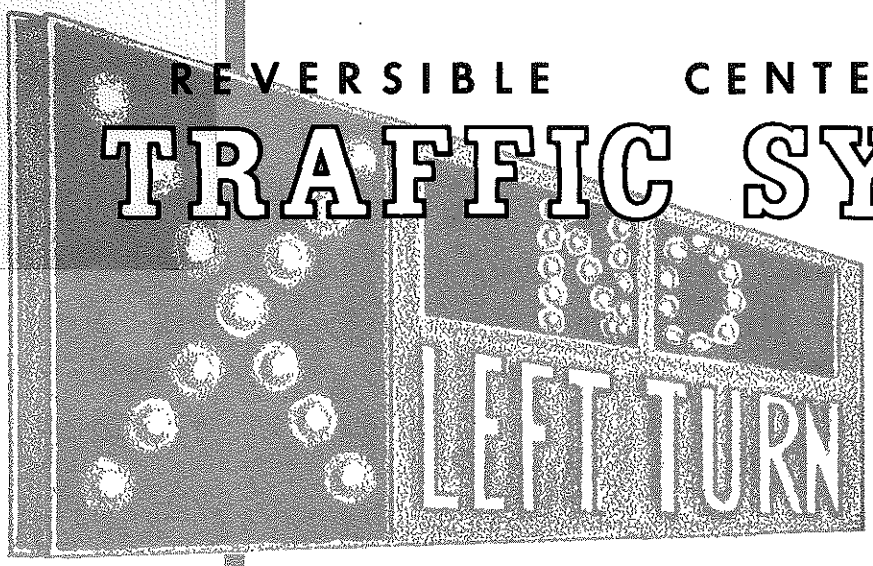
REVERSIBLE CENTER LANE TRAFFIC SYSTEM



TRAFFIC DIVISION
STATE OF MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

REVERSIBLE CENTER LANE TRAFFIC SYSTEM - DIRECTIONAL AND LEFT TURN USAGE

Conducted by the

Traffic Research Section
Traffic Division

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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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Study Report . . . . . .Frank DeRose, Jr.

PREFACE

For some time, traffic operations on Michigan Avenue (US-12) in the city of Dearborn had been of serious concern to the traffic engineers of the Michigan Department of State Highways and the Dearborn public safety officials.

This street carries approximately 46,000 vehicles per day in both directions - primarily through traffic with heavy directional movements during the morning and afternoon peak periods. It is a divided arterial with the exception of a 1.2-mile section in the western portion of the city.

The accident rate of 1920 accidents per hundred million vehicle miles was considerably higher than the average for the area. This factor, coupled with the daily congestion, justified the interest and concern for this problem.

In a cooperative effort, the State Highway traffic engineers and the Dearborn public safety officials reviewed the possible methods for improving the traffic operations on Michigan Avenue. The operational system selected for application was a center reversible lane system.

This report presents the description of the system, the development of a new combination electrical sign and signal for lane usage control, and an evaluation of the system operation.

REVERSIBLE CENTER LANE TRAFFIC SYSTEM - DIRECTIONAL AND LEFT TURN USAGE

Introduction

The Reversible Center Lane Traffic System was developed for use within the city limits of Dearborn, Michigan, where US-12 (a divided trunkline) becomes an undivided street through the business area. This trunkline operated with six 10-foot lanes, with parking prohibited during the peak hours in the direction of the heavy flow. Left turns were prohibited only at signalized intersections.

Traffic using this route is primarily through traffic, characterized by heavy directional movements. Accident rates have been high in this area.

After consideration of the total situation, it was decided to establish a reversible lane operation on this section of trunkline. The following conditions were requisite for effective operation:

1. Parking was prohibited at all hours.
2. The street was marked to provide five 12-foot lanes.
3. The center lane was designated as a reversible lane for the heavy directional flow - eastbound, 6:00-9:00 a.m., and westbound, 3:00-6:00 p.m.
4. During off-peak hours - 9:00 a.m. to 3:00 p.m. and nighttime - the center lane throughout the area was reserved for left turns.
5. A single overhead signal to inform motorists of the changes in traffic operation was developed.

Development of Reversible Lane Signal

The utilization of the center lane required a single signal to inform the motorist, simply and positively, of the center lane usage as follows:

1. To permit three lanes of traffic, including center lane, for the peak direction while prohibiting all left turns during the peak hours.
2. To permit the center lane to be used and reserved for left turns during off-peak hours.

The standard reflective signs lacked sufficient flexibility

and attention-attracting ability; therefore, a new electrical signal was developed to accomplish these objectives.

In this development, Department engineers utilized the successful experience gained from development and operation of changeable message signs on the Mackinac Bridge and the TV Surveillance Project in Detroit. These lane control signals, composed of the red X and green arrow, with their implied messages, had proven to be excellent for obtaining the desired motorist reaction as follows:

1. Red X indicating "Lane Closed" --
   The motorist understood immediately that he was not to use this lane and would move out of it as soon as it was safe to do so.

2. Green arrow indicating "Lane Open" --
   It was clear to the motorist that this lane was open for use by traffic.

The multi-lamp lane control signal developed for the TV Surveillance Project became the basic pattern for the complex reversible lane signal. The multi-lamp design permits more than one message. These messages are

mounted on a quick-change panel with a louvered screen providing the "disappearing legend" or "blankout" effect. The signal case is of extruded aluminum with welded construction.

Two messages were combined in a single, compact unit as follows:

1. Eleven R-20 50-Watt reflector lamps, coated with a weatherproof green coloring, provided the arrow message.
2. Thirteen R-20 50-Watt reflector lamps, coated with a weatherproof red coloring, provided the "X" message.*

The reversible lane signal is a combination of the multi-lamp lane control signal (red X and green arrow) and an internally-illuminated sign presenting the messages "No Left Turn" or "Only Left Turn", as needed, and was fabricated as one device.

The "Left Turn" message on the signal is illuminated by 800 ma fluorescent lamps. The message is cut out of black lettering film and overlaid on yellow plexiglas. The changeable "No--Only" message was designed larger and used

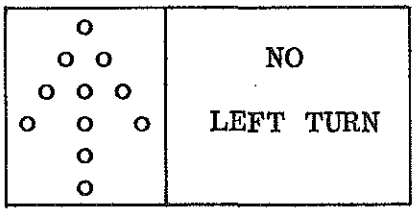
*For further details on the multi-lamp lane signal, refer to TV Surveillance Project report, "Blankout Signals for Freeway Traffic Control," Bushnell and Richard, MSHD 1963.

27-watt incandescent yellow lamps. The larger size and yellow color are used to attract the driver's attention to the change in the message.

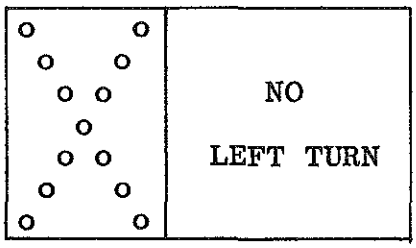
The messages presented by the signal are as follows:

1. Morning peak hour traffic in eastbound direction. Reversible lane control sign in operation from 6:00 a.m. to 9:00 a.m. as follows:

   (a) 3 lanes in eastbound direction. Use center lane for thru traffic.

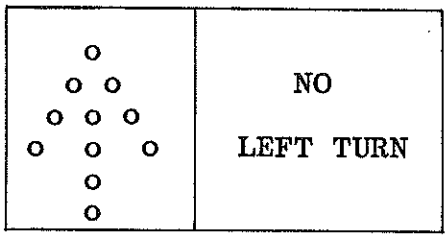


   (b) 2 lanes in westbound direction. Do not use center lane.

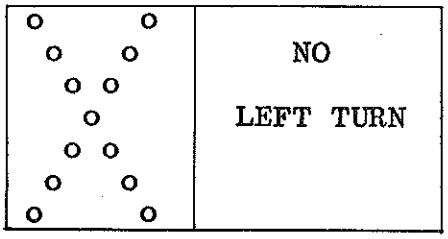


2. Afternoon peak hour traffic in westbound direction. Reversible lane control sign in operation from 3:00 p.m. to 6:00 p.m. as follows:

(a) 3 lanes in westbound direction. Use center lane for thru traffic.

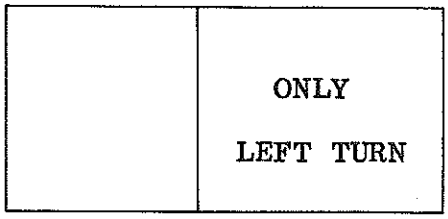


(b) 2 lanes in eastbound direction. Do not use center lane.

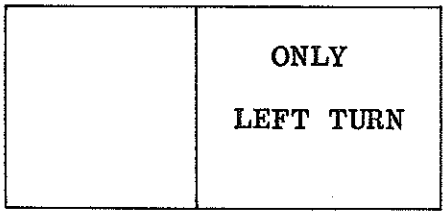


3. Off-peak hour traffic. Reversible lane control sign in operation as follows:

(a) 2 lanes in eastbound direction.



(b) 2 lanes in westbound direction.



The dimensions of the casing for the X and arrow are 31½" x 36". The dimensions of the casing for the illuminated "Left Turn" sign are 61-3/8" x 36". The overall dimensions of the sign are approximately 92" x 36". Eight-inch letters are use for "Left Turn" and 13-inch letters for "No--Only".

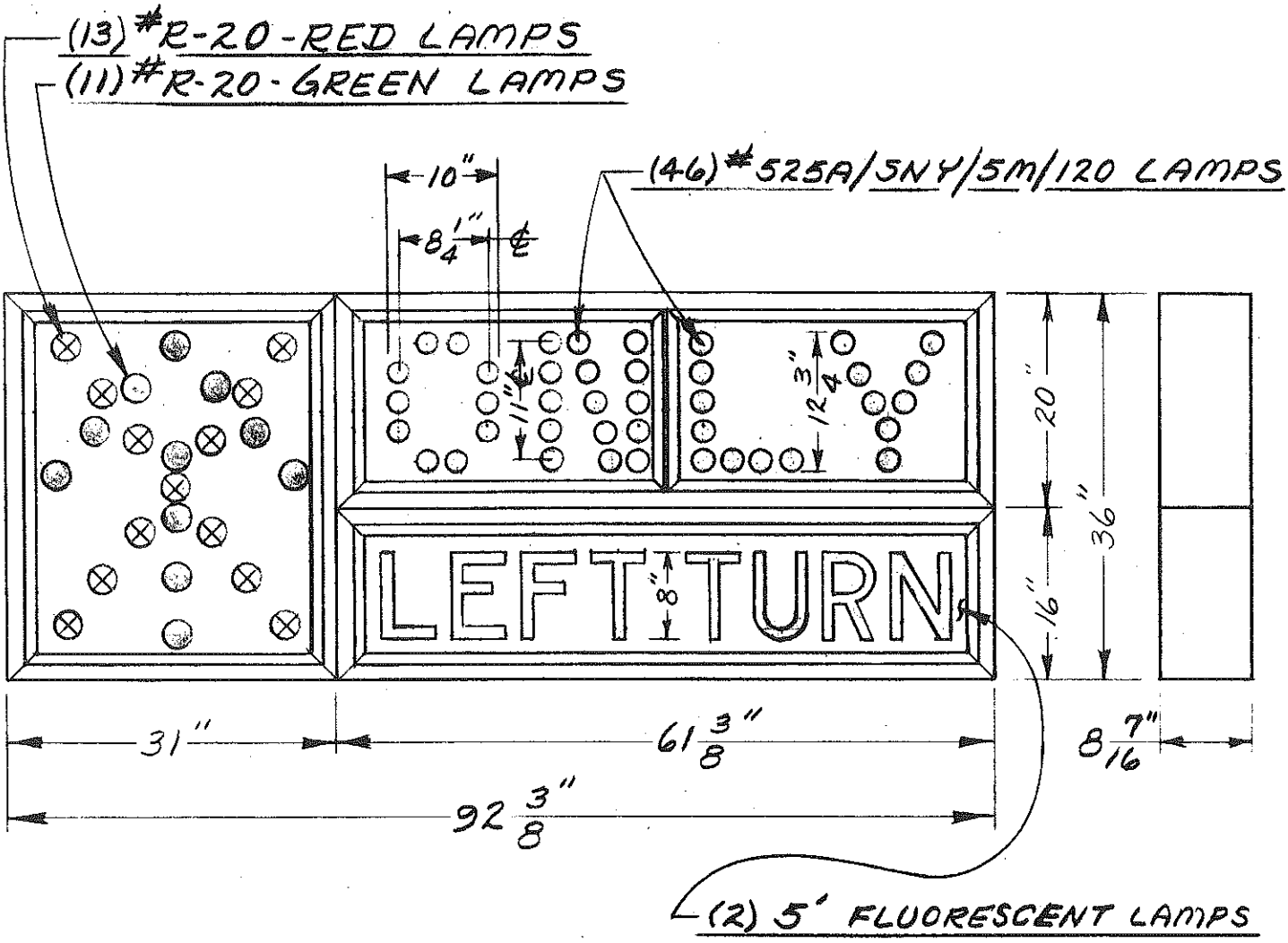
Figure 1 details the physical and electrical characteristics of this reversible center lane signal.

Figure 2 presents the reversible center lane signal with a view in the direction of peak eastbound traffic and displays a green arrow for center lane usage.

Figure 3 presents the reversible center lane signal with a view of peak eastbound traffic as seen by westbound traffic. The red "X" is displayed for westbound traffic, indicating the center lane is not open for their use.

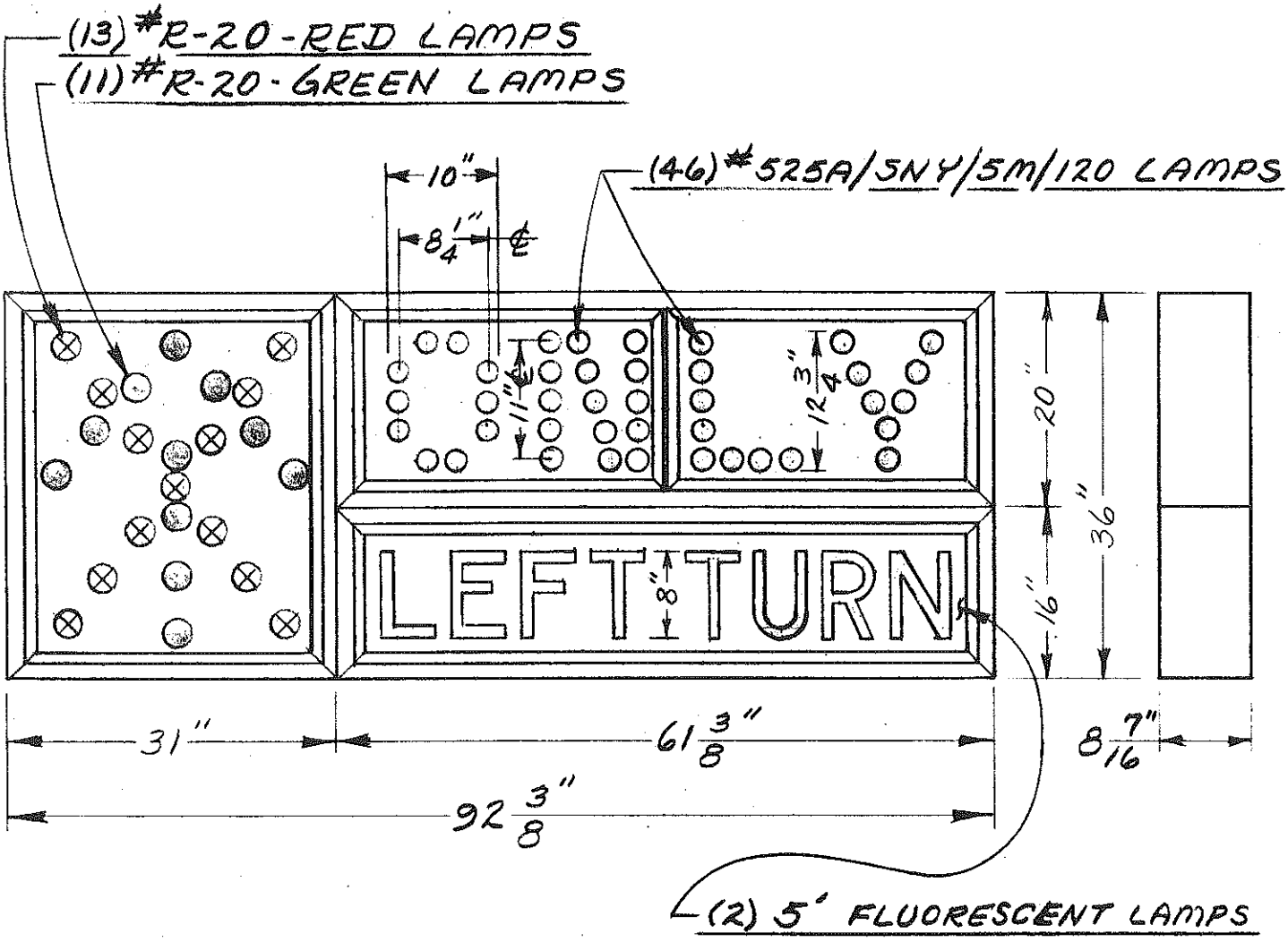
Figure 4 presents off-peak traffic in which the center lane is reserved for left turns only.

FIGURE #1.



MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC DIVISION	REVERSIBLE LANE SIGNAL SCALE: 1/16" = 1"	AUTH. NO.	NAME W.C.G.
		CONT. SEC.	DATE 9-9-64
		REF.	SCALE 1/16" = 1"
		SHEET 1 OF 1	PLAN

FIGURE #1.



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		CONT. SEC.	DATE 9-9-64
		REF.	SCALE 1/16" = 1"
		SHEET 1 OF 1	PLAN

FIGURE 2

FIGURE 3

FIGURE 4

Evaluation of Operation

The reversible center lane signals were placed over the center lane at strategic points throughout the 1.2-mile section of trunkline. They were placed at mid-block locations to present a left-turn or no-left-turn area control rather than an intersection or point control.

Figure 5 is a strip map of the reversible center lane study area presenting the location of the signals.

The evaluation of the reversible center lane system was based primarily upon its operation during peak traffic periods. The measurements for this evaluation are as follows:

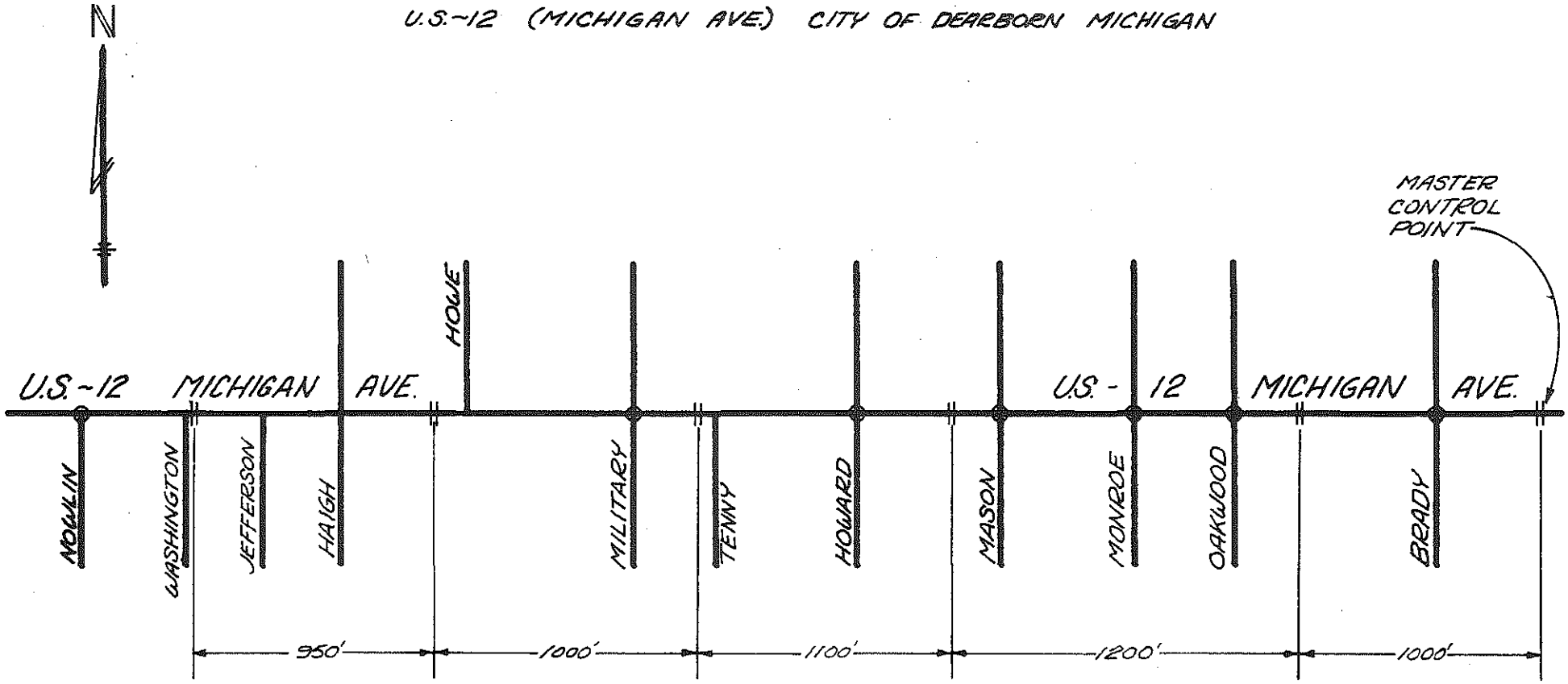
1. Traffic Volume Comparisons
2. Travel Time Comparisons
3. Accidents

In addition, observance of the left-turn prohibition during peak periods was studied to determine the effectiveness of the left-turn area control feature of the system. Further, an investigation of the effects of street parking removal was performed as well as an inventory of off-street parking facilities.

FIGURE 5

REVERSIBLE CENTER LANE TRAFFIC SYSTEM

U.S.-12 (MICHIGAN AVE.) CITY OF DEARBORN MICHIGAN



LEGEND

REVERSIBLE LANE CONTROL SIGNAL

SIGNALIZED INTERSECTION

Traffic Volume Comparisons

Traffic volumes were obtained within the reversible lane section for the peak directions and during the A.M. and P.M. peak periods. Volume comparisons for the peak period - peak direction are presented in Tables 1 and 2.

In addition to peak period totals, the high 2-hour, high hour and high 15-minute volumes are shown. Traffic volumes were obtained on two occasions for "after" comparison. The first "after" was conducted in October 1963, approximately three weeks after the installation of the reversible center lane system. The second "after" was conducted in January 1965.*

Traffic volumes were obtained at five stations. Data from three stations are presented here for the traffic volume consideration. The location of the traffic volume stations is presented in Figure 6.

In general, the volume comparisons show slight but definite increases in peak direction traffic volumes.

*During the first year of operation adjustments and modifications were made in signalization relative to spacing of signals and progression. Thus, the second "after" was conducted in January 1965 following these adjustments and modifications.

TABLE 1

TRAFFIC VOLUME COMPARISONS

PEAK PERIOD PEAK DIRECTION

EAST BOUND 6-9 AM

STATION	1			3			5		
	BEFORE	AFTER #1	AFTER #2	BEFORE	AFTER #1	AFTER #2	BEFORE	AFTER #1	AFTER #2
DATE	AUG. '63	OCT. '63	JAN. '65	AUG. '63	OCT. '63	JAN. '65	AUG. '63	OCT. '63	JAN. '65
PEAK PERIOD TOTALS	4805	5190	5028	4046	4427	4855	4074	4406	4593
% INCREASE		8.0	4.6		9.4	20.0		8.1	12.7
HIGH 2HR.	3607	4220	3953	3276	3567	3826	3122	3504	3584
% INCREASE		17.0	8.8		8.9	16.8		12.2	14.8
HIGH HOUR	2134	2605	2466	1932	2069	2302	1777	2041	2130
% INCREASE		22.0	15.6		7.0	19.1		14.9	19.9
HIGH 15 MINUTE	589	871	676	552	572	645	498	543	581
% INCREASE		47.9	14.8		3.6	16.8		9.0	16.7

TABLE 2

TRAFFIC VOLUME COMPARISONS

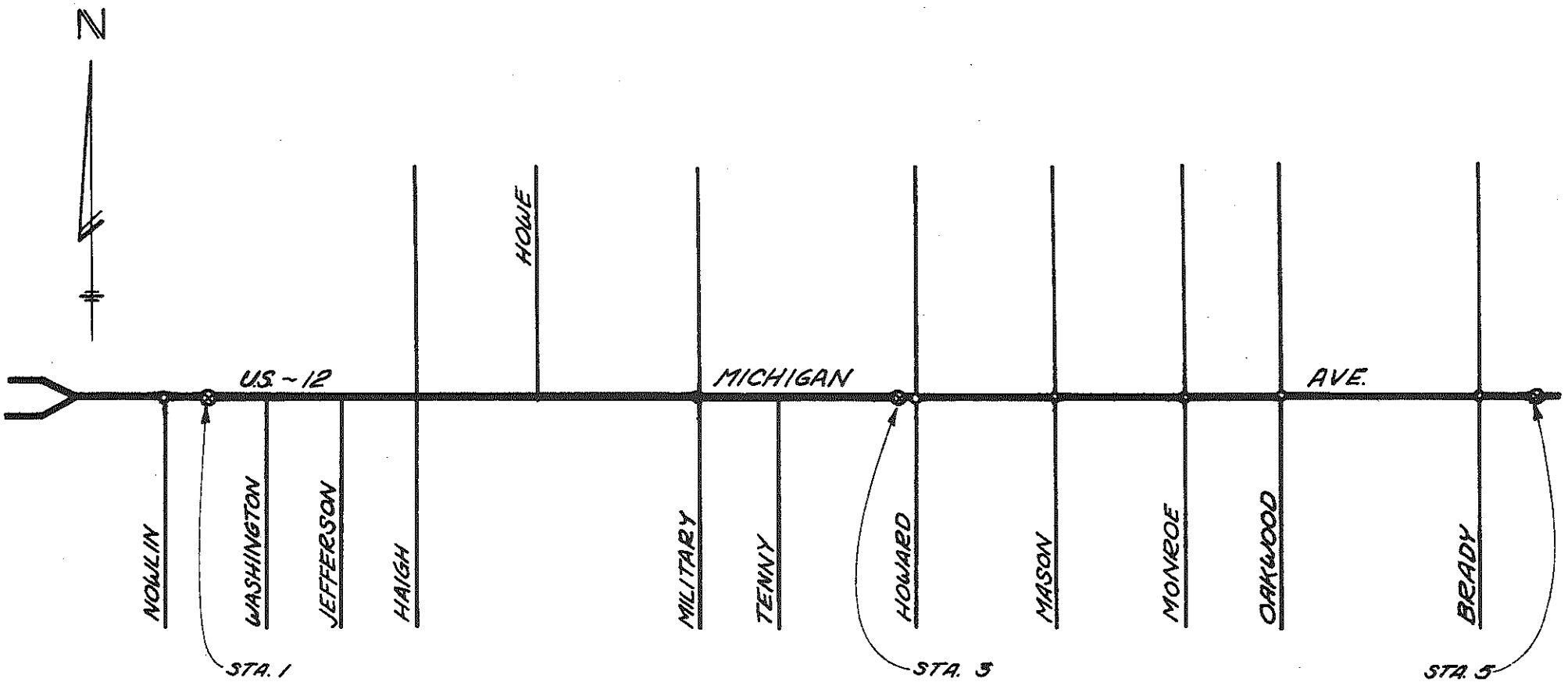
PEAK PERIOD PEAK DIRECTION

WEST BOUND 3-6 PM

STATION	1			3			5		
	BEFORE	AFTER #1	AFTER #2	BEFORE	AFTER #1	AFTER #2	BEFORE	AFTER #1	AFTER #2
DATE	AUG. '63	OCT. '63	JAN. '65	AUG. '63	OCT. '63	JAN. '65	AUG. '63	OCT. '63	JAN. '65
PEAK PERIOD TOTALS	6338	6641	6321	5500	5739	5897	4406	4567	4463
% INCREASE		4.8	-0.3		4.3	7.2		3.7	1.3
HIGH 2HR.	4619	4908	47.54	4278	4218	4453	3189	3361	3339
% INCREASE		6.2	2.9		-2.2	3.3		5.4	4.7
HIGH HOUR	2514	2818	2705	2351	2467	2500	1772	1867	1879
% INCREASE		12.1	7.6		5.0	6.3		5.4	6.0
HIGH 15 MINUTE	697	764	719	678	692	737	505	509	564
		9.6	3.2		2.1	8.0		0.8	11.7

FIGURE 6

REVERSIBLE CENTER LANE TRAFFIC SYSTEM



Legend

⊗ Traffic Volume Station

✛ Intersection Signal

The total traffic utilizing US-12 (Michigan Avenue) was not expected to increase a great deal, as the character of this urban traffic remains generally the same. This fact was supported by 8-hour and 24-hour traffic counts not shown herein. However, the high hour and high 15-minute volumes do reveal the improvement received in capacity under the reversible center lane system.

Figures 7 and 8 present graphically the peak period traffic volumes by peak direction by 15-minute intervals. These figures show the increases in volumes during the peak periods, but also illustrate graphically that traffic volumes over the same time intervals reached higher peaks. It appears that, compared to the "before", the system permitted slightly higher volumes to pass during the same time period, or passed the same volumes in a shorter time. The peak period thus seems to have begun later and ended sooner.

Table 3 presents the time required to clear the equivalent of the "before" high 2-hour volume after the system was installed.

FIGURE 7

REVERSIBLE CENTER LANE TRAFFIC SYSTEM

PEAK PERIOD PEAK DIRECTION

EAST BOUND MORNING PERIOD

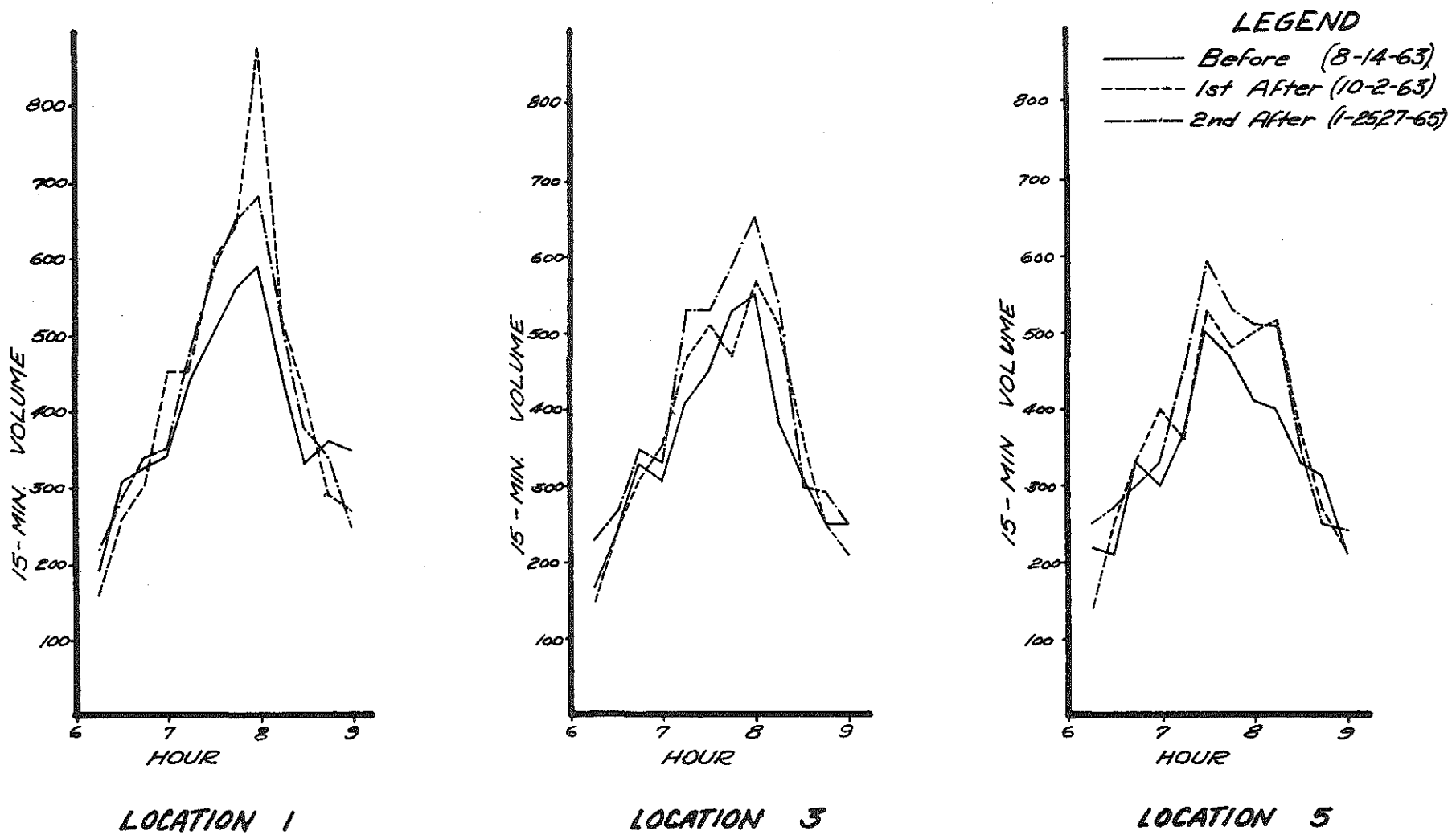
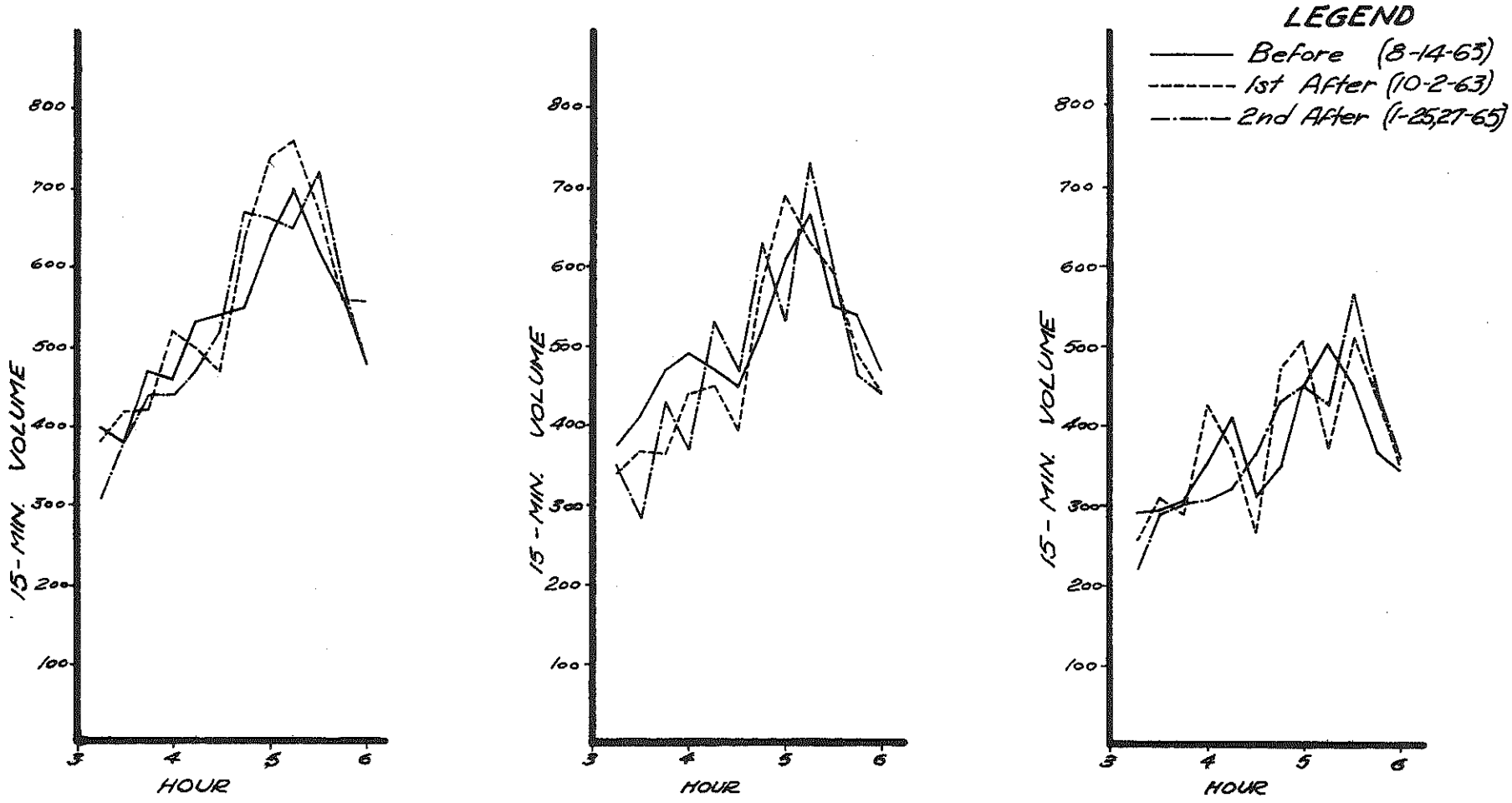


FIGURE 8

REVERSIBLE CENTER LANE TRAFFIC SYSTEM

PEAK PERIOD PEAK DIRECTION

WEST BOUND AFTERNOON PERIOD



LOCATION 1 LOCATION 3 LOCATION 5

TABLE 3

REQUIRED TIME FOR EQUIVALENT TRAFFIC VOLUME

("BEFORE" HIGH 2HR. VOLUME)*

PEAK PERIOD PEAK DIRECTION

	EASTBOUND		WESTBOUND	
	AFTER #1	AFTER #2	AFTER #1	AFTER #2
DATE	OCT. 1963	JAN. 1965	OCT. 1963	JAN. 1965
TIME	1HR. 34MIN.	1HR. 44MIN.	1HR. 51MIN.	1HR. 56 MIN.
STATION 3				
TIME	1HR. 48 MIN.	1HR. 33 MIN.	2HR. 3MIN.	1HR. 55MIN
STATION 5				
TIME	1HR. 42 MIN.	1HR. 39 MIN.	1HR. 54 MIN.	1HR. 53 MIN

* THE TIME DURING WHICH THE EQUIVALANT "BEFORE HIGH 2 HR. TRAFFIC VOLUME TRAVELED THROUGH THE STUDY AREA.

Travel Time Comparisons

Travel times, through the reversible center lane system, are presented in Table 4. Travel time was measured from Outer Drive to Elm Street. Thus the reversible center lane system was contained within this area. Travel time runs were conducted during the peak periods for the peak directions. For the "before" condition travel time, data was obtained in August 1963. For comparison with the system installed, travel time data was obtained in December 1963, approximately three months after the installation of the system, and again in March 1964, approximately six months after its installation. Travel time comparisons were made from the number of travel time runs as follows:

	Before	After #1	After #2
A.M. Peak	15	16	16
P.M. Peak	12	16	16

The travel time runs were conducted in a manner to assure that speed and movement of the test vehicle were representative of the character of the traffic. In some runs, the test vehicle remained in the same lane through the section, while in other runs, lane changes were made.

TABLE 4

TRAVEL TIME AND SPEED COMPARISONS

PEAK PERIODS ~ PEAK DIRECTIONS

	7 ~ 9 A.M.						4 ~ 6 P.M.					
	EASTBOUND						WESTBOUND					
	BEFORE		AFTER*			INCREASE OR DECREASE	BEFORE		AFTER*			INCREASE OR DECREASE
	MIN.	SEC.	No.	MIN.	SEC.		MIN.	SEC.	No.	MIN.	SEC.	
AVERAGE TRAVEL TIME	3	28	1	2	54	-16.0 %	4	39	1	4	09	-11.0 %
			2	2	49	-18.8 %			2	3	45	-20.0 %
	M.P.H.		M.P.H.				M.P.H.		M.P.H.			
AVERAGE SPEEDS	24.2		1	29.0		+20.0%	18.1		1	20.2		+12.0%
			2	29.8		+23.2%			2	22.4		+23.8%

* AFTER STUDY No. 1 ~ DEC. 1963, AFTER STUDY No. 2 ~ MAR. 1964

Figure 9 presents the travel time comparisons graphically.

The effect of the reversible lane system has been a reduction in travel time for peak-direction, peak-period traffic. The data obtained in the second "after" study revealed an additional reduction in travel time.

Speed comparisons are presented in Table 4. The speed comparisons reflect the decrease in travel time.

Speed comparisons are presented in Table 4. The speed comparisons reflect the decrease in travel time as a result of the increase in speed. Figure 9A presents the average speed comparison data. The speed comparisons between the first and second "after" studies revealed an additional increase in average speeds after a six-month's period of operation.

FIGURE 9

TRAVEL TIME COMPARISONS

PEAK PERIOD ~ PEAK DIRECTION

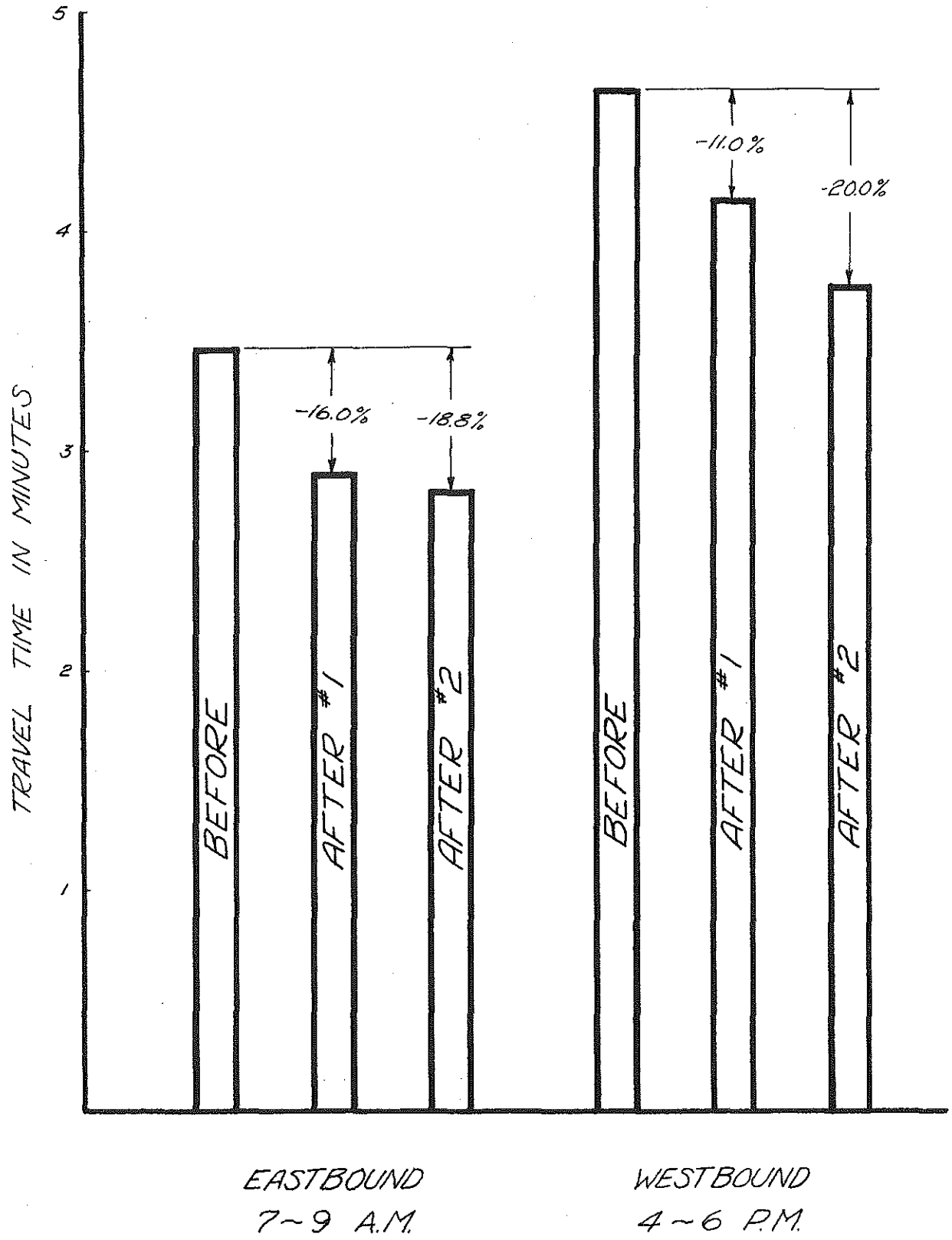
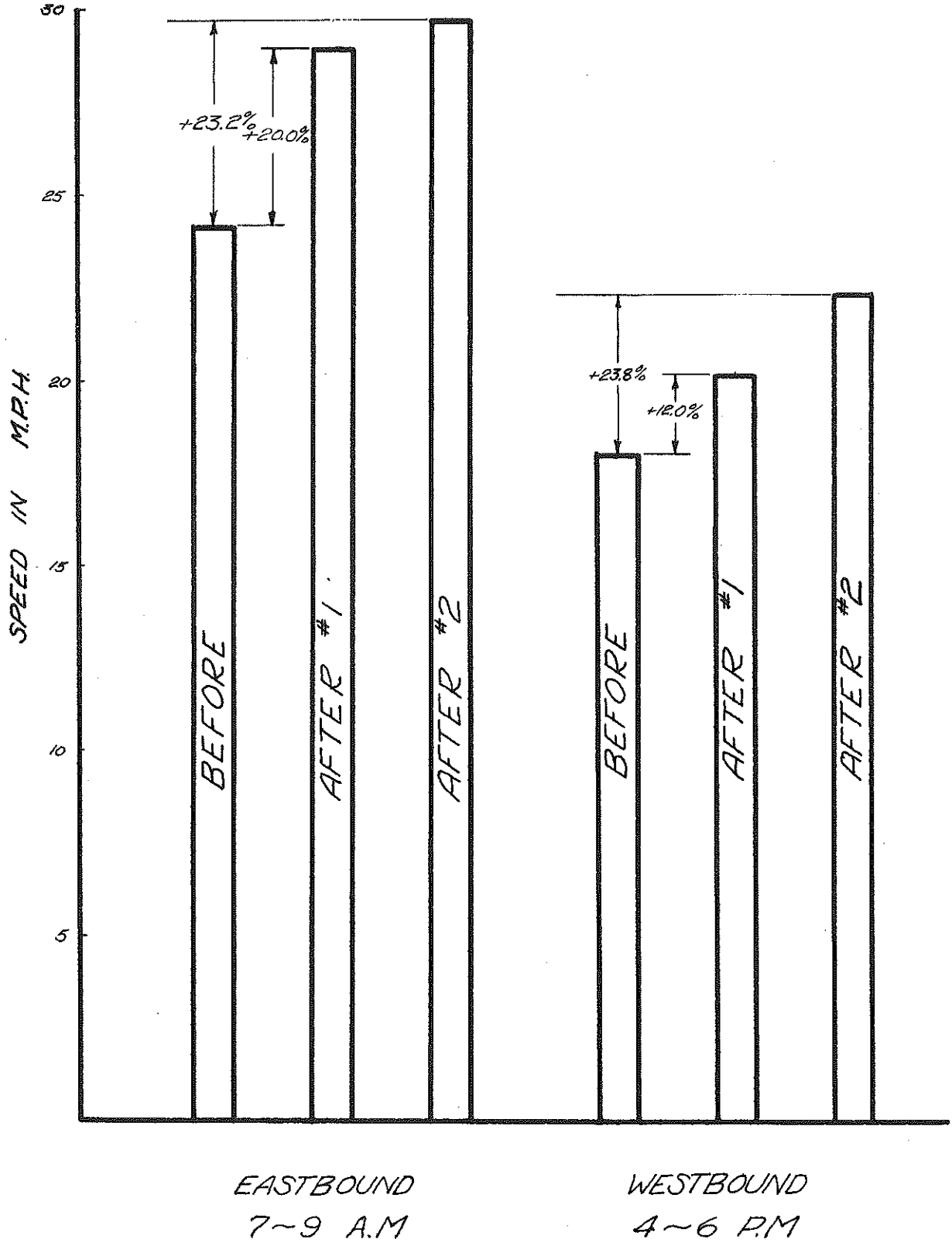


FIGURE 9A

SPEED COMPARISONS

PEAK PERIOD ~ PEAK DIRECTION



Accident Study

The total accident summary by type is shown in Table 5 for the time periods as follows:

1. One year before installation of the system
2. First year of operation
3. Second year of operation

As mentioned previously, considerable adjustments and modifications were performed to the traffic signal system relative to spacing and progression during the first year of the system's operation. Also, some construction work under way for most of the first year required blocking of one lane during off-peak hours. These factors, according to the Dearborn officials, rendered the first year accident record not wholly representative. Thus it was deemed advisable to obtain the accident experience for the second year of operation which perhaps would be a more representative period.

It is interesting to note the achieved reduction in accidents related to parking. Parking was removed when the system was installed. It is also important to report that not one head-on accident occurred in the center lane

TABLE 5

ACCIDENT STUDY
TOTAL ACCIDENT SUMMARY

TYPE OF ACCIDENT	ONE YEAR BEFORE*	1ST YEAR AFTER†	DIFF.	2ND YEAR AFTER‡	DIFF.
REAR END					
STRAIGHT	137	192	+ 55	147	+10
LEFT-TURN	57	32	- 25	10	-47
RIGHT-TURN	18	23	+ 5	15	- 3
TOTAL	212	247	+35	172	-40
HEAD-ON LEFT-TURN	2	0	-2	22	+20
PARKING	59	17	-42	4	-55
SIDESWIPE					
SAME DIRECTION	22	26	+4	30	+8
OPPOSING DIRECTION	3	0	-3	1	-2
TOTAL	25	26	+1	31	+6
PEDESTRIAN	9	5	-4	12	+3
FIXED OBJECT	7	4	-3	7	0
RIGHT ANGLE	31	34	+3	31	0
TOTAL	345	333	-12	279	-66

FIRST YEAR DECREASE = 12 = 3.5%

SECOND YEAR DECREASE = 66 = 19%

* SEPT. 16, 1962 TO SEPT. 15, 1963

† SEPT. 15, 1963 TO SEPT. 15, 1964

‡ NOV. 20, 1964 TO NOV. 20, 1965

when it was utilized as a reversing lane for peak traffic movements.

The first year of operation showed an increase in straight rear-end accidents. Perhaps increased volumes and speed are accountable for this increase. These rear-end accidents were associated with the signalized intersections almost entirely. The increase in head-on left-turn accidents for the second year of operation is also noteworthy and will be reviewed further. Table 5 shows a decrease of 3.5 percent for the first year and 19 percent for the second year of operation.

Figure 10 graphically presents the total accident summary.

Table 6 presents the total accidents by peak and off-peak periods. The total accidents during peak periods remained essentially the same. This must be examined along with increased traffic volumes, reduced travel times, and increased speeds to obtain the true picture. Further, a decided decrease in total off-peak accidents resulted. A further examination of off-peak accidents indicated a reduction in left-turn rear-end accidents as follows: Before - 40, first year after - 20, second year after - 4.

FIGURE 10

ACCIDENT STUDY
TOTAL ACCIDENT SUMMARY

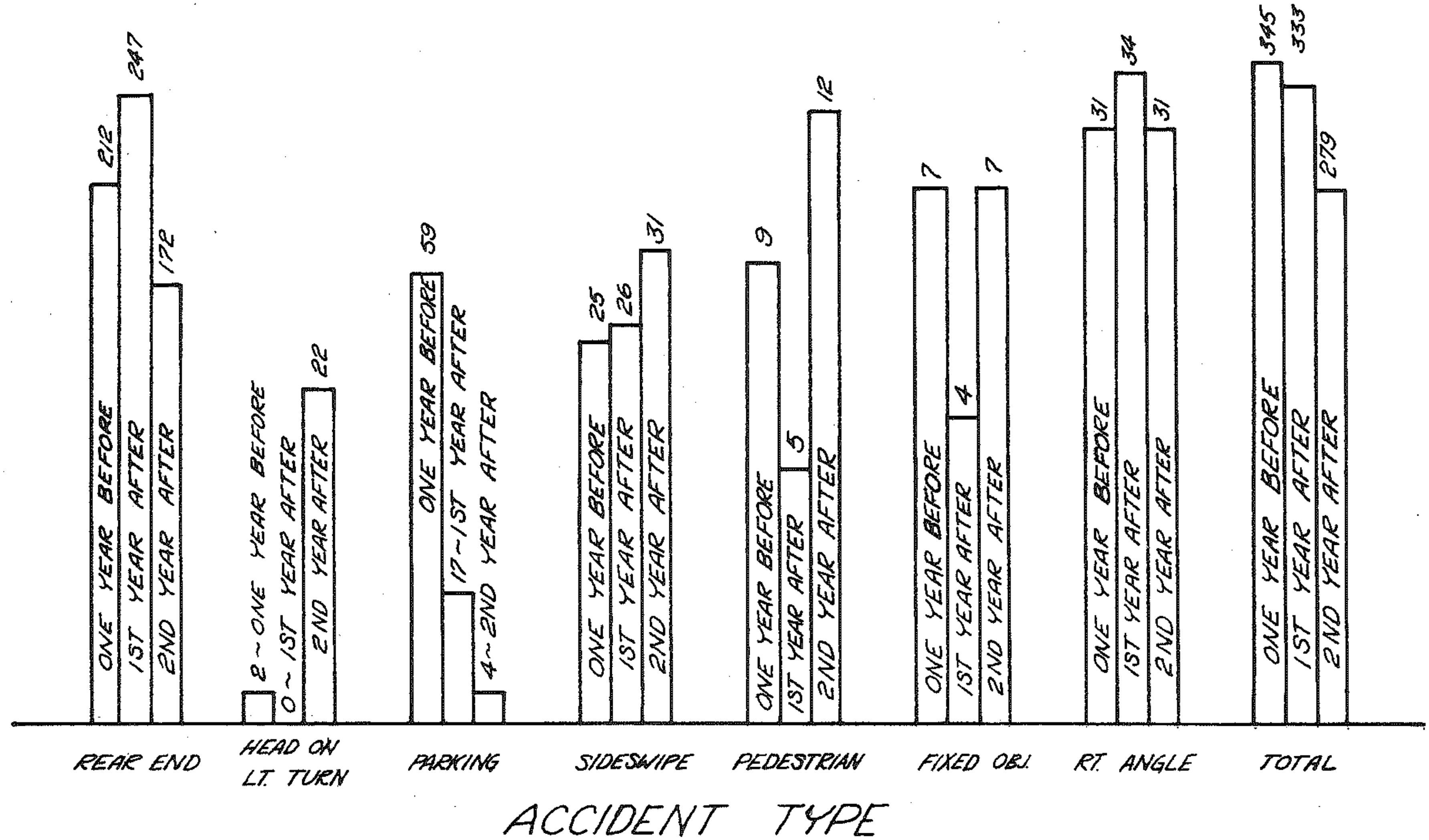


TABLE 6

ACCIDENT STUDY

TOTAL ACCIDENTS ~ PEAK & OFF PEAK PERIODS

	PEAK PERIODS			OFF~PEAK
	6~9 A.M.	3~6 P.M.	TOTAL	
ONE YEAR BEFORE	31	84	115	230
1ST YEAR AFTER	34	86	120	213
2ND YEAR AFTER	30	80	110	169

This is interesting in view of the fact that left turns are now permitted throughout the study section; whereas, before, left turns were prohibited at signalized intersections. It does perhaps reveal a benefit of the center lane being reserved for left turns during the off-peak period.

Left Turn Area Control Observance

Prior to the installation of the reversible lane system, left turns were prohibited at all signalized intersections. However, left turns were permitted mid-block.

With the installation of the reversible lane system and the five-lane operation, it was necessary to prohibit left turns during peak periods throughout the reversible lane section. During the off-peak periods, the center lane was reserved for left turns only. The left-turn message applied to the entire area or length of the section.

The reversible lane signal provides the left turn control feature for an area basis. An attempt was made to evaluate this feature of left turn area control vs. left turn point control. However, a left turn

control observance study was not conducted prior to the installation of the system. Thus a comparison was made of the left turn area control in the reversible center lane system and the system in operation on Grand River in Detroit. The Grand River System has the center lane reversed for peak traffic flow and the center lane reserved for left turns in the off-peak period. This system, however, utilized the standard fixed message signs.

This comparison revealed no correlation between the left turn controls on either system because of the different environmental characteristics, commercial development, and traffic characteristics, as well as the important potential difference in enforcement between the two cities. The Grand River System has been in operation for several years. Therefore, a common base for comparison was not possible.

A few reports of confusion with the zone control feature of the left turn phase of the reversible lane signal were received. It was, therefore, decided to install a reflectorized sign with the legend "Zone Control" below the electrical reversible lane signals. Observations

of left turn area control compliance were made before and after this sign was installed. These observations covered the total area control by the reversible lane system. As mentioned before, left turns were permitted during the off-peak periods only. A very comprehensive and complete collection of left turn violations was conducted. The results of these observations revealed no significance in changes in the observance of the left turn area control with or without the sign "Zone Control" installed. This was at the five percent level of probability.

The areas where left turn violations existed to any consequence were at the extreme ends of the system and at Monroe. (See Figure 5) This led to a review of the spacing of the reversible lane signals. Thus additional signals are being considered for these locations to provide as complete information as possible.

It was also felt that additional education and enforcement would readily eliminate any remaining misunderstanding over the area control for left turns.

Parking Summary

The reversible lane system required the removal of curb parking from both sides of Michigan Avenue and a total of 170 stalls were removed.

The off-street parking facilities provided by the City of Dearborn were more than adequate to offset the loss of street parking.

The inventory of parking availability and its present occupancy is presented in Table 7. A comparison of these factors to the Northland Center parking lots is presented to verify relative adequacy.

TABLE 7

PARKING SUMMARY

U.S.-12 (MICHIGAN AVE.) CITY OF DEARBORN, MICHIGAN

REVERSIBLE CENTER LANE SYSTEM

NORTHSIDE : BRADY TO HAIGH

10 LOTS

750 STALLS *

41 % AVG. OCCUPANCY

SOUTHSIDE : BRADY TO NOWLIN

33 LOTS

2181 STALLS

44 % AVG. OCCUPANCY

NORTHLAND SHOPPING CENTER (APRIL 1959) †

8000 STALLS

38 % OCCUPANCY

* NORTHSIDE SPECIAL ACCESSMENT DISTRICT TO PROVIDE FOR 440 STALLS BETWEEN OAKWOOD & MILITARAY A COST OF #400,000

† STUDY PERIOD WED. & THUR. AVERAGE ~ 9:30 A.M. TO 6:00 P.M. FOR ½ HR. INCREMENTS

Summary and Conclusions

The reversible center lane system installed on Michigan Avenue (US-12) in the City of Dearborn, Michigan, resulted in the following improvements in operation:

Traffic Volume Comparisons

The comparisons of operation by traffic volume can best be illustrated by the increase in high hours and high 15-minute volumes at three traffic stations. This data is shown as of January 1965, one year and four months of operation.

Morning peak (6:00-9:00 a.m.) - Eastbound Traffic - 3 Lanes

Station	1	3	5
High Hour	2466	2302	2130
Percent Increase	15.6	19.1	19.9
High 15-Minutes	676	645	581
Percent Increase	14.8	16.8	16.7

Afternoon peak (3:00-6:00 p.m.) - Westbound Traffic - 3 Lanes

Station	1	3	5
High Hour	2705	2500	1879
Percent Increase	7.6	6.3	6.0
High 15-Minutes	719	737	564
Percent Increase	3.2	8.0	11.7

Travel Time Comparisons

The average travel time decreased and average speeds increased for all travel time runs as follows:

Morning peak (7:00-9:00 a.m.) - Eastbound Traffic - 3 Lanes

Period	Before	After #1	After #2
Avg Travel Time	3 min 28 sec	2 min 54 sec	2 min 49 sec
Percent Decrease		167.	18.8
Avg Speeds	24.2 mph	29 mph	29.8 mph
Percent Increase		207.	23.2

Afternoon peak (4:00-6:00 p.m.) - Westbound Traffic - 3 Lanes

Period	Before	After #1	After #2
Avg Travel Time	4 min 39 sec	4 min 09 sec	3 min 45 sec
Percent Decrease		11.	20.0
Avg Speeds	18.1 mph	20.2 mph	22.4 mph
Percent Increase		12.	23.8

Accident Summary

The accident summary for one year before as compared to the first year and second year of operation shows a decrease in 3.5 percent and 19 percent respectively. However, it was expected and is noteworthy that a reduction in accidents occurred when parking was removed. This affirms very definitely the effect of parking removal as related to accidents.

Some types of accidents increased during two years of operation. Certain types of accidents were not associated with the reversible center lane system. However, all are presented for the general trend. Past experience has shown definitely that rear-end accidents will occur at signalized intersections. The increase in this type during the first year cannot completely be explained. Many adjustments to the traffic signal system and modification therein in spacing and progression may have some bearing on this fact. The increase in speed of traffic may be a contributing factor.

Nevertheless, the general result is a reduction in total accidents with the reversible center lane system in operation.

When the increase in traffic volumes and the decrease in travel time are taken into account, the system perhaps provides greater potential safety than before its installation.

The left turn area control, which presented a new concept for this type of prohibition, has been successful with minor exceptions. These exceptions, it appears, can be rectified by additional reversible lane signals at the extremities of the study area and in the vicinity of the Monroe intersection.

The planning by the City of Dearborn officials for the off-street parking program simplified and eased the curb parking removal. No extreme inconvenience resulted for the business area in general. Actually the business community in this area has become more active since the program for off-street parking was initiated.

Conclusion

Finally, the general conclusion of this evaluation is that the application of the reversible lane system to a two-way street, with heavy directional movements, is a proven success in providing increased traffic volumes

and reduced travel time in the peak period and still improved the accident experience.

The system on US-12 (Michigan Avenue) in Dearborn has received highly favorable public acceptance and excellent support from the Dearborn city officials.

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