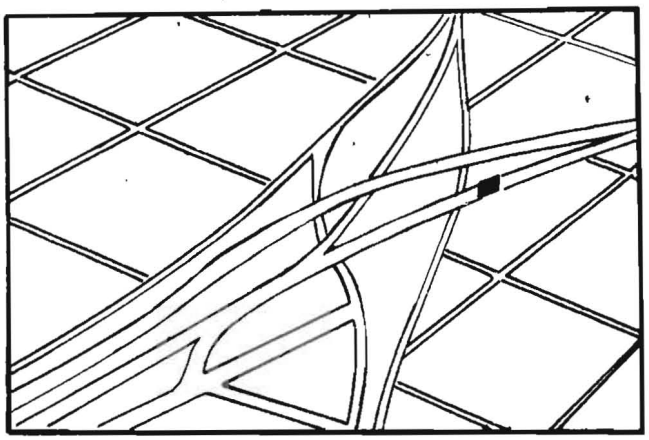
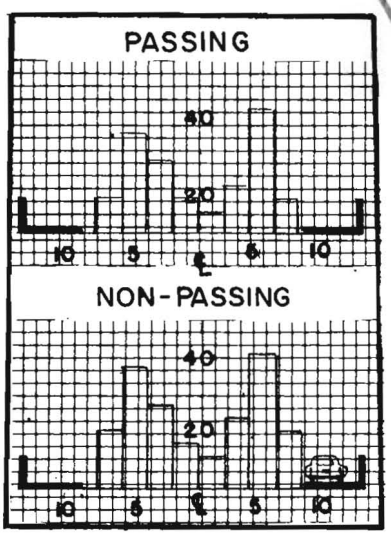


FREEWAY BRIDGE



- VEHICLE
- SPEED
- AND
- PLACEMENT
- SURVEY
- JULY, 1957

PREPARED BY ROAD DESIGN DIVISION
TEXAS HIGHWAY DEPARTMENT

This research was performed under the general direction of the Road Design Division and was made possible by the co-operation of the U. S. Bureau of Public Roads who furnished the measuring equipment used and also much expert advice and assistance through their representatives from the Headquarters, Regional and District Offices. The project was a co-ordinated effort of the Road Design Division, the Planning Survey Division and the Fort Worth District.

The report has been reviewed and approved by the Research and Development Committee of the Texas Highway Department.

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I. GENERAL OBJECTIVES

The intended purpose of this study was to determine the effect on traffic behavior of a vehicle stopped on the six foot shoulder of a two lane one-way freeway overpass. In the course of the study, however, it became evident that much of the data being collected was adaptable to further analysis dealing with the general operating characteristics of traffic. The speed and lateral placement of vehicles under various traffic volume conditions, are indicative of the adequacy of the design with respect to horizontal clearances, lane width, and shoulder width.

The conditions without and with vehicle on six foot emergency shoulder are shown by Figures 1 and 2.

SITE 25

Figure 1

SHOULDER CLEAR

SITE 26

Figure 2

PASSENGER CAR PARKED ON PARTIAL SHOULDER WITH HOOD RAISED, SIMULATING DISABLED VEHICLE

II. SUMMARY OF CONCLUSIONS

The vehicle stopped on the six foot shoulder did have an effect on traffic, but as traffic volumes increased the effect decreased. Differences in behavior in both speed and lateral placement were detected, with the lateral placement being most noticeably affected.

The presence of the vehicle, although it had an influence on traffic, did not seriously decrease the capacity or noticeably impair the safety of the facility which would indicate that a six foot emergency shoulder can accommodate a single stalled vehicle without seriously affecting traffic operation.

The application of the data collected in this study to general freeway operating characteristics is necessarily tied in with the association of this data with that collected at other locations. For this reason, no conclusions have been drawn on this phase of the study. However, the data has been presented in full.

Conditions existing during this study which should be considered in the application of these results are as follows:

There was no one visible around the disabled vehicle during the time of the study.

The disabled vehicle was stopped so close to the bridge rail that it was impossible to open the right door.

The percentage of trucks at this particular location was small, amounting to less than one percent of the vehicles during the peak hour.

III. METHOD OF STUDY

The equipment used in obtaining the field data consisted of combination speed meters and transverse placement detectors, described in detail in the April 1940 issue of Public Roads.[1] This equipment was furnished and operated by the U. S. Bureau of Public Roads.

The speed meters operated by use of pneumatic detectors that actuated a timing device which in turn recorded the speed of the vehicle on a moving paper tape. The speed was recorded by groups, and for this survey there were twenty-five groups with the upper and lower limits being open classifications.

Figure 3

[1] E. H. Holmes & S. E. Reymer "New Techniques in Traffic Behavior Studies" April 1940 Public Roads.

An electro-mechanical tape which actuated a recording device was used to measure the transverse placement. The plates on the tape were separated so that most vehicles actuated only two pens on the recorder thus giving an accurate location of the vehicle within three inches.

The moving paper tapes used for recording were timed so that they moved past the pens at a constant rate. This made possible the classification of maneuvers by time spacing and also the matching of speed and placement for each vehicle. Manual notes were made on the paper tape for vehicles other than passenger cars and for passing maneuvers.

The truck containing the recording equipment was completely hidden from view of the traffic on the freeway bridge to avoid influencing driver behavior. The data was hand coded and transferred to punch cards for machine tabulation.

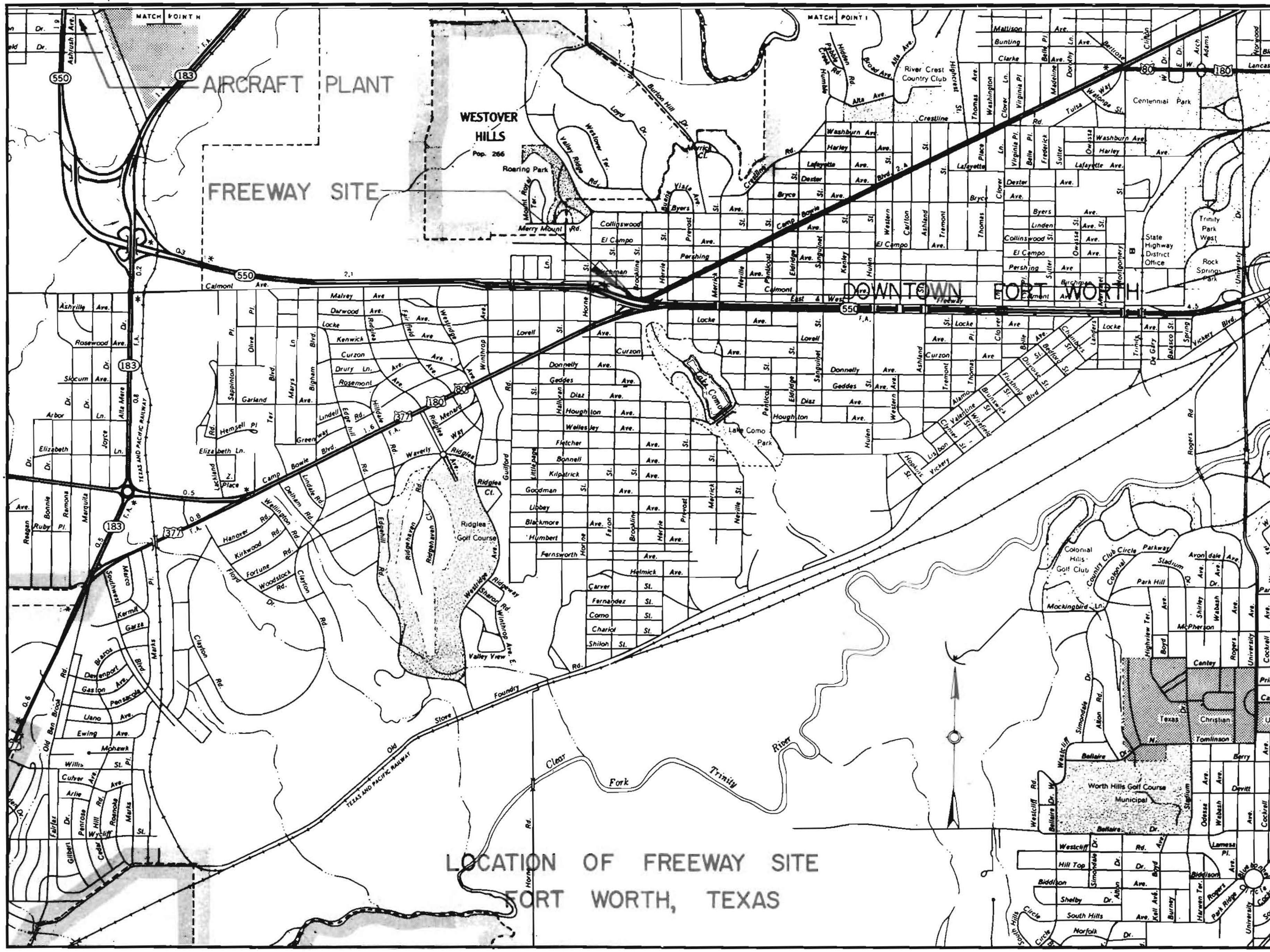
Vehicles were originally classified into 10 types, but samples in some types were small and operating characteristics were similar. For analysis, only two classifications were used. One included passenger cars and pick-ups, while the other included buses and all trucks.

The following classifications of vehicle maneuvers were made:

Passing - 1.8 sec. or less behind or ahead of car being passed. Passing vehicles are always in the left lane.

Being Passed - 1.8 sec. or less behind or ahead of car passing. Being-passed vehicles are always in the right lane.

Non-Passing - Includes all vehicles in either lane not included in the two classifications above.



LOCATION OF FREEWAY SITE
FORT WORTH, TEXAS

Figure 4

IV. LOCATION AND DESCRIPTION OF SITE

The study was conducted on the westbound lanes of State Highway 550 Freeway bridge crossing over Camp Bowie Boulevard in Fort Worth, Texas. A photograph of the overall site is shown in Figure 3.

The location of the study is shown in Figure 4 and photographs of the site without and with the vehicle stopped on the shoulder are shown in Figures 1 and 2 respectively.

CROSS-SECTION OF FREEWAY BRIDGE

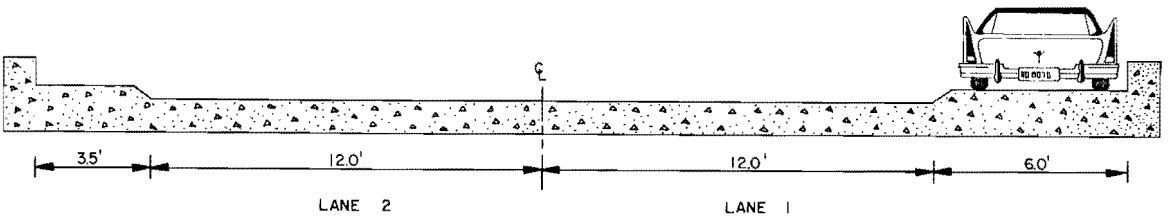


Figure 5

The freeway bridge roadway is 24 feet wide with standard guard rail, plus a six foot emergency shoulder on the right and a three and one half foot shoulder on the left. This section is shown in Figure 5. The roadway at the point of the study is on a 2 degree curve to the right.

The freeway at this point carries a considerable amount of traffic bound for the Convair Aircraft Plant and Carswell Air Force Base, which causes a high peak interval for a relatively short duration. The average daily traffic at this point for the one-way two-lane bridge is 15760 vehicles while the highest hour studied was 1414 vehicles. A five-minute volume counted during the peak interval, which lasted about 20 minutes, resulted in an hourly volume of 2484 vehicles when expanded.

V. DISCUSSION OF STUDIES

The study was conducted from 7:00 AM to 12:00 midnight on March 19, 1956 and March 20, 1956. On the first day the six foot shoulder was clear as shown in Figure 1. On the second day a car, supposedly a disabled vehicle, was stopped on the shoulder with the hood raised as shown in Figure 2. There was no one visible around the parked car. Speed and lateral placement were studied under both of these conditions.

Due to the similarity of volumes during parts of the time period studied, certain of the hours were grouped together for analysis.

This grouping and the averages resulting from the combination of hours are shown in Figure 6. For certain figures the data for the peak five minute period was extracted but the majority includes one or more full hours. This five minute extraction was made to show the operation at near capacity conditions.

The number of commerical vehicles observed in this study was too small for accurate analysis, and so it has been omitted from all computations except Figure 6.

Speed

Cumulative speed curves and the 85 percentile speeds for the various volume conditions and vehicle maneuvers are shown in Figures 7,

AVERAGE HOURLY TRAFFIC VOLUMES

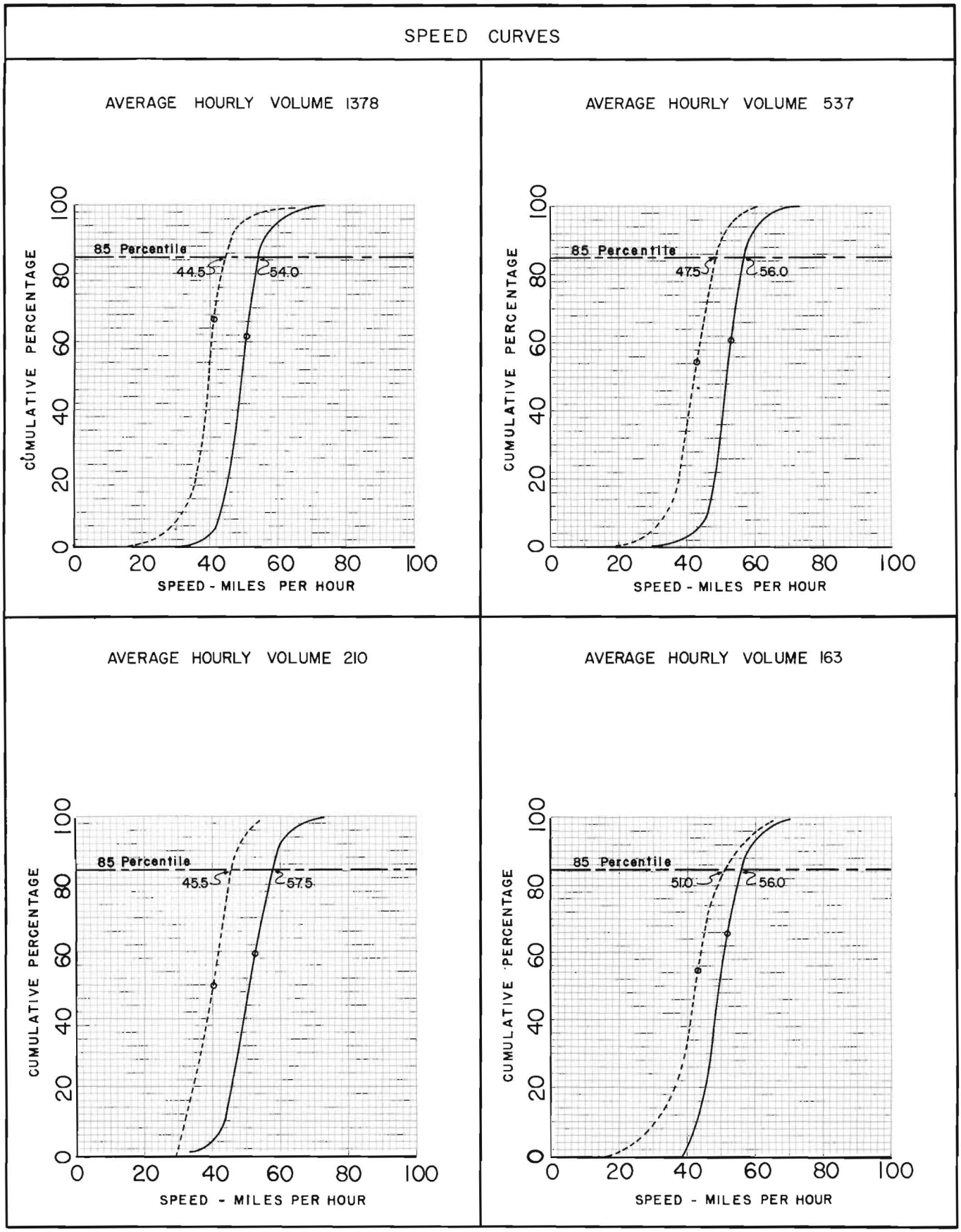
TIME	VOLUME CONDITION	SITE NO.	PASSENGER VEHICLES		COMMERCIAL VEHICLES		TOTAL VEHICLES		AVERAGE HOURLY TRAFFIC VOLUME
			LANE 1	LANE 2	LANE 1	LANE 2	LANE 1	LANE 2	
7:45 A.M.	PEAK EXPANDED FROM 5 MINUTE PEAK INTERVALS.	25	1440	1032	—	—	1440	1032	2472
		26	1308	1176	—	—	1308	1176	2484
		AVERAGE	1374	1104	—	—	1374	1104	2478
7 to 8 A.M.	PEAK HOUR	25	892	501	21	—	913	501	1414
		26	827	494	19	1	846	495	1341
		AVERAGE	860	497	20	1	880	498	1378
2 to 6 P.M.	MID-PEAK	25	418	120	6	—	424	120	544
		26	363	158	8	1	371	159	530
		AVERAGE	390	139	7	1	397	140	537
8 A.M. to 2 P.M. 6 to 7 P.M.	NORMAL	25	188	19	10	—	198	19	217
		26	153	41	10	—	163	41	204
		AVERAGE	170	30	10	—	180	30	210
7 to 11:59 P.M.	NIGHT	25	152	16	—	—	152	16	168
		26	118	39	—	—	118	39	157
		AVERAGE	135	28	—	—	135	28	163

ALL FIGURES ARE HOURLY AVERAGES FOR THE TIMES INDICATED.

LANE 1 - RIGHT LANE OR SHOULDER LANE
LANE 2 - LEFT LANE OR MEDIAN LANE

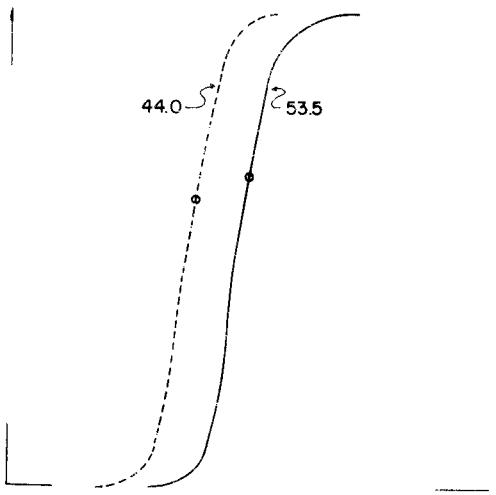
SITES 25 & 26 ARE THE SAME LOCATION
SITE 25 - SHOULDER CLEAR
SITE 26 - VEHICLE ON SHOULDER

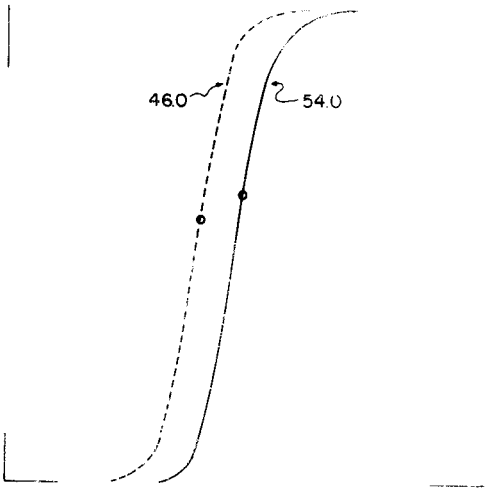
Figure 6

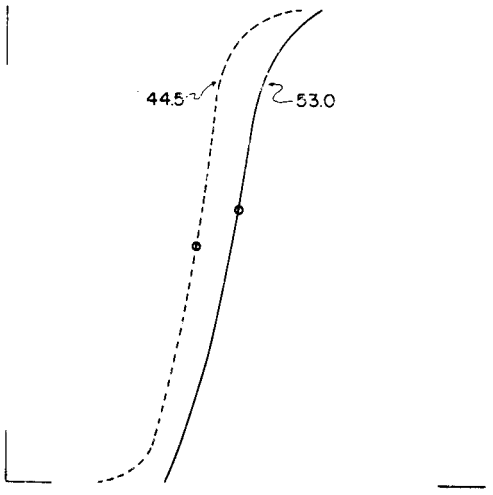


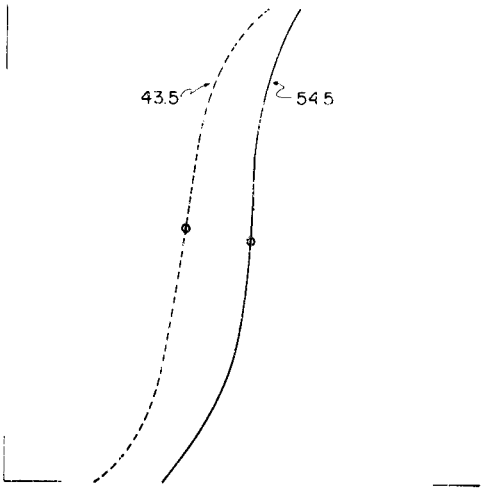
SITE 25 (WITHOUT VEHICLE)
— PASSING --- BEING PASSED
• AVERAGE SPEED

Figure 7



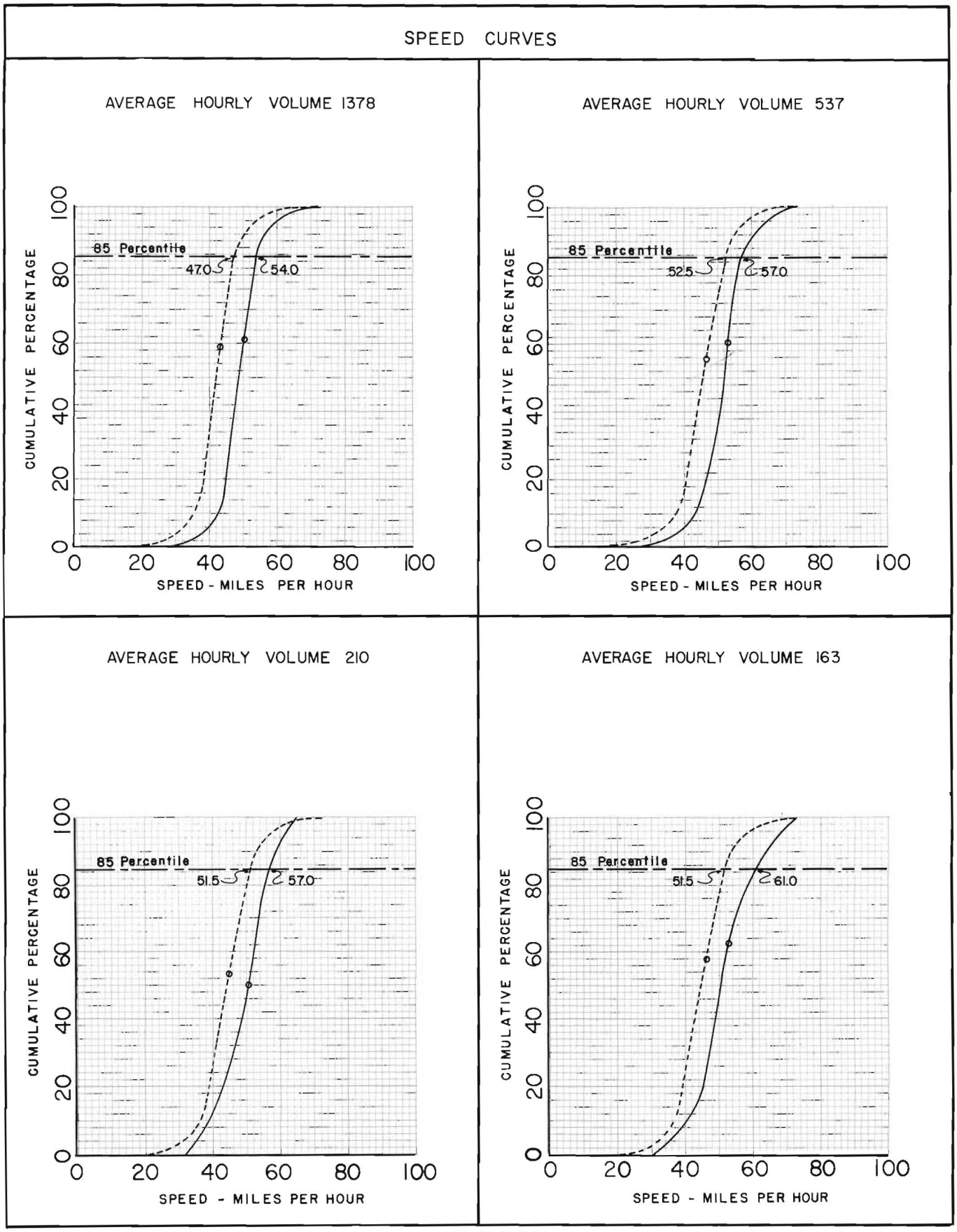






SITE 26 (WITH VEHICLE)

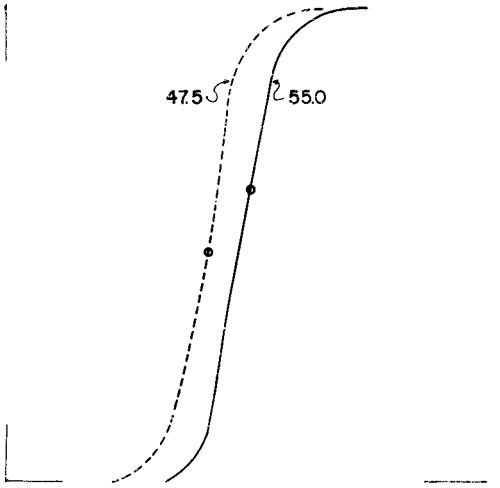
Figure 7A

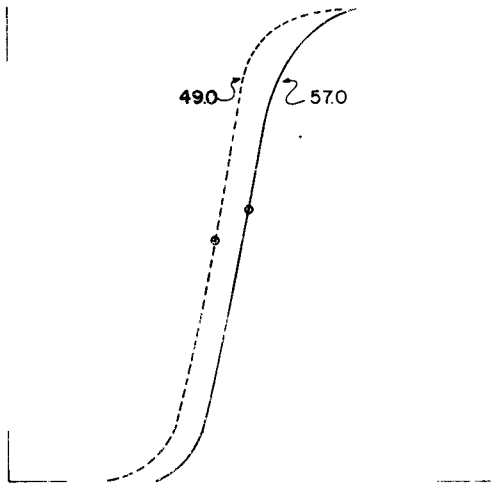


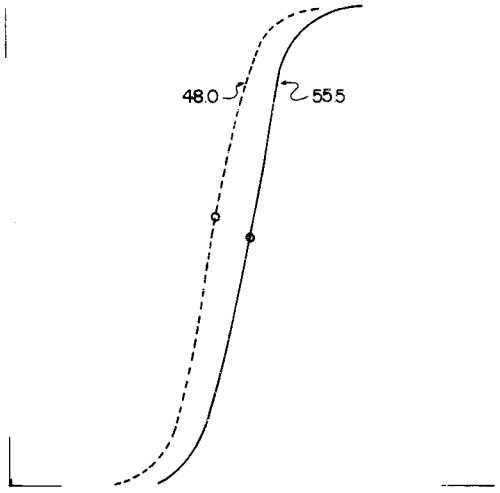
NON-PASSING
SITE 25 (WITHOUT VEHICLE)

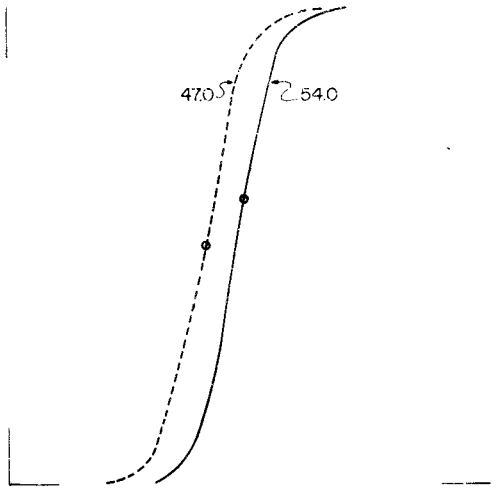
--- LANE 1 — LANE 2
AVERAGE SPEED

Figure 8









SITE 26 (WITH VEHICLE)

Figure 8A

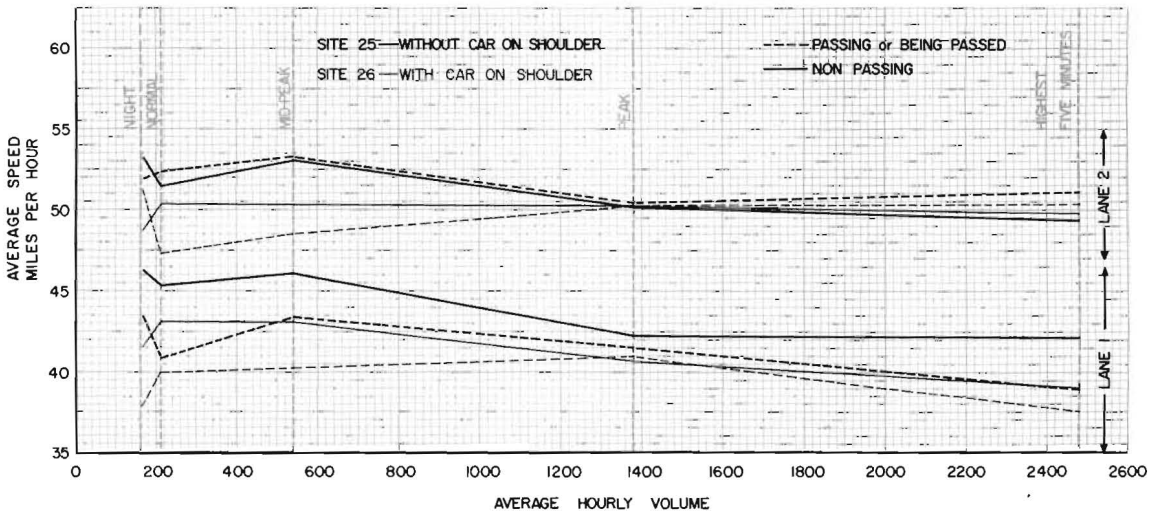
7A, 8 and 8A. These curves have been arranged so that comparisons may be made between the two shoulder conditions. The general effect of the parked car seems to have been to reduce speeds. It is also evident that speeds are lower in the right lane than they are in the left lane.

Speed Volume

Figure 9 shows the average speed plotted in relation to the hourly traffic volumes for the two shoulder conditions. Several things are illustrated here. Speeds in Lane 1, the right lane, are less than they

SPEED—VOLUME RELATIONSHIP

Figure 9



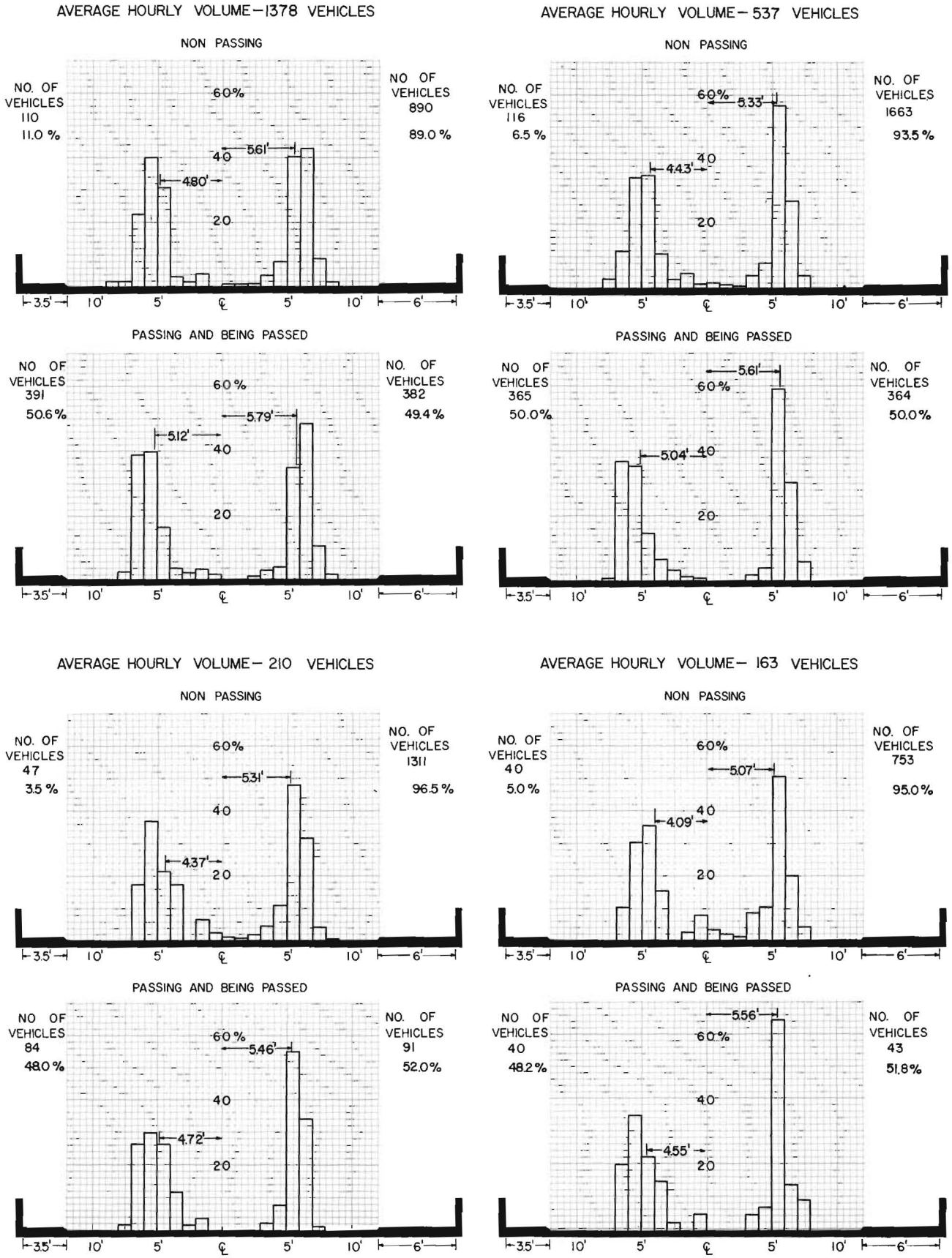
are in Lane 2. This difference seems to be increased by the presence of the vehicle on the shoulder, as volumes increase. This increased influence is more pronounced for passing and being passed vehicles than for non-passing vehicles, which indicates that a car in the right lane decreases its speed when it is "sandwiched," so to speak, between

a car on the shoulder and a car in the left lane. The effect on speeds by the vehicle on the shoulder is somewhat similar for both lanes for lower volumes, but as volumes increase, the effect on the left lane decreases.

There is a general converging of the speeds at the peak hour, with vehicles in the left lane traveling at a speed of about 50 MPH and those in the right lane at about 41 MPH. Speeds in the left lane continue to be fairly constant through the peak 5-minute volume while speeds in the right lane tend to decrease and show a wider variation between passing and non-passing vehicles.

Lateral Placement

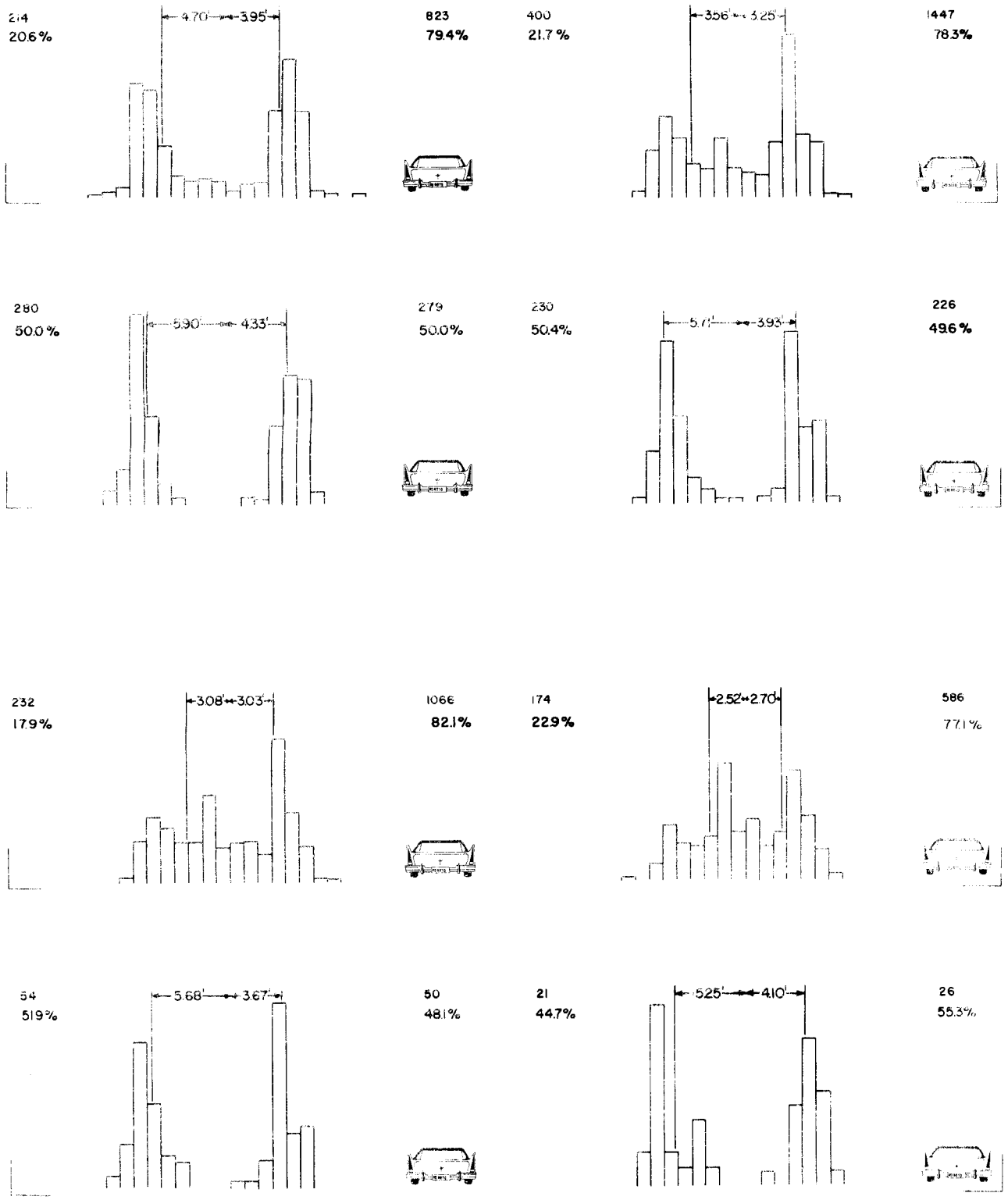
The lateral placement of the vehicles is shown in the form of bar charts in Figures 10 and 10A. These bar charts show the distribution of vehicles within the lanes and the percentage is shown by the height of the bars. Each lane is plotted separately so that the percentages in each lane will add up to 100 percent. Volumes are not the same in each lane. Figure 11 shows the lane volume distribution for the various volumes studied. The percentage of the traffic in the right lane decreases steadily as the total volume increases. The effect of the car on the shoulder was to increase the percentage of vehicles in the left lane at all volume conditions, indicating that regardless of the volume some vehicles moved from the right lane to the left lane because of the vehicle on the shoulder.



SITE 25 (WITHOUT VEHICLE)

LATERAL PLACEMENT OF VEHICLES BY LANE

Figure 10



SITE 26 (WITH VEHICLE)

Figure 10A

This movement became less pronounced as volumes increased, partly because it became more difficult to find a gap in the left lane to move into, and partly because vehicles traveling in a more dense stream of traffic did not become aware of the vehicle on the shoulder until after it was too late to take any action.

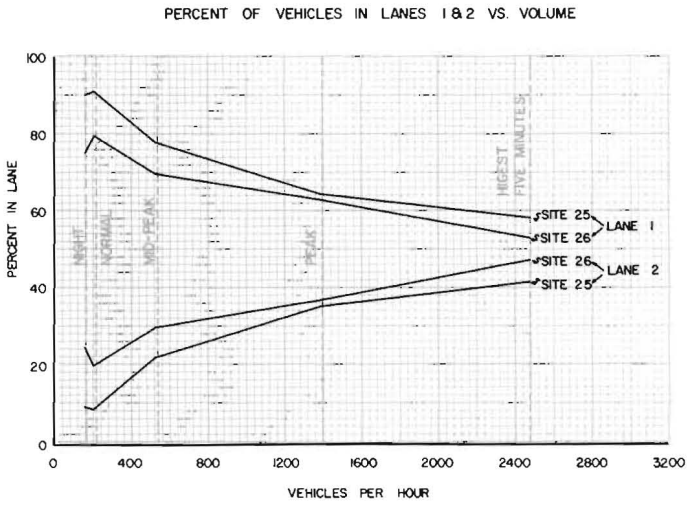
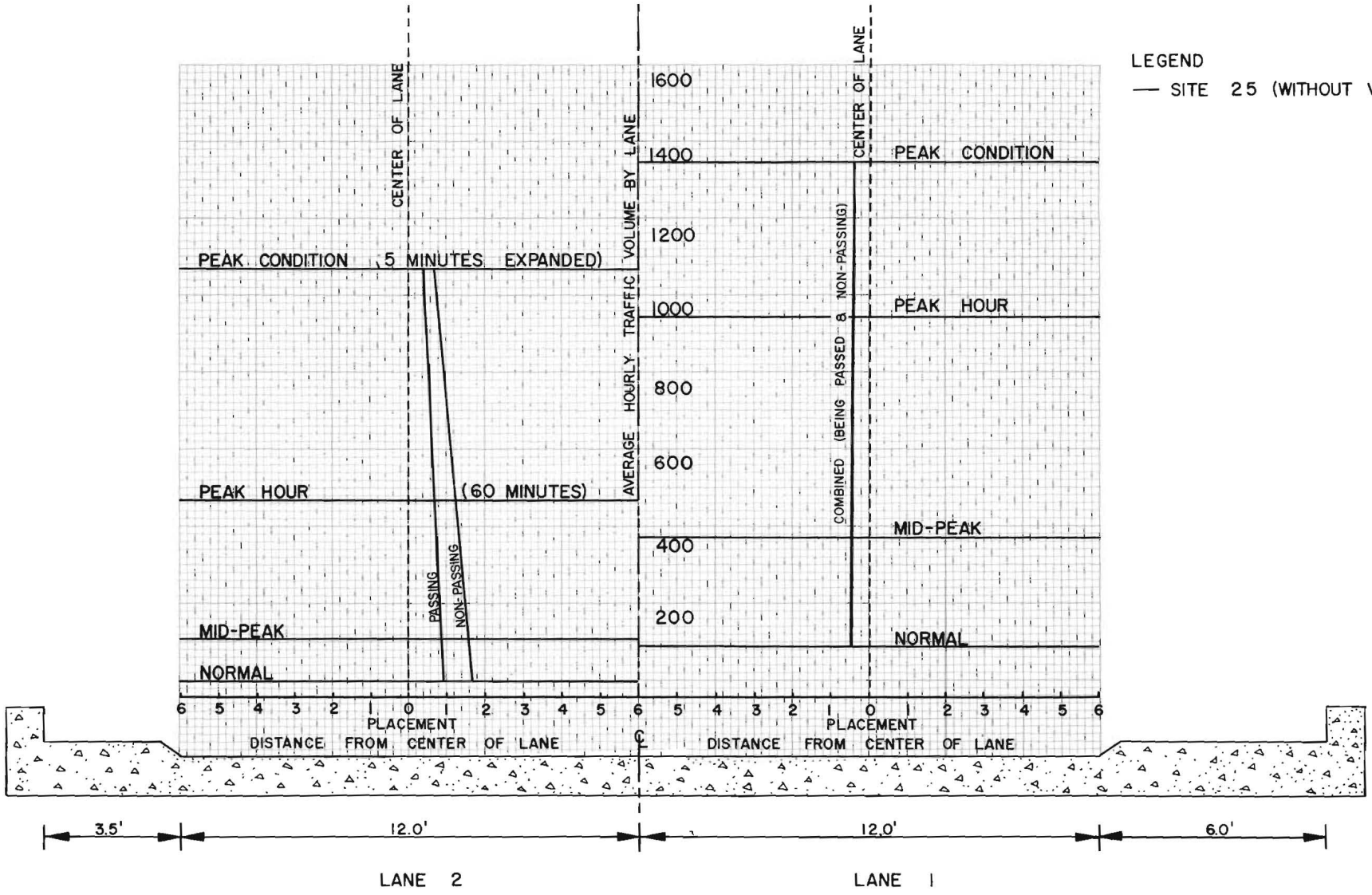


Figure 11

Figures 12 and 12A show vehicle placement plotted against traffic volumes. These figures show the most conclusive effect of the car on the shoulder. The effect of the vehicle is particularly pronounced in the right lane and at lower volumes. As volumes increase, the effect of the stopped vehicle decreases. It should also be noted that for all conditions as volumes increase the vehicle placement moves closer to the center of the lane, and also, for all conditions, the average placement for both the left and right lane lies closer to the center of lane than to the outer edge of the pavement.

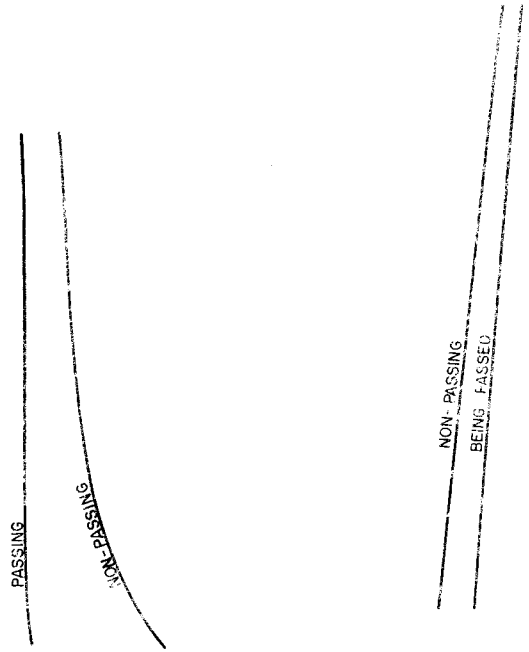
FREEWAY BRIDGE PLACEMENT AS RELATED TO TRAFFIC VOLUMES

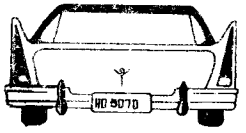


PLACEMENT OF VEHICLES ON TWO LANE FREEWAY BRIDGE IN RELATION TO TRAFFIC VOLUME AND WITHOUT DISABLED VEHICLE ON SIX FOOT EMERGENCY SHOULDER

Figure 12

— SITE 26 (WITH VEHICLE)





WITH

Figure 12A

The shape of the curve for the non-passing vehicles in the left lane with the car on the shoulder indicates that, at lower volumes, vehicles were moving from the right lane to the left lane to allow a greater lateral distance to the stopped vehicle. This substantiates Figure 11, which shows a greater percentage of vehicles in the left lane when the car was stopped on the shoulder.