the first few months after the bypass from that for a similar period before the bypass. On the other hand, others reported increased earnings. Many of the owners of the businesses which suffered decreases were, however, in favor of the bypass. They were certain that it relieved congestion in their area and later expected to attract more local customers.

A few fringe-area businesses not located in the downtown business district but located on the old route near the junction points of the bypass and the old route suffered considerably. Many of these businesses catered to transient trade and now find themselves in locations where little of that type of trade can be expected.

In both cities a majority (68 percent at Kokomo and 59 percent at Lebanon) of all businessmen contacted were sure, 6 mo. after the bypasses were opened to traffic, that the bypasses had not hurt their business and were hopeful of obtaining more local customers. Those businesses that were most detrimentally affected were looking for more preferable locations, often on the bypass.

During the origin-destination surveys, data were collected on the number of through vehicles that actually did stop in the two cities and the purposes for which they stopped. A summarization of these data for the two cities is shown in Figure 11. These data indicate that less than 25 percent of the total through traffic desired to stop within the cities and that a large portion of this total, because of certain stop purposes, necessitated a stop in the city with or without the bypass. During the after study similar purpose of stop data indicated that a large percentage (60) of those who stopped to eat, get gas and oil, or for any purpose did not use the bypass but continued into the city. This information is shown in Table 3 for the Kokomo bypass. An analysis of this information indicates that the bypass should not adversely affect business on the former route. For example, the Kokomo business district, with 1,315 throughtrips

on US 31 of which 24.9 percent wished to stop in the city, lost the business of only about 130 vehicles (40 percent of 24.9 percent of 1,315).

**CONCLUSIONS**

The following conclusions are drawn from the analysis of the Kokomo and Lebanon By-Pass Surveys:

1. The effects of the bypasses on the two cities have been significant with benefits being received by the motorist

(savings in time and vehicle operation), the land owner (increase in land value and easier access for some), and the community (alleviation of congestion, opening of a new area for development, and increased valuation for taxation).

2. The bypasses are effectively routing the through traffic (approximately 90 percent) on the routes for which they were built around the city.

3. The relief of congestion on the former city routes is only minor at Kokomo but is very appreciable at Leba-

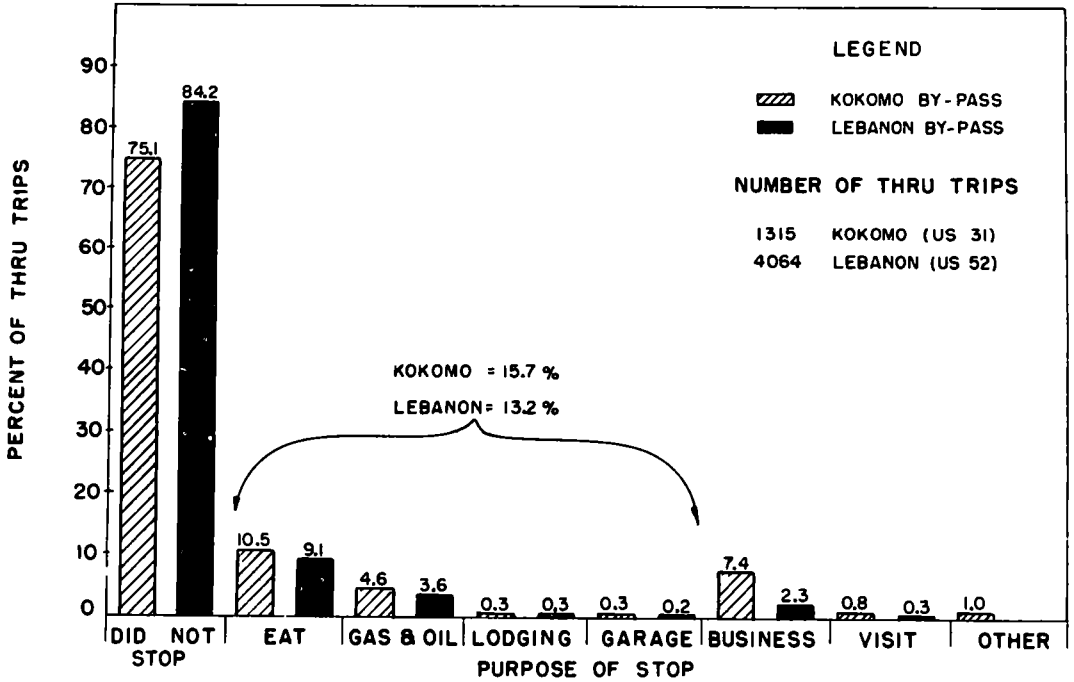


Figure 11. Stops by through vehicles.

TABLE 3

PURPOSE OF STOP VERSUS ROUTE TAKEN FOR ALL THROUGH VEHICLES ON US 31

Purpose of stop	Total no. trips	Bypass		Through city	
		vehicles	percent	vehicles	percent
No Stop	1161	1035	89.1	126	10.9
Eat	86	46	53.5	40	46.5
Gas and Oil	37	22	59.5	15	40.5
Lodging	1	0	0	1	100.0
Business	50	5	10.0	45	90.0
Garage	1	0	0	1	100.0
Visit	11	2	18.2	9	81.8
Other	2	0	0	2	100.0
<b>Total Stop</b>	<b>188</b>	<b>75</b>	<b>39.9</b>	<b>113</b>	<b>60.1</b>

non. The difference of effect here is due to the differences in the percentages of through traffic in the before traffic volumes on the old routes. This indicates that bypasses are not always the answer to congestion problems.

4. The bypasses are used extensively as collectors and distributors of local traffic. The Kokomo Bypass is used more extensively for this purpose because of its close proximity to developed areas of the city.

5. More than 90 percent of all traffic whose origins and destinations were both within the cordon area and who used the

bypasses had both termini of their trip within 1 mi. of the bypasses.

6. Accidents decreased in number on the former city routes, but the number and severity of accidents on the bypasses appear to have offset this decrease.

7. The presence of the bypasses has increased the rate of development of the bypass areas. Quick action by local and state government is necessary to prevent a disorderly development of the area.

8. A method such as limited access appears to be necessary to assure continued ease of movement on the bypasses and thus to assure maximum economic return and safety.

9. The value of land adjoining the bypasses was increased about 50 percent because of the presence of the bypasses. It is reasonable to assume that increases in tax valuations and revenue for local government will follow.

10. The majority of businesses within the two cities have not suffered detrimental effects from the bypasses. A few types of business, especially if located on the old routes outside the central business districts, such as tourist homes, hotels, restaurants, and gasoline stations, have suffered some economic losses. A great majority of businessmen in both cities feel that the bypasses are definite assets to their cities.

11. The variations between the effects of the bypass on traffic in the two cities indicate that a bypass should not be constructed before a thorough analysis of all local traffic characteristics.

12. Future periodic surveys of the bypass areas would determine further effects of the bypasses and provide important information on the operation and control of such facilities.

#### ACKNOWLEDGEMENTS

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#### REFERENCES

1. Ableman, Meyer, "Small City By Passes", Traffic Quarterly, April, 1950, pp. 164-173.
2. "Auburn Study", California Highways and Public Works Magazine, May-June, 1950.
3. Automobile Facts and Figures, Automobile Manufacturers Association, 1952.
4. Do By Passes Hurt Business? Chamber of Commerce of the United States, Washington, D.C.
5. Federal-Aid Highway Act, (42 Stat. 212), November 9, 1921.
6. Federal-Aid Highway Act of 1944, (58 Stat. 838), Public Law 521, 1944.
7. Federal-Aid Highway Act of 1952, Public Law 413.
8. "Freeway Ups Business", California Highways and Public Works Magazine, January - February, 1950.
9. Highway Practice in the United States, Public Roads Administration, U.S. Government Printing Office, 1949.
10. Highways of Indiana, State Highway Commission of Indiana, Indianapolis, Indiana, 1948.
11. Land Acquisition and Control of Adjacent Area, Bulletin 55, Highway Research Board, 1952.
12. Lawton, Lawrence, "Evaluating Highway Improvements on Mileage and Time-Cost Basis", Traffic Quarterly, January, 1950, pp. 102-125.
13. Lebanon Traffic Survey Report, Joint Highway Research Project, Purdue

University and Metropolitan Area Traffic Survey Department, State Highway Commission of Indiana, 1952, (unpublished).

14. Manual of Procedures for the Metropolitan Area Traffic Studies, Public Roads Administration.

15. Michael, H. L., "Traffic and Engineering Report of the "Before" and "After" Surveys of the Kokomo By-Pass", Thesis, Purdue University, 1951.

16. Public Aids to Domestic Transportation, House Document No. 159, U.S. Government Printing Office, 1945.

17. Ritter, L.J., Jr., and Paquette, R. J., Highway Engineering, Ronald Press, 1951.

18. Roadside Protection, American Automobile Association, Washington, D.C., 1951.

19. Traffic Engineering Handbook, Second Edition, Institute of Traffic Engineers, Henry K. Evans, Editor, 1950.

20. Tucker, Harry, and Leager, Marc C., Highway Economics, International Textbook Co., 1942.

21. United States Public Roads, Bureau of, Annual Report, fiscal 1951.

22. Use of the Kokomo By Pass, Joint Highway Research Project, Purdue University and Metropolitan Area Traffic Survey Department, State Highway Commission of Indiana, 1952, (unpublished).