Evaluation of New Passing Zone Gore Design

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The purpose of this research was to determine the effects of a new passing zone gore design on traffic characteristics. The new design was a painted gore at the beginning of the passing zone to guide the traffic into the right lane, thereby directing the slow-moving vehicles out of the left lane. The project was to determine whether the new gore design is more efficient than the old design because it allows more vehicles to pass and reduces illegal and erratic maneuvers and whether it has any effect on the safety of the roadway. The study demonstrated that when the new passing zone gore design was used, passing efficiency within the passing zone actually decreased at the 0.4-mile site, although it increased slightly at the 0.9-mile site. The number of illegal or erratic maneuvers, such as passes on the right and platoon leaders staying left or going through the gore, was reduced at the longer site, but increased at the shorter site. Safety did not appear to be affected by either passes on the right or going through the painted gore. From these findings came the following recommendations: (a) the new passing zone gore design should not be implemented at this time on passing zones of one-half mile or less in length; (b) the new passing zone gore design could be implemented on passing zones greater than one-half mile; (c) further research to deal with such factors as total passes and different passing zone lengths should be carried out to determine more specifically the effects of this new design on the traffic characteristics.

In the past, when a sufficient number of safe passing sections could not be afforded on two-lane roadways because of the vertical or horizontal alignment, transportation departments designed and installed additional passing lanes to improve the quality of service of the through lanes by eliminating the interference caused by slower vehicles. This approach prevented the development of bottlenecks. These passing lanes usually extended for less than 1 mile.

The additional lanes have always been added on the right-hand side, as shown in Figure 1. Under this design, slower vehicles should move to the right to allow faster vehicles to pass on the left. At the end of the passing lane, the slower traffic moved back to the left, into the through lane. Therefore, slower traffic must voluntarily make two distinct lane changes for this design to work effectively. However, drivers of some slower vehicles are hesitant to move to the right because they will need to merge back to the left in a short distance. This situation causes a dilemma for drivers of the vehicles in the rear that want to go faster: They must either pass on the right, which is illegal in New Jersey and creates a safety problem, or stay behind the slower vehicle and not pass, which makes the roadway less efficient and defeats the purpose of installing the added lane.

Because of these problems, personnel from the New Jersey Division of Transportation's (NJDOT) Division of Design have introduced a new design (Figure 2) that leads all traffic to enter the added right lane, creating the new lane to be used for passing on the left. The slower vehicles should no longer remain in the left lane, thereby allowing more vehicles to pass properly and improving the efficiency of the roadway. At the end of the passing zone, the right-lane traffic will merge into the left lane, which is the current practice.

A literature search revealed that this design has been used for other purposes. However, it has never been used for the addition of a passing lane on a two-lane roadway. This design project was initiated to determine whether the new passing zone gore design is more effective than the old design because it allows more vehicles to pass, and reduces illegal and erratic maneuvers, and whether it has any effect on the safety of the roadway.

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PROCEDURE

Literature Search

A literature search determined that the gore design had been used but not at the beginning of a passing zone. Bennett (*1*) showed how the use of this gore at intersections to introduce left-turn lanes could reduce accidents. The new median lanes of the eight-lane Garden State Parkway in New Jersey, were reserved for high occupancy vehicles (HOVs). To make sure that only HOVs were in these lanes, consultants for NJDOT proposed a striping plan very similar to the new gore design, which brought the new median lane in on the left, so that vehicles had to make a lane change to enter it (*2*). Botha and May developed a computer model for a passing lane with this gore design, but never actually implemented or studied it (*3*). No data were found to describe how the new gore design would affect traffic operations in a passing zone.

Field Study Design

The next step was the design of the field studies. The first phase was to determine what data to collect and the data-collection method. The size of platoons entering the passing zone was an essential element of the evaluation. This variable would provide the number of drivers that wanted to pass the platoon leader and indicate whether the same population would exist when both the traditional design and new gore design were studied. To determine who the platoon leaders were was difficult, however.

Platoons have been defined as groups of vehicles with headways ranging from as little as 2 sec to as much as 5 sec. For

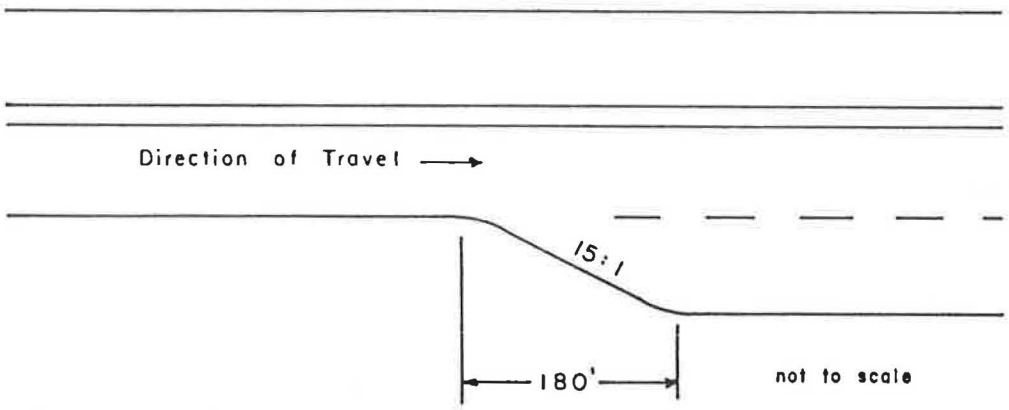

FIGURE 1 Traditional passing zone design.

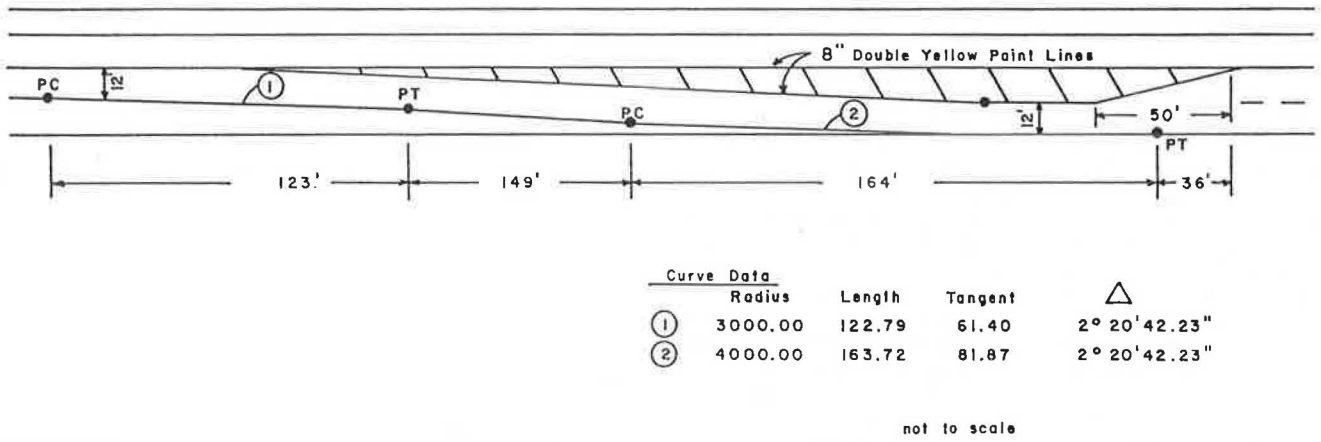

FIGURE 2 New passing zone design.

the New Jersey study, vehicles were included in the same platoon if they were within 3 sec of each other. This definition was based on the fact that at 50 mph, the headway between two cars would be 200 ft, or approximately 10 car lengths. At this distance, the car in the rear would not be influenced by the car that it was following.

A videotape camera, positioned at the beginning of the passing zone, collected data. The time in 100ths of a second was superimposed on the tape. The camera recorded the time at which each vehicle crossed a strip of reflectorized tape on the pavement; from this information the platoon leaders and size of platoon were determined. The reflectorized tape, from all observations, had no effect on traffic characteristics. Figure 3 for NJ-31 and Figure 4 for NJ-206 show the location of both the camera and reflectorized tape. The criteria for selecting these routes will be discussed later. Because the new passing gore was not expected to have an effect on platoon size, this variable was not expected to change.

Determining the speeds of platoon leaders was another way to assure that the same population existed when both traditional and new gore designs were studied. The videotape camera at the beginning of the passing zone recorded the time it took the platoon leader to travel 100 ft between two strips of reflectorized tape. With this time and distance, the speed could be calculated. Figures 3 and 4 show the configuration. Because the new passing zone gore was not expected to have an effect on platoon leader speed, this variable was expected not to change.

The number of platoon leaders that stay in the left lane is a measure of those vehicles that do not obey the "keep right except to pass" law, as well as of the vehicles that cause others to break the "pass only on the left" law. Going through the newly installed gore was illegal because to do so, a vehicle would have to cross a double yellow line. For these reasons, tracking the location of platoon leaders was essential. Two videotape cameras, positioned to capture essentially the entire passing zone area, recorded this information. Camera locations are identified in Figures 3 and 4.

Platoon leaders were classified in four groups:

- Those who moved right;
- Those who stayed left with the traditional design or who traveled through the gore and stayed left with the new gore design;
- Those who stayed or moved left for approximately one-half of the passing zone's length; and
- Those who—using the new design—followed the gore and then immediately returned to the left lane.

The new passing zone gore design was expected to move almost all platoon leaders into the right lane, leading to the expectation of a large decrease in the number of platoon leaders remaining to the left.

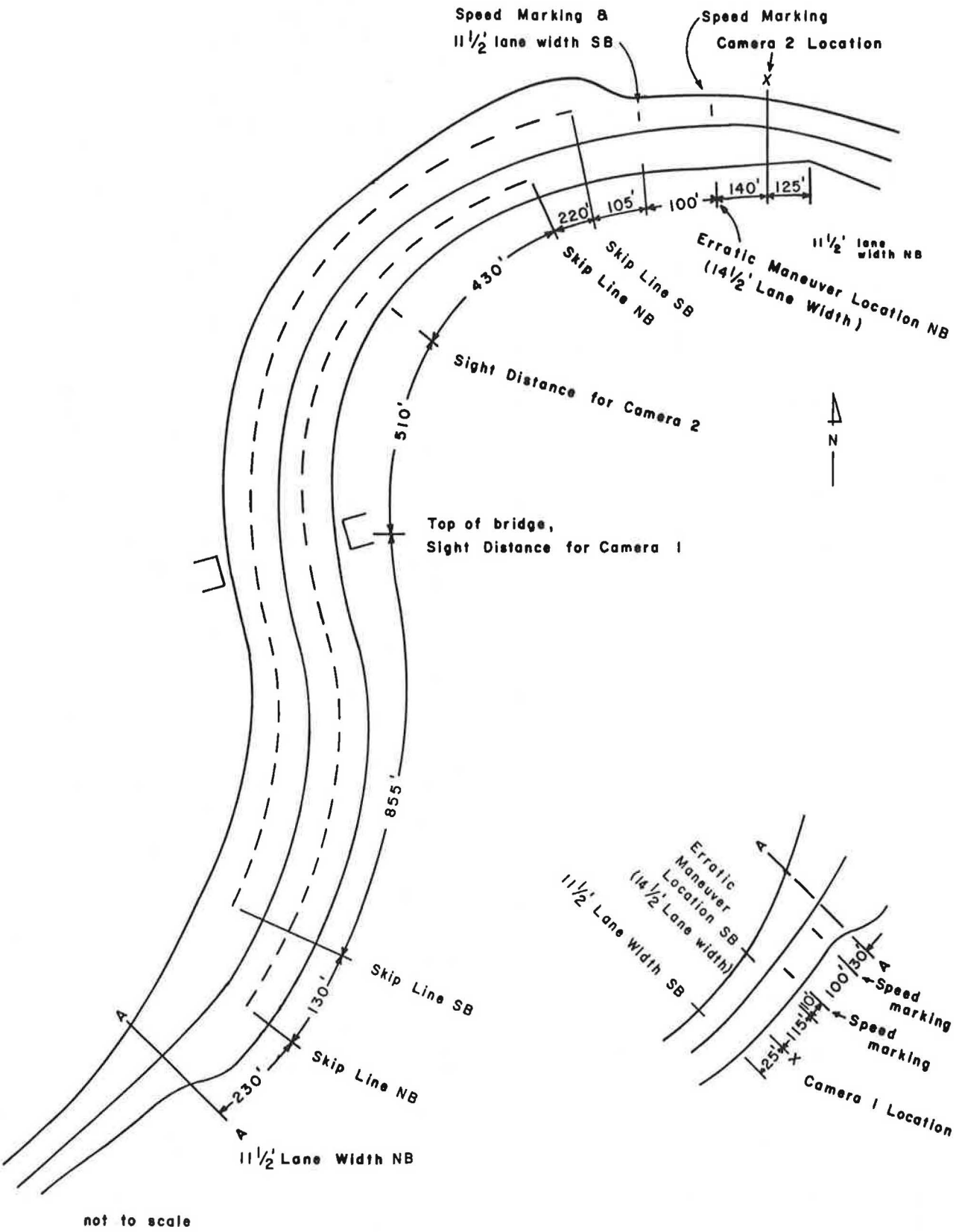

FIGURE 3 Rt. 31 test and control sites; data collection locations.

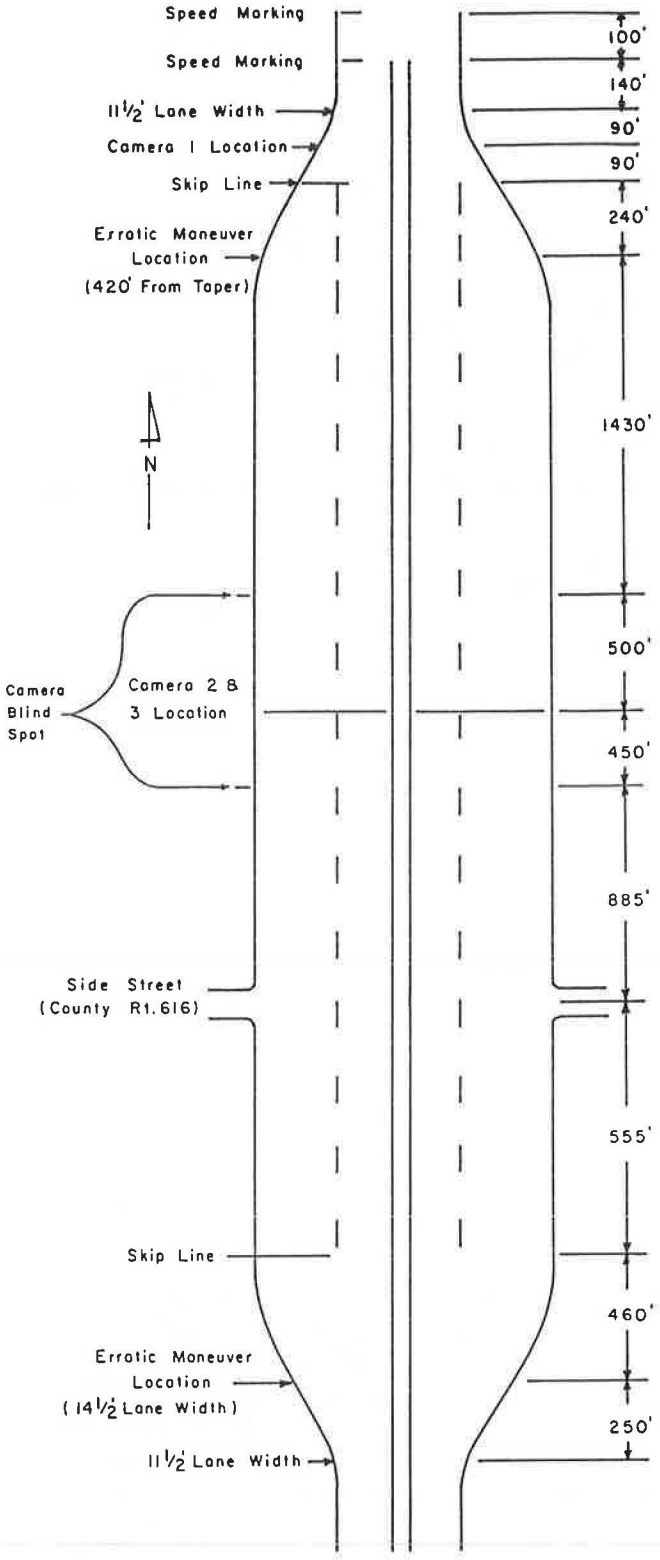

FIGURE 4 Rt. 206 test site; data collection location (not to scale).

Followers passing through the new gore were acting illegally. Therefore, collecting data about this maneuver was very important to the evaluation of the design. Two road tubes (shown in Figure 5) placed on the roadway recorded car movement. It was possible to observe if a vehicle were more than halfway into the left lane or gore area. Data were also collected using the traditional design at the NJ-206 site. Of interest was whether the area now covered by the new gore (420 ft) was previously used by followers to pass. If this pattern were true, the loss of this distance could be critical to short passing zones by reducing the effective distance a vehicle had to pass. The new passing zone gore design was expected to move the followers to the right lane, a maneuver that was not considered to be a future problem.

One of the two possible consequences of platoon leaders' staying to the left is that followers must pass them on the right, which is illegal in New Jersey. Data about this behavior would demonstrate whether the new gore design was meeting its objectives. Information about passes on the right within the platoon among followers was also important. Two videotape cameras that viewed the entire passing zone were used to collect data. Because platoon leaders were expected to be moved into the right lane, passing on the right was expected to decrease substantially.

The total number of passes by platoon leaders was the main measure used to determine whether a passing zone was efficient. Unless a follower passes the platoon leader, it cannot increase its speed. These essential data were also collected by the two videotape cameras that viewed the entire passing zone.

Because the new gore was expected to force the slower platoon leaders into the right lane, the efficiency of the passing zone was also expected to improve. Therefore, total passes of platoon leaders were expected to increase.

When the new design was used, it was anticipated that more of the slower vehicles would be in the right lane. Concern arose that these vehicles would not be able to move into the single lane at the end of the passing lane and, as a result, would cross the shoulder edgeline. Information about this erratic maneuver was collected by using a road tube in the transition area from two lanes to one lane, as shown in Figure 6. This variable was not expected to be affected by the new passing zone gore design.

The major problem with erratic and illegal maneuvers is that they are not anticipated by other drivers and may create conditions that result in accidents. An important element for analysis was if this new gore design had an effect on safety. Accident reports from sites using the traditional and new gore designs were reviewed to determine the causes of accidents at study sites and at the control site. Because of the infrequent occurrence of accidents and the brief study period, conclusions about accidents were not expected.

After the types of data to be collected and hypotheses were determined, a decision was made when to collect data. Peak hours were selected because traffic volumes were the highest during these periods. It was expected that the highest passing rates would occur at these times. In other words, it was assumed that the peak hours are when added passing lanes are needed the most. The decision was made to collect data for three days per study period to avoid any possible 1 day problems, such as an upstream accident, and to obtain a larger sample.

Data were to be collected from 4:00 p.m. to 6:00 p.m. on 3 days at the site with the traditional design and on 3 days at the sites with the new gore design. The data were to be compared to determine it a difference existed. Studies would be performed in July and August in successive years. It was anticipated that the same type of traffic would be present for both designs and that there would be ample time between

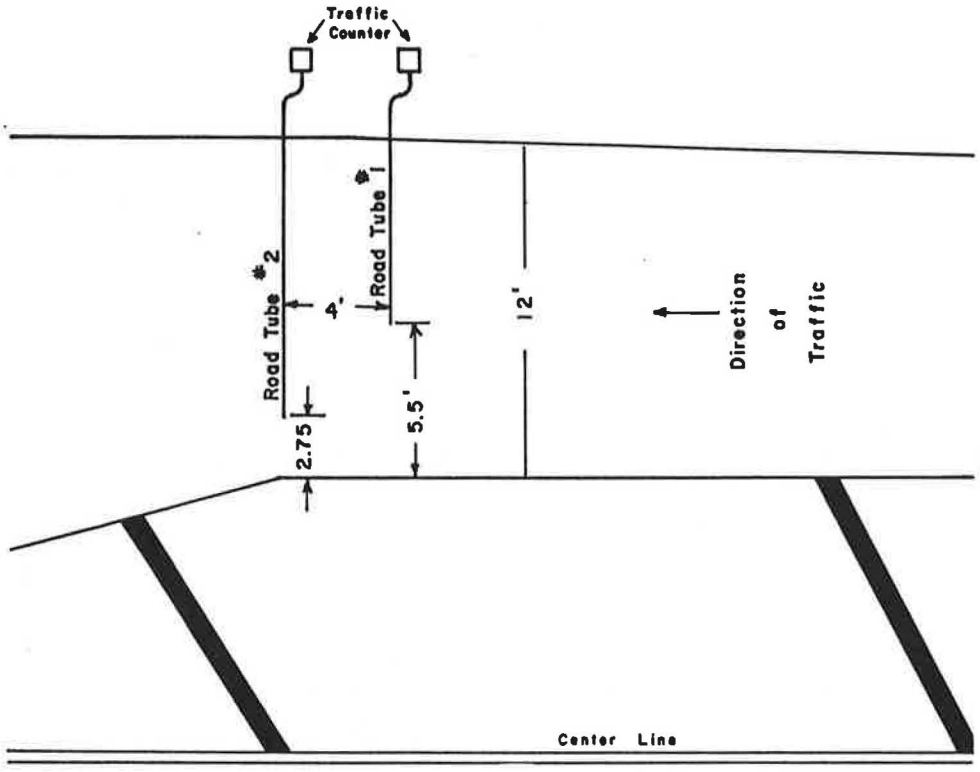

FIGURE 5 Road tube setup for passing gore encroachment study.

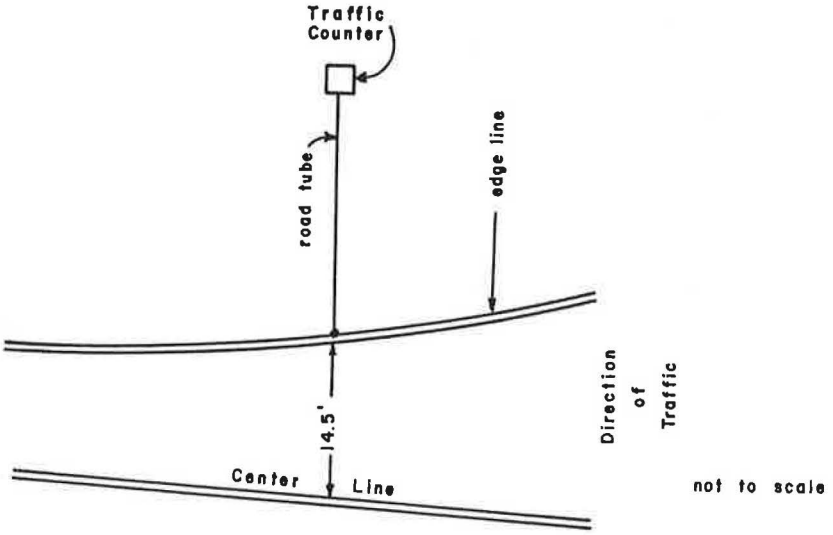

FIGURE 6 Road tube setup for end of passing zone encroachment study.

installation of the new gore design and collection of data to eliminate "newness" of the gore as an influence on the data.

Another decision involved the type of sites to be studied. Major considerations included good sight angles and locations for the videotape cameras that were to collect data, minimal effects from traffic signals upstream of or within the passing zone, different volume levels, and different passing zone lengths. Twenty-five passing zone locations were reviewed. Due to budget limitations, only two sites were to be studied: one approximately 1 mile long and the other approximately one-half mile long. Southbound NJ-206 in Burlington County, from milepost 21.2 to milepost 22.1, and northbound NJ-31 in Mercer County, from milepost 6.8 to milepost 7.2, were chosen as the test sites for the new gore design. Southbound NJ-31 at the same location was chosen as the control site. The NJ-206 site is a straight roadway with one cross street and a few driveways. The NJ-31 site, on the other hand, is an S-curve, with no cross streets and a few driveways.

The study of the traditional design was performed in 1984 for NJ-31; data were collected in 1985 for the new gore design study. The NJ-206 traditional design study was delayed by construction until 1985; data for the new gore design study

were collected in 1986. Because the NJ-31 control site data had to be collected for all three years and because the NJ-31 study site was simply the opposite direction, the decision was made to collect and analyze a second year of new gore design data for the NJ-31 study site.

All data collected on videotape were brought back to the office for reduction. The data were then run through the Statistical Analysis System computer package to determine the means and standard deviations for some of the variables.

RESULTS

The literature review yielded no studies concerning the use of the new gore design at the beginning of a passing zone. The New Jersey investigation amassed such data. The results of the data collection and analysis effort are presented here.

Once the data were reviewed, it became clear that certain vehicles should not be included in the analysis. These included any vehicle traveling by itself, all vehicles in a platoon where a turn off or turn on to the highway affected the performance of the platoon, and all vehicles in a platoon in which the platoon leader stayed left to pass a member of another platoon. In this way, only platoons that were not affected by other vehicles or other platoons were analyzed.

Table 1 presents the data by platoons and vehicles for the NJ-31 control site for the three study periods. Tables 2 and 3 present the equivalent data for the NJ-31 study site and the NJ-206 study site. Approximately 45 to 55 percent of the platoons for each site were considered in the analysis that made up approximately 70 to 80 percent of the total volume.

Eight specific variables were analyzed, and an overall evaluation of the effect of the new passing zone gore on traffic characteristics was prepared. Table 4 presents data about platoon size by day and by study period for each of the three sites. At all sites the platoon size increased slightly in successive years. However, it was concluded that these changes in platoon size were not caused by the new gore design and did not have an effect on the number of vehicles passing the platoon leader. This result was as anticipated.

Data concerning platoon leaders' speed, by day and by study period for each of the three sites, are presented in Table 5. The speeds increased slightly at the two study sites, but it was concluded that these changes were not caused by the new gore design and would not affect the passing maneuvers in the platoons. This result was as anticipated.

Platoon leaders' locations by day and by study period for each of the three sites are profiled in Table 6. At the control site the number of platoon leaders staying in the left lane increased in each successive year (1984, 378; 1985, 442; and 1986, 505). However, with the installation of the new passing zone gore at both study sites, the number of platoon leaders going through the new gore and staying in the left lane (NJ-31: 1985, 6; 1986, 7; NJ-206: 1986, 4) combined with those that followed the new gore and then immediately returned to the left lane (NJ-31: 1985, 20; 1986, 25; NJ-206: 1986, 8) was much lower than the number of platoon leaders staying in the left lane with the traditional striping (NJ-31: 1984, 168; NJ-206: 1985, 207). The objective of decreasing these illegal maneuvers was reached.

The number of followers traveling through the new gore for the study sites is displayed in Table 7. Almost 400 of the followers traveled through this gore (new gore studies). The expected result—that the number of illegal maneuvers would not be large—did not occur. This maneuver is potentially dangerous: vehicles that follow the new gore correctly and then start moving to the left to pass do not expect anyone to be going through the gore.

TABLE 1 RT. 31 CONTROL SITE: SIX-HOUR TOTAL PLATOONS AND VEHICLES, BY STUDY PERIOD

	TRADITIONAL - 1984		TRADITIONAL - 1985		TRADITIONAL - 1986	
	Platoons	Vehicles	Platoons	Vehicles	Platoons	Vehicles
PLATOONS ANALYZED	817	3545	947	4082	1008	4451
SINGLE VEHICLES	847	847	750	750	828	828
SINGLE VEHICLES WITH TURNS	7	7	6	6	8	8
OTHER PLATOONS WITH TURNS	8	27	11	53	17	63
SINGLE VEHICLES WITH LEADER PASSING	17	17	24	24	21	21
OTHER PLATOONS WITH LEADER PASSING	12	59	10	39	21	79
SINGLE VEHICLES WITH BOTH	1	1	1	1	0	0
OTHER PLATOONS WITH BOTH	1	2	0	0	1	5
TOTAL	1710	4505	1749	4955	1904	5455
AVERAGE PER HOUR	285	751	292	826	317	909

TABLE 2 RT. 31 STUDY SITE: SIX-HOUR TOTAL PLATOONS AND VEHICLES, BY STUDY PERIOD

	TRADITIONAL - 1984		NEW GORE - 1985		NEW GORE - 1986	
	Platoons	Vehicles	Platoons	Vehicles	Platoons	Vehicles
PLATOONS ANALYZED	915	2932	913	3074	1005	3451
SINGLE VEHICLES	1059	1059	999	999	940	940
SINGLE VEHICLES WITH TURNS	10	10	13	13	9	9
OTHER PLATOONS WITH TURNS	12	36	33	140	27	121
SINGLE VEHICLES WITH LEADER PASSING	25	25	20	20	21	21
OTHER PLATOONS WITH LEADER PASSING	16	53	19	59	13	34
SINGLE VEHICLES WITH BOTH	1	1	0	0	1	1
OTHER PLATOONS WITH BOTH	0	0	2	5	0	0
TOTAL	2038	4116	1999	4310	2016	4577
AVERAGE PER HOUR	340	686	333	717	336	763

TABLE 3 RT. 206 STUDY SITE: SIX-HOUR TOTAL PLATOONS AND VEHICLES, BY STUDY PERIOD

	TRADITIONAL - 1985		NEW GORE - 1986	
	Platoons	Vehicles	Platoons	Vehicles
VEHICLES ANALYZED	707	2615	760	2854
SINGLE VEHICLES	664	664	645	645
SINGLE VEHICLES WITH TURNS	6	6	17	17
OTHER PLATOONS WITH TURNS	17	82	18	82
SINGLE VEHICLES WITH LEADER PASSING	51	51	48	48
OTHER PLATOONS WITH LEADER PASSING	36	122	37	126
SINGLE VEHICLES WITH BOTH	0	0	1	1
OTHER PLATOONS WITH BOTH	0	0	0	0
TOTAL	1481	3540	1526	3773
AVERAGE PER HOUR	247	590	254	629

TABLE 4 SUMMARY, PLATOON SIZE (VEHICLES/PLATOON)

ROUTE 31 CONTROL SITE

	TRADITIONAL - 1984	TRADITIONAL - 1985	TRADITIONAL - 1986
DAY 1	4.26	4.29	4.15
DAY 2	4.21	4.26	4.66
DAY 3	4.53	4.38	4.45
AVERAGE	4.34	4.31	4.42

ROUTE 31 STUDY SITE

	TRADITIONAL - 1984	NEW GORE - 1985	NEW GORE - 1986
DAY 1	3.14	3.39	3.31
DAY 2	3.06	3.29	3.39
DAY 3	3.40	3.42	3.60
AVERAGE	3.20	3.37	3.43

ROUTE 206 STUDY SITE

	TRADITIONAL - 1985	NEW GORE - 1986
DAY 1	3.60	3.64
DAY 2	3.80	3.97
DAY 3	3.70	3.62
AVERAGE	3.70	3.76

TABLE 5 SUMMARY, PLATOON LEADER SPEED (MILES/HOUR)

ROUTE 31 CONTROL SITE

	TRADITIONAL - 1984	TRADITIONAL - 1985	TRADITIONAL - 1986
DAY 1	44.9	45.6	46.7
DAY 2	45.8	46.1	45.9
DAY 3	48.0	45.0	46.3
AVERAGE	46.3	45.5	46.3

ROUTE 31 STUDY SITE

	TRADITIONAL - 1984	NEW GORE - 1985	NEW GORE - 1986
DAY 1	45.8	47.0	46.6
DAY 2	46.2	46.8	47.7
DAY 3	45.6	45.8	47.0
AVERAGE	45.9	46.5	47.1

ROUTE 206 STUDY SITE

	TRADITIONAL - 1985	NEW GORE - 1986
DAY 1	52.6	53.0
DAY 2	52.3	51.9
DAY 3	51.9	52.0
AVERAGE	52.2	52.3

When the area now occupied by the new gore was studied with the traditional design at the NJ-206 site, the results showed that at the point where the gore would be the widest, approximately 50 percent of all the leaders were in the left lane, whereas 75 to 80 percent of the followers were in this lane. This compares with 1 percent of the platoon leaders and 18 percent of the followers that went through the gore area with the new gore installed.

The data show that although a large number of the followers were in the left lane with the traditional striping and in a position to use this future gore area to pass, most of them couldn't because at this same point, more than half of the platoon leaders were also in the left lane. This situation may be caused by drivers who do not follow the shoulder edgeline and take 400 to 500 ft to move to the right lane. Therefore, it is concluded that although the loss of this new gore area (420 ft) from the possible passing distance may have reduced passing opportunities slightly, it did not have a major effect.

Table 8 summarizes data by day and study period at all sites for total passes on the right. These data are in two groups—

TABLE 6 SUMMARY, PLATOON LEADER LOCATION (VEHICLES)

ROUTE 31 CONTROL SITE

	TRADITIONAL - 1984			TRADITIONAL - 1985			TRADITIONAL - 1986		
	A	B	C	A	B	C	A	B	C
DAY 1	131	118	13	142	144	21	140	177	27
DAY 2	113	136	17	153	150	11	135	162	40
DAY 3	141	124	24	149	148	29	126	166	35
TOTAL	385	378	54	444	442	61	401	505	102

ROUTE 31 STUDY SITE

	TRADITIONAL - 1984			NEW GORE - 1985				NEW GORE - 1986			
	A	B	C	A	B	C	D	A	B	C	D
DAY 1	239	57	1	274	3	0	5	290	2	16	8
DAY 2	253	55	1	293	1	0	11	332	4	14	9
DAY 3	253	56	0	312	2	8	4	315	1	6	8
TOTAL	745	168	2	879	6	8	20	937	7	36	25

ROUTE 206 STUDY SITE

	TRADITIONAL - 1985			NEW GORE - 1986			
	A	B	C	A	B	C	D
DAY 1	150	60	11	234	1	17	3
DAY 2	137	57	14	241	3	29	4
DAY 3	180	90	8	212	0	15	1
TOTAL	467	207	33	687	4	61	8

LEGEND
A = Right Lane B = Left Lane or Going Through the Gore
C = Left Lane For Approximately Half the Passing Zone Distance
D = Followed Gore Then Returned to Left Lane

TABLE 7 SUMMARY, FOLLOWERS TRAVELING THROUGH NEW GORE (VEHICLES)

ROUTE 31 STUDY SITE

	NEW GORE - 1985			NEW GORE - 1986		
	A	B	C	A	B	C
DAY 1	126	673	18.7	102	729	14.0
DAY 2	121	698	17.3	141	859	16.4
DAY 3	139	790	17.6	139	858	16.2
TOTAL	386	2161	17.9	382	2446	15.6

ROUTE 206 STUDY SITE

	NEW GORE - 1986		
	A	B	C
DAY 1	133	674	19.7
DAY 2	124	822	15.1
DAY 3	121	598	20.3
TOTAL	378	2094	18.1

LEGEND
A = Followers Through the Gore
B = Total Followers
C = Percent of Followers Through the Gore

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ROUTE 206 STUDY SITE
TRADITIONAL - 1985

	A	B	C	D	E	F
DAY 1	438	575	76.2	105	221	47.4
DAY 2	451	582	77.4	98	208	47.3
DAY 3	598	751	79.6	155	278	55.7
TOTAL	1487	1908	77.9	358	707	50.6

LEGEND
A = Followers Through Future Gore Area B = Total Followers
C = Percent of Followers Through the Future Gore Area
D = Platoon Leaders Through the Future Gore Area E = Total Platoon Leaders
F = Percent of Platoon Leaders Through the Future Gore Area

TABLE 8 SUMMARY, TOTAL PASSES ON RIGHT (VEHICLES)

ROUTE 31 CONTROL SITE

	TRADITIONAL - 1984		TRADITIONAL - 1985		TRADITIONAL - 1986	
	A	B	A	B	A	B
DAY 1	38	25	48	42	65	58
DAY 2	38	43	41	64	53	83
DAY 3	32	42	38	67	47	91
TOTAL	108	110	127	173	165	232

ROUTE 31 STUDY SITE

	TRADITIONAL - 1984		NEW GORE - 1985		NEW GORE - 1986	
	A	B	A	B	A	B
DAY 1	10	8	2	1	3	0
DAY 2	9	1	2	1	8	1
DAY 3	9	5	0	4	2	0
TOTAL	28	14	4	6	13	1

ROUTE 206 STUDY SITE

	TRADITIONAL - 1985		NEW GORE - 1986	
	A	B	A	B
DAY 1	47	41	0	11
DAY 2	29	25	6	12
DAY 3	53	72	0	6
TOTAL	129	138	6	29

LEGEND
A = Passes of the Platoon Leader
B = Other Passes Within the Platoon

TABLE 9 SUMMARY, TOTAL PASSES OF PLATOON LEADER (VEHICLES)

ROUTE 31 CONTROL SITE

	TRADITIONAL - 1984				TRADITIONAL - 1985				TRADITIONAL - 1986			
	A	B	C	D	A	B	C	D	A	B	C	D
DAY 1	168	38	854	24.1	172	48	1009	21.8	150	65	1082	19.9
DAY 2	141	38	855	20.9	200	41	1025	23.5	217	53	1233	21.9
DAY 3	162	32	1019	19.0	174	38	1101	19.3	195	47	1128	21.5
TOTAL	471	108	2728	21.2	546	127	3135	21.5	562	165	3443	21.1

ROUTE 31 STUDY SITE

	TRADITIONAL - 1984				NEW GORE - 1985				NEW GORE - 1986			
	A	B	C	D	A	B	C	D	A	B	C	D
DAY 1	197	10	637	32.5	187	2	673	28.1	177	3	729	24.7
DAY 2	195	9	637	32.0	194	2	698	28.1	181	8	859	22.0
DAY 3	229	9	743	32.0	203	0	790	25.7	204	2	858	24.0
TOTAL	621	28	2017	32.2	584	4	2161	27.2	462	13	2446	23.5

ROUTE 206 STUDY SITE

	TRADITIONAL - 1985				NEW GORE- 1986			
	A	B	C	D	A	B	C	D
DAY 1	222	47	575	46.8	315	0	674	46.7
DAY 2	223	29	582	43.3	352	6	822	43.6
DAY 3	266	53	751	42.5	306	0	598	51.2
TOTAL	711	129	1908	44.0	973	6	2094	46.8

LEGEND
A = Passes on the Left B = Passes on the Right
C = Total Followers D = Percent of Followers That Passed

TABLE 10 SUMMARY, ERRATIC MANEUVERS AT PASSING ZONE END (VEHICLES)

ROUTE 31 CONTROL SITE

	TRADITIONAL - 1984			TRADITIONAL - 1985			TRADITIONAL - 1986		
	A	B	C	A	B	C	A	B	C
DAY 1	80	1588	5.0	87	1739	5.0	80	1871	4.3
DAY 2	92	1606	5.7	83	1748	4.7	96	1888	5.1
DAY 3	94	1634	5.8	95	1787	5.3	102	2013	5.1
TOTAL	266	4828	5.5	265	5274	5.0	278	5772	4.8

ROUTE 31 STUDY SITE

	TRADITIONAL - 1984			NEW GORE - 1985			NEW GORE - 1986		
	A	B	C	A	B	C	A	B	C
DAY 1	167	1411	11.8	232	1361	17.0	221	1416	15.6
DAY 2	164	1302	12.6	163	1443	11.3	297	1580	18.8
DAY 3	161	1422	11.3	198	1517	13.1	160	1554	10.3
TOTAL	492	4135	11.9	593	4321	13.7	678	4550	14.9

ROUTE 206 STUDY SITE

	TRADITIONAL - 1985			NEW GORE - 1986		
	A	B	C	A	B	C
DAY 1	3	1243	0.2	11	1377	0.8
DAY 2	13	1237	1.1	16	1524	1.0
DAY 3	13	1490	0.9	9	1249	0.7
TOTAL	29	3970	0.7	36	4150	0.9

LEGEND
A = Erratic Maneuvers B = Total Volume
C = Percent Making Erratic Maneuvers

TABLE 11 SUMMARY, ACCIDENTS IN PASSING ZONES

	1984			1985			1986			1-6/1987		
	A	B	C	A	B	C	A	B	C	A	B	C
RT. 31 CONTROL SITE	5	3	NA	1	0	NA	1	0	NA	0	0	NA
RT. 31 STUDY SITE	0	0	NA	2	0	0	2	0	0	1	0	0
RT. 206 STUDY SITE	6	0	NA	9	0	NA	11	0	0	3	0	0
RT. 206, MP. 16.6-17.5	4	0	NA	2	0	0	10	0	0	3	0	0
RT. 206, MP. 11.1-12.5	6	1	NA	5	0	0	3	0	0	3	0	0
TOTAL	21	4	NA	19	0	0	27	0	0	10	0	0

LEGEND
A = Total Accidents B = Passes on the Right Accidents
C = Going Through the Gore Accidents
NA = Not Applicable, No Gore Present

passes of platoon leaders on the right and passes on the right within the platoon among followers. Illegal maneuvers at NJ-31 control site increased in successive years. However, with the introduction of the new passing zone gore design, the number of total passes on the right was reduced greatly at both study sites. Therefore, it is concluded that the objective of reducing this illegal maneuver was met.

Table 9 summarizes the total passes of platoon leaders by day and by study period for all the sites. The number of total passes at the NJ-31 control site increased, whereas the percentage of followers passing their platoon leaders stayed relatively constant. At the NJ-206 study site, both the number and the percentage of followers passing their platoon leaders increased slightly when the new passing gore design was introduced. However. at the NJ-31 study site, both the number and their percentage decreased in successive years after the new gore was introduced. Results for this variable were mixed and were not the expected one—that is, increasing passing efficiency at both study sites.

Table 10 gives the number of vehicles crossing the white edgeline near the transition from two lanes to one lane at the end of the passing zones, by day and study period. The data include all vehicles that went through the passing zone because there was no way to determine original platoons at the end of the passing zone. At the NJ-31 control site, the number of vehicles crossing the edgeline stayed relatively the same in successive years, but the percentage of the vehicles doing it decreased. At each of the study sites, both the number and percentage increased slightly. The large difference between the findings at NJ-31 and at NJ-206 was believed to be caused by the geometrics of the sites. NJ-206 was straight and level, with low edgeline crossings, while end conditions on Rt. 31

TABLE 12 SUMMARY, ILLEGAL MANEUVERS (VEHICLES)

	ROUTE 31 CONTROL SITE		
	TRADITIONAL 1984	TRADITIONAL 1985	TRADITIONAL 1986
PASSES OF PLATOON LEADER ON THE RIGHT	108	127	165
OTHER PASSES ON THE RIGHT WITHIN THE PLATOON	110	173	232
PLATOON LEADERS STAY LEFT OR GO THROUGH GORE	378	442	505
PLATOON LEADERS FOLLOW GORE & RETURN TO LEFT LANE	NA	NA	NA
FOLLOWERS GOING THROUGH THE GORE	NA	NA	NA
TOTAL	596	742	902

	ROUTE 31 STUDY SITE		
	TRADITIONAL 1984	NEW GORE 1985	NEW GORE 1986
PASSES OF PLATOON LEADER ON THE RIGHT	28	4	13
OTHER PASSES ON THE RIGHT WITHIN THE PLATOON	14	6	1
PLATOON LEADERS STAY LEFT OR GO THROUGH GORE	168	6	7
PLATOON LEADERS FOLLOW GORE & RETURN TO LEFT LANE	NA	20	25
FOLLOWERS GOING THROUGH THE GORE	NA	386	382
TOTAL	210	422	428

	ROUTE 206 STUDY SITE	
	TRADITIONAL 1985	NEW GORE 1986
PASSES OF PLATOON LEADER ON THE RIGHT	129	6
OTHER PASSES ON THE RIGHT WITHIN THE PLATOON	138	29
PLATOON LEADERS STAY LEFT OR GO THROUGH GORE	207	4
PLATOON LEADERS FOLLOW GORE & RETURN TO LEFT LANE	NA	8
FOLLOWERS GOING THROUGH THE GORE	NA	378
TOTAL	474	425

NA = Not Applicable, No Gore Present

were downhill and curved to the right, with thus a greater number of edgeline crossings. It was concluded that the increase did not represent a practical change. This result was the one anticipated.

Table 11 presents the actual number of accidents that occurred from January 1984 to the middle of 1987 at the three sites studied. Also included are two other sections of NJ-206 that had the passing zone gore installed but were not studied. Only four accidents associated with passing on the right occurred during this 3.5-year period at the five sites. Three of these occurred in 1 year at the control site. No accidents associated with the new passing gore were found. Such small accident numbers do not justify concerns about the safety problems and possible accidents caused by the two illegal maneuvers.

The best approach to take in determining the effect of the new passing zone gore design on the traffic characteristics is to look at how this study's objectives were met.

The first objective was to determine whether the new gore created a more efficient passing zone by allowing more followers to pass their platoon leaders. The results are mixed. The data in Table 9 indicate that the efficiency increased slightly for the NJ-206 study area but decreased tremendously for the NJ-31 study area.

As for the second objective, reducing the number of illegal and erratic maneuvers, Table 12 summarizes all illegal maneuvers for the three sites by study period. The maneuvers are different for the two striping plans. With the traditional striping, passes on the right and staying left (leaders only) are the illegal maneuvers; with the new gore striping, going through the gore (leaders and followers) are the illegal maneuvers. Again, mixed results were found. The NJ-206 study site improved slightly, but the NJ-31 study site worsened markedly.

Finally, no safety problems were associated with the new passing zone gore. There were hardly any accidents at the sites, and none was associated with the new gore. However, the belief that passing on the right is unsafe was not found to be justifiable from this study either, again because of the low number of accidents.

RECOMMENDATIONS

1. Because of the increase in illegal and erratic maneuvers and the decrease in passing efficiency at the NJ-31 site, the new passing zone gore design should not be implemented at this time on passing zones of one-half mile or less in length.
2. Because illegal and erratic maneuvers and passing efficiency remained relatively the same or improved slightly at the NJ-206 site, the new passing zone gore design could be implemented on passing zones of greater than one-half mile.
3. Further research dealing with such factors as total passes and different passing zone lengths should be carried out to determine more specifically the effects of this new design on the traffic characteristics.

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