PROGRESS REPORT NO. 1

EXPERIMENTS WITH A DIVIDED HIGHWAY CROSSING SIGN TO REDUCE WRONG-WAY DRIVING

by

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(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways & Transportation and the University of Virginia)

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DESCRIPTION AND PLACEMENT OF EXPERIMENTAL SIGNS

Based on a report[1] by the present author, the Traffic Research Advisory Committee recommended the installation of divided highway crossing signs on Route 29 from Charlottesville to Culpeper and from Warrenton to Gainesville. The approximately 57 miles of road in these two sections include 72 intersections.

The divided highway crossing sign used in this experiment is a copy of the one used by the Delaware Department of Highways and Transportation. Delaware engineers claim that they have used this sign for the past 20 years with excellent results.

The Delaware Department of Highways and Transportation has requested the Federal Highway Administration to approve an alternate to paragraph 2B-28 and figure 2-3 of the Manual on Uniform Traffic Control Devices for streets and highways (F-MUTCD). The alternate to paragraph 2B-28 as recommended by them is as follows:

> The divided highway crossing sign should be used on approach legs that intersect with a divided highway. The sign shall be used only where the median of the divided highway is less than 200 feet wide and there is no visual obstruction in the median that would obstruct the driver from seeing both directions of the divided facility when approaching on the crossroad.[2]

Figure 2-3 of F-MUTCD is reproduced in figure 1.* The arrangement they recommend is shown in figure 2. This request reflects the

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*Figures and tables are appended.

Delaware Highway and Transportation Department's intention to do away with the one-way sign most commonly found at intersections of crossroads and 4-lane divided highways.

In Virginia there is a similar need to inform the drivers about the geometry of the intersection before he begins to negotiate it. In addition, research has shown that at many intersections due to improper geometrics, it may be very desirable to guide the driver from the crossroad through a left turn to the far side of the median during darkness. For this purpose a "turn around the nose" sign is being recommended for use under the following conditions:

a. When the crossroad slopes downwards from the 4-lane divided highway such that the headlights of cars approaching the highway from the crossroad do not fall on the road surface, as is shown on the left in Figure 3.

b. The dual lanes of the 4-lane divided highway are at different elevations and the headlights do not illuminate the nose of the median, as is shown on the right in Figure 3.

c. When the crossroads meet the 4-lane divided highway at an angle such that the driver is unable to locate the nose of the median on his left.

d. Any other causes which obstruct a driver's view of the nose of the median on his left.

e. When the nose of the median on the driver's left is not visible during darkness and it may be necessary to use this reflectorized sign to help provide guidance.

Figure 4 shows the Delaware recommendations and also provision of the "turn around the nose" sign. The "turn around the nose" sign should be so located as to lie within the keg of night legibility described by the author in earlier presentations[4] and as shown in Figure 4.

The divided highway crossing sign as recommended by the Delaware Department of Highways and Transportation is of two designs as shown in Figures 5 and 6. The one in Figure 5 is for a crossroad intersection on a divided highway and the one in Figure 6 is for a T-intersection on a divided highway. Each of these signs is 610 mm (24 in.) wide and 450 mm (18 in.) high. The turn around the nose sign is shown in Figure 7. It is 610 mm (24 in.) wide and 760 mm (30 in.) high. Each of these signs has a non-reflectorized black legend and border on a white reflectorized background of engineering grade sheeting.

Divided highway crossing signs are intended to inform drivers entering divided highways from crossroads of the geometry of the intersections. On non-signalized intersections such signs could, therefore, be placed below the stop sign or signs as shown in Figure 2. On signalized intersections, they could be placed under regulatory signs near the stop line. Preferably, they should be placed on the right-hand side of the driver entering the intersection as shown in Figure 2.

On the experimental sections of Route 29 the locations of the divided highway crossing signs vary from intersection to intersection, depending upon where the stop sign was already located. In cases where sign islands did not exist there was either one stop sign on either the left or right corner of the intersection of the cross-road with the 4-lane divided highway, or stop signs were on both corners. In cases where sign islands were provided there was either one stop sign on the sign island or one on the right corner and one on the island. Whatever the location of the stop sign, the divided highway crossing sign has been placed under it. Figures 8 and 9 show the two types of such locations. On the two experimental sections, "turn around the nose" signs have been provided near the noses of the medians at all intersections. These signs should be provided as near the nose and as near the driver entering the divided highway as possible, because this placement will enable the driver to see the sign under low beam headlights at night.

Many times wrong-way entries have been caused by drivers coming out of private residential or commercial areas, and the district traffic engineers often have to collaborate with such private parties to provide divided highway crossing signs within their domain. On the two experimental sections during the last three years there was only one fatal accident. This accident was caused by a wrong-way driver coming out of private property (Badger Powhattan Plant) on Route 29. Therefore, provision of the sign on private property should not be overlooked.

A driver approaching a divided highway from a crossroad is informed by a stop sign that he must stop and is informed of the geometry of the intersection by a divided highway crossing sign. The latter sign also tells him the direction of permissible travel. One-way signs like those shown in Figures 8 and 9 become redundant after the installation of the divided highway crossing sign, and their redundancy is increased by the installation of turn around the nose signs. One-way signs below the guide signs as shown in Figure 8 also are redundant.

Delaware Division of Highways engineers argue that the confusion caused by a series of one-way signs as shown in Figure 1 would be eliminated by the use of divided highway crossing signs as shown in Figure 2. Removal of the redundant signs is essential to reduce sign congestion.

EVALUATION AND RECOMMENDATIONS

The best way to determine the effect of divided highway crossing signs on the two sections of Route 29 is to study data on wrong-way entries before and after their installation. The installation of these signs took about one month and was completed on April 23, 1976. Wrong-way entry data for about 4 years before this installation, covering the period from January 1, 1973, to October 22, 1976, which included a period of about 7 months after the installation, are given in Table 1. This table shows that 9 wrong-way entries were reported during the 3 years prior to the installation and that no wrong-way entries have been recorded since the installation. This period of evaluation is too short to allow any definite conclusions, however, the results seem to be encouraging. The following recommendations are therefore made:

1. Continue evaluation, by studying wrong-way entry counts, accidents due to wrong-way entries, and subjective questioning.

2. The divided highway crossing sign and turn around the nose sign should be provided at all cross and T intersections of 4-lane divided highways with crossroads, including intersections with commercial and residential subdivision roads, on the two experimental sections. This experiment should be extended to all intersections on Route 29 between Culpeper and Warrenton including all intersections in the townships along this route. The reason for this is as follows: many a time the traffic police officer is not able to determine the exact location of the wrong-way entry. The provision of the divided highway crossing signs at all junctions will — in case of a wrong-way entry — prove that the driver did ignore the divided highway crossing sign.

3. Since the provision of the experimental signs have created no problems and the results seem encouraging, the types of signs should be tried at the following locations.

   a. Intersections of interstate exit ramps and 4-lane divided crossroads. Table 2 gives data on wrong-way entries at such locations. Priority should be given to the installation of the signs at the intersections listed in Table 2.

   b. Intersections other than those with exit ramps where wrong-way entries have been

repeatedly reported during the last 6 years. Table 3 lists such locations.

4. The signs were publicized immediately after their installation. Frequently, publicity by the district traffic engineers about the meaning and purpose of the signs would lead the public to familiarize themselves with the signs and would enable better conformance with the sign messages.

REFERENCES

1. Vaswani, N. K., "Engineering Measures for Reducing Wrong-way Driving," Virginia Highway and Transportation Research Council, VHTRC 76-R8, September 1975.

2. Delaware Division of Highways. A letter dated August 2, 1976, from Raymond S. Pusey, Chief, Bureau of Traffic, to Robert E. Connor, Federal Highway Administration, Washington, D. C., asking for approval of intersection plan containing the divided highway crossing sign.

3. "Summary of Wrong-way Incident Data," Traffic and Safety Division, Virginia Highway and Transportation Department, and the Virginia Department of State Police.

4. Vaswani, N. K., "Poor Visibility Under Low Beam Headlights, A Common Cause of Wrong-way Driving," a paper to be presented at the Annual Meeting of the Transportation Research Board, January 1977, Washington, D. C.

APPENDIX

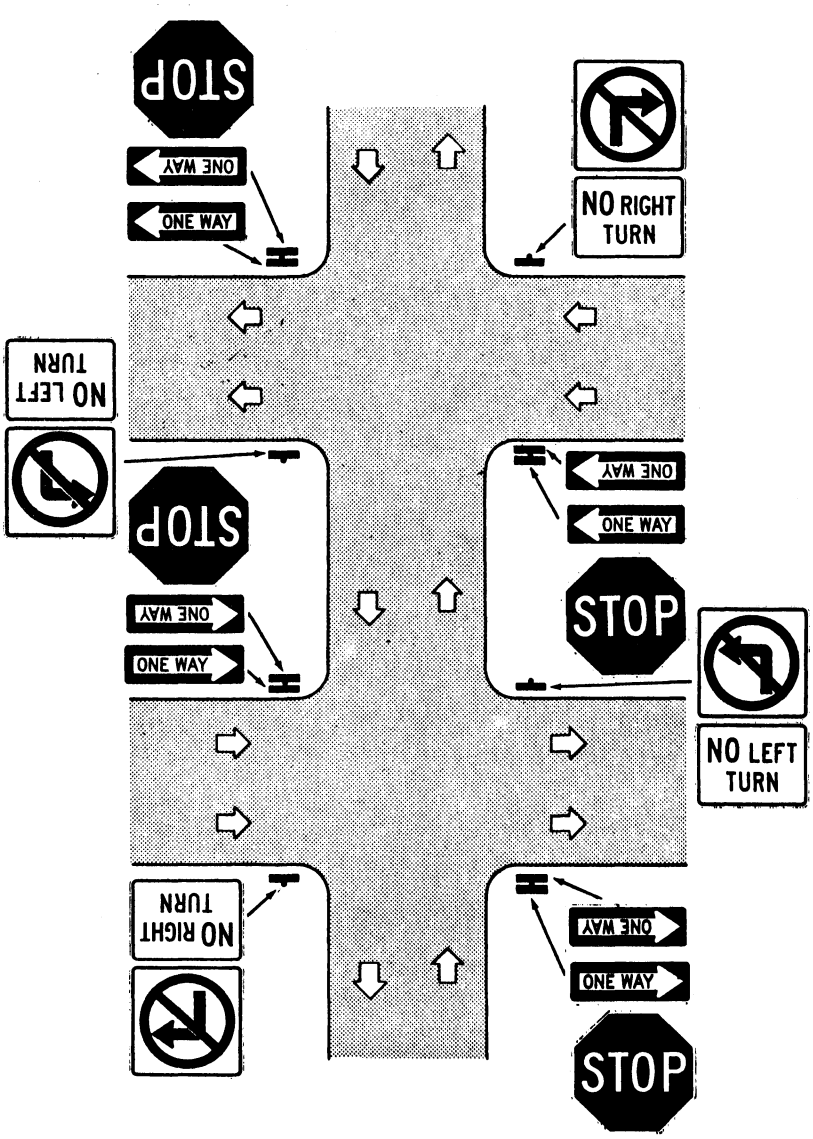

Figure 1. Location of one-way and turn prohibition signs as shown in Figure 2-3 of F-MUTCD.

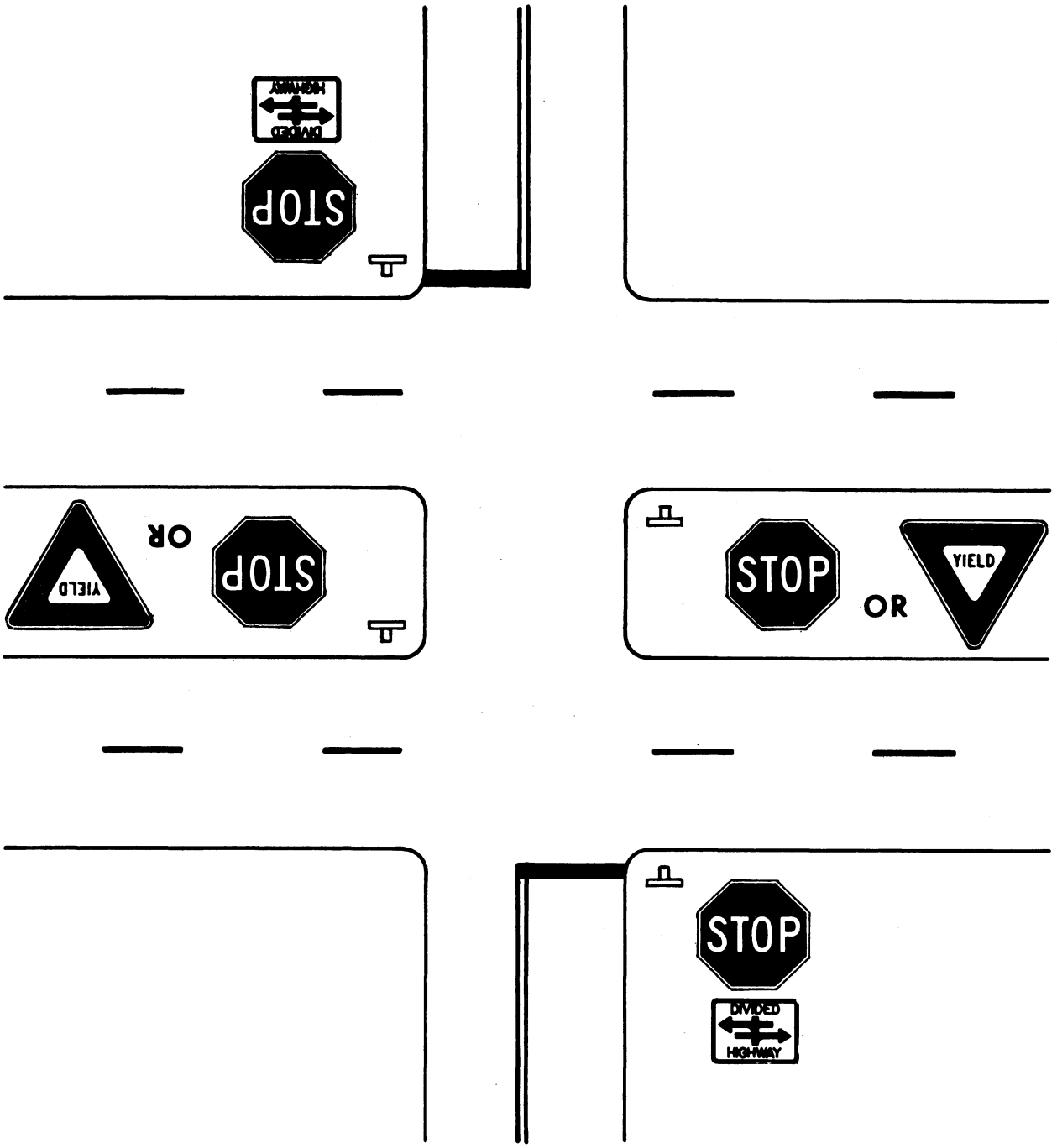

Figure 2. Location of divided highway crossing sign. (Recommended by Delaware Department of Highways and Transportation as an alternate to signs shown in Figure 2-3 of the F-MUTCD.)

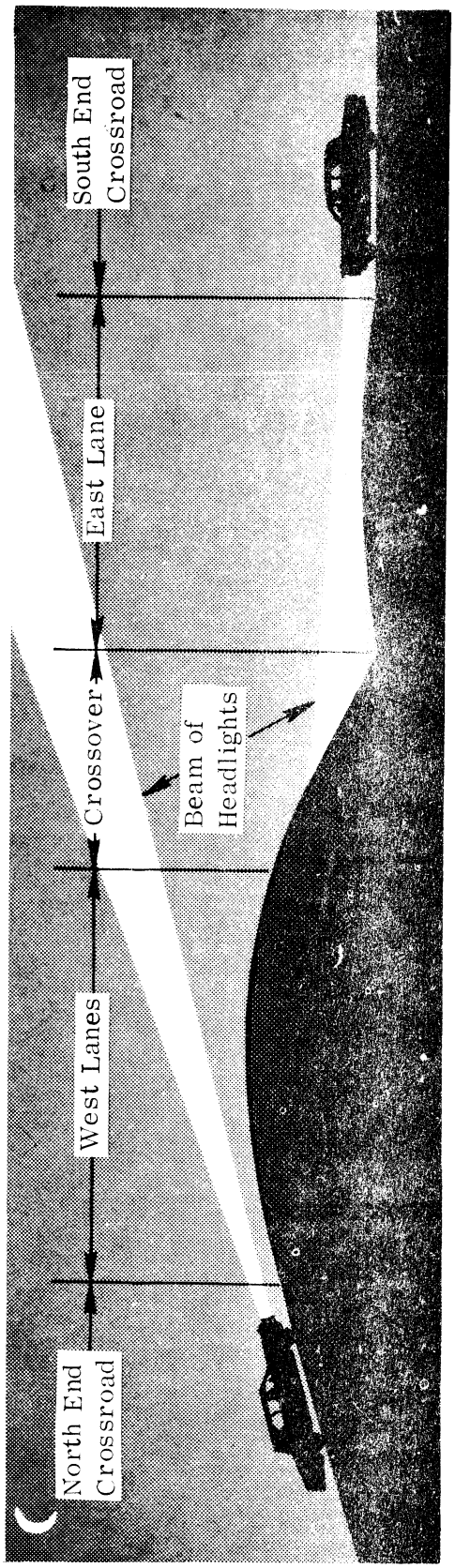

Figure 3. Intersection of a 4-lane divided highway and a crossroad at which, because of a difference in levels of the lanes, headlights do not properly illuminate the median.

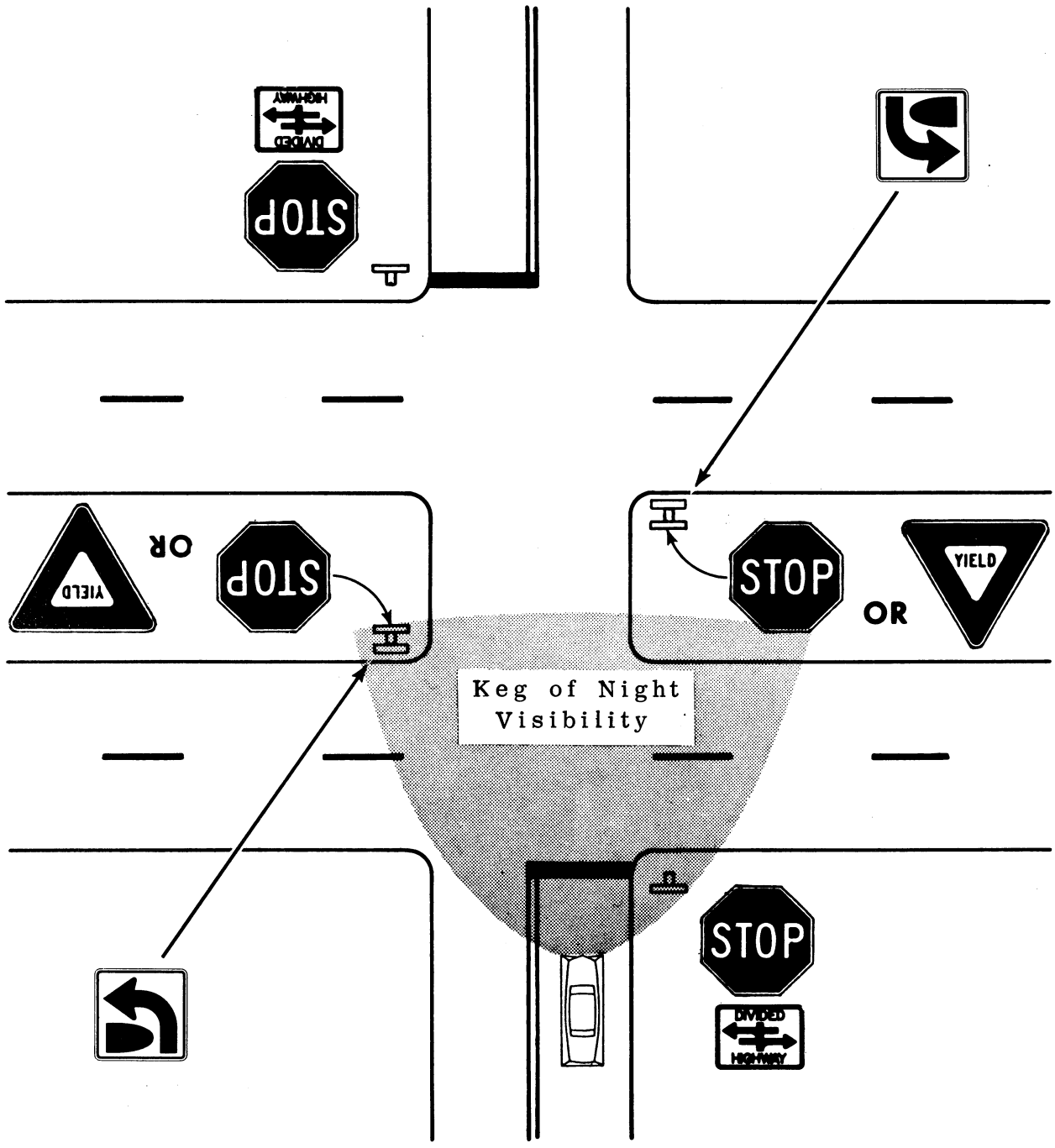

Figure 4. Turn around the nose sign superimposed on the Delaware Department of Highways and Transportation sign system shown in Figure 2.

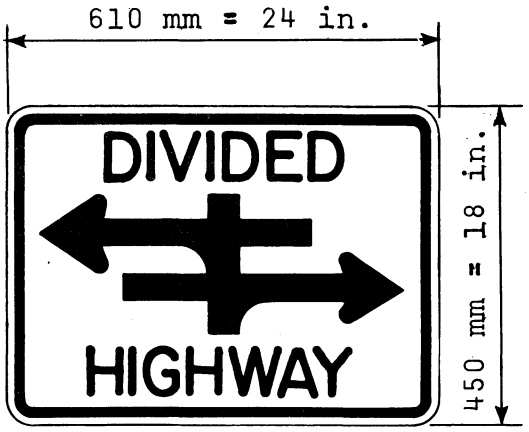

Figure 5. Four-legged intersection divided highway crossing sign.

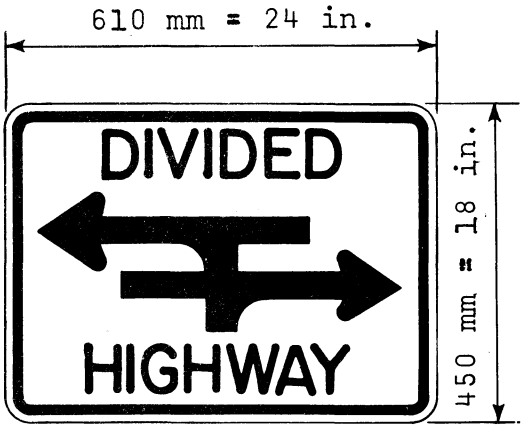

Figure 6. Three-legged intersection divided highway crossing sign.

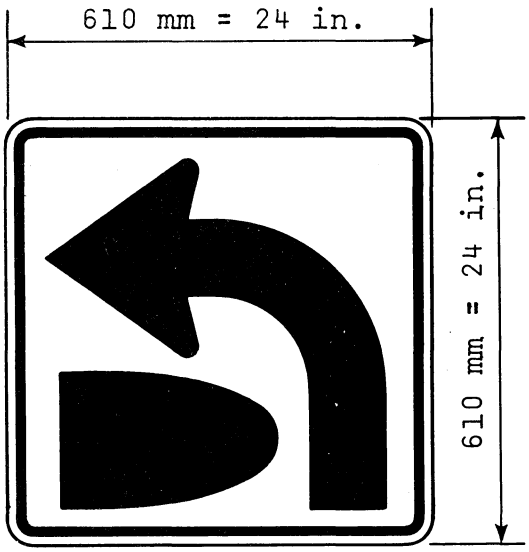

Figure 7. Turn around the nose sign.

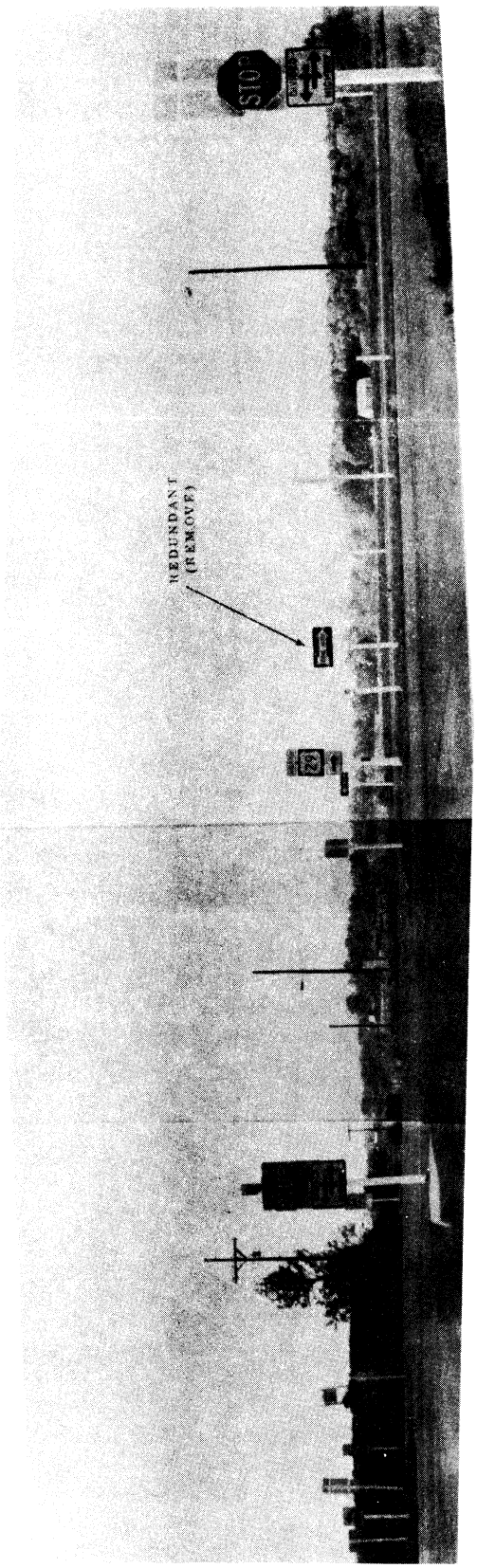

Figure 8. Location of divided highway crossing signs and turn around the nose sign.

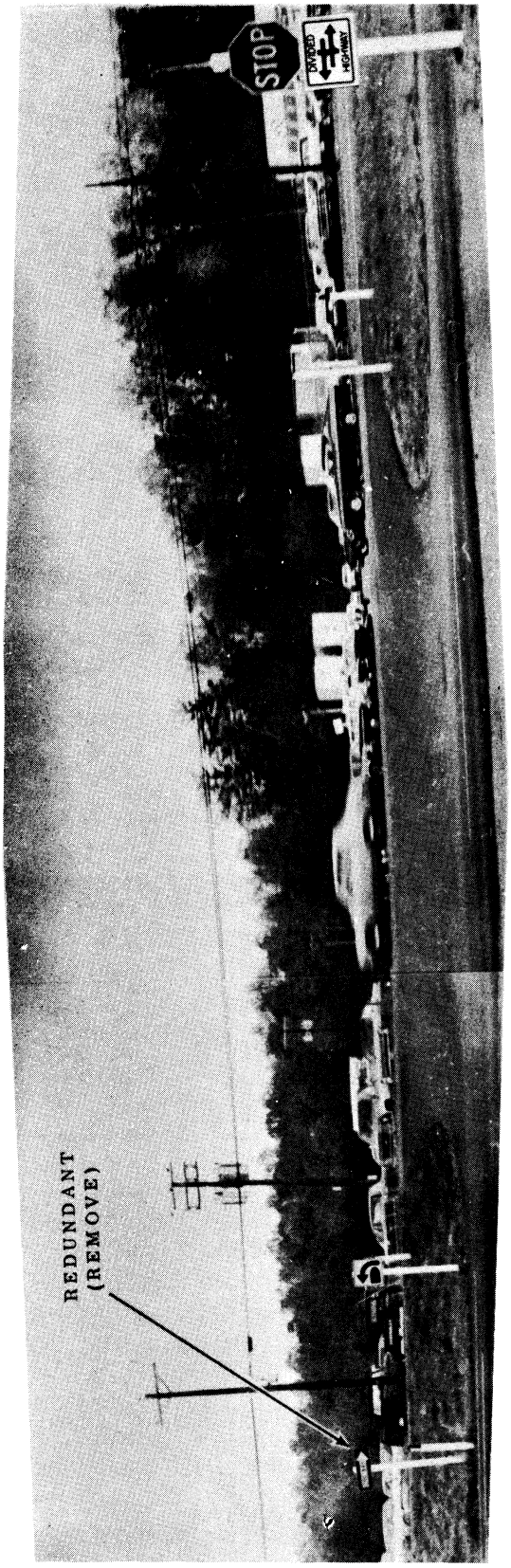

Figure 9. Location of divided highway crossing sign and turn around the nose sign.

Table 1

Wrong-way Entries from January 1, 1973, to October 22, 1976
on Route 29 Where the 4-lane Divided Highway (Delaware) Sign
and Turn Around the Nose Sign Have Been in Place
Since April 23, 1976

Date of Incidence	County	Site	Driver Condition	Light	Accident		
					Yes or No	Killed	Injured
2-10-73	Culpeper	Rte. 15	Normal	Dark	No	—	—
6- 8-73	Fauquier	Business District	Normal	Day	No	—	—
6-13-73	Culpeper	Business Exit	Normal	Day	No	—	—
7- 5-73	Madison	Route 647	Aged	Day	No	—	—
12-27-73	Madison	Private Drive	Normal	Day	No	—	—
5-10-74	Fauquier	Crossover	Normal	Day	No	—	—
7-22-75	Albemarle	Badger Powhatan Plant	Normal	Day	Yes	1	1
2- 4-76	Madison	Rte. 230	Normal	Dark	No	—	—
2- 5-76	Culpeper	Rte. 29 Business	Aged	Day	No	—	—

Up to October 22, 1976 — None

Note: No wrong-way entry by a drunken driver has been established on these two experimental sections.

Table 2

Sites of Wrong-way Entries from Interstate Exit Ramps onto 4-Lane Divided Highways
Where Divided Highway Crossing Sign and Turn Around the Nose Sign Need to be Provided

Interstate	Intersecting Highway	County	Date of Incidence	Driver Condition	Light	Direction of Travel	Accident			Remarks
							Yes or No	No. Killed	No. Injury	
95	1	Spotsylvania	12-70	Normal	Dusk	N in SBL	No	—	—	
95	1	Spotsylvania	9-71	Normal	Dusk	N in SBL	No	—	—	
95	1	Spotsylvania	9-71	Normal	Dusk	N in SBL	No	—	—	
95	1	Spotsylvania	1-72	Normal	Day	N in SBL	Yes	0	2	
95	1	Spotsylvania	11-72	Normal	Day	N in SBL	No	—	—	
95	1	Spotsylvania	5-73	Normal	Dark	N in SBL	No	—	—	Flares removed after May 1973.
95	301	Greensville	6-71	Normal	Day	N in SBL	No	—	—	
95	301	Greensville	4-74	Normal	Dark	N in SBL	No	—	—	
85	58	Mecklenburg	6-72	Normal	Day	E in WBL	No	—	—	
85	58	Mecklenburg	2-75	Normal	Dark	W in EBL	No	—	—	
81	11	Rockbridge	9-70	Normal	Day	N in SBL	No	—	—	One-way, do not enter, and, wrong-way signs not provided.
81	11	Rockbridge	5-72	Normal	Day	N in SBL	No	—	—	Flares removed after 1973.
81	11	Rockbridge	4-75	Normal	Dark	S in NBL	No	—	—	Do not enter and wrong-way signs needed.
81	612	Augusta	7-70	Normal	Dark	E in WBL	No	—	—	
81	612	Augusta	8-73	Drunk	Dark	W in EBL	No	—	—	
81	612	Augusta	7-70	Normal	Dark	E in WBL	No	—	—	
81	612	Augusta	8-73	Drunk	Dark	W in EBL	No	—	—	
95	30	Hanover	9-71	Normal	Day	N in SBL	No	—	—	
85	1	Mecklenburg	3-74	Drunk	Dark	N in SBL	No	—	—	
81	11	Rockingham	9-70	Normal	Day	S in NBL	No	—	—	
81	250	Augusta	7-71	—	Day	E in WBL	No	—	—	
81	52	Wythe	9-71	Normal	Dawn	S in NBL	Yes	0	1	
66	29	Fauquier	9-72	Drunk	Dark	W in EBL	No	—	—	
64	250	Albemarle	11-71	Normal	Dark	E in WBL	No	—	—	
64	340	Augusta	12-71	Normal	Dark	S in NBL	No	—	—	
64	60	Alleghany	2-72	Normal	Dark	W in EBL	No	—	—	

Table 3

Sites of Repeated Wrong-way Entries on 4-lane Divided Highway Intersections Where Divided Highway Crossing Sign and Turn Around the Nose Sign Should be Provided

4-lane Highway	Cross-road	County	Date of Incidence	Driver Condition	Light	Direction of Travel	Accident			Remarks
							Yes or No	Killed	Injured	
7	028	Loudoun	6-71	Drunk	Dark	W in EBL	No	—	—	All drivers were drunk. Signs may not help. Rumble strip provided after May 1973.
7	028	Loudoun	12-71	Drunk	Dark	W in EBL	No	—	—	
7	028	Loudoun	8-72	Drunk	Dark	E in WBL	No	—	—	
7	028	Loudoun	5-73	Drunk	Dark	W in EBL	Yes	3	3	
7	228	Loudoun	2-74	Nervous	Day	W in EBL	No	—	—	
7	228	Loudoun	3-76	Nervous	Day	W in EBL	Yes	—	—	
17	033	Gloucester	11-70	Unknown	Dark	N in SBL	No	—	—	
17	033	Gloucester	8-71	—	Day	N in SBL	Yes	—	—	
29	24	Campbell	12-70	Drunk	Dark	S in NBL	No	—	—	
29	24	Campbell	1-72	Drunk	Dark	N in SBL	No	—	—	
29	28	Fauquier	6-72	Normal	Dark	N in SBL	No	—	—	
29	28	Fauquier	7-72	Drunk	Dark	S in NBL	No	—	—	
29	230	Madison	10-70	Drunk	Dark	N in SBL	No	—	—	
29	230	Madison	2-76	Normal	Dark	N in SBL	No	—	—	
29	719	Pittsylvania	12-70	Normal	Day	S in NBL	No	—	—	
29	719	Pittsylvania	10-71	Drunk	Day	S in NBL	No	—	—	
33	605	King & Queen	5-72	Normal	Day	E in WBL	No	—	—	
33	605	King & Queen	2-74	Normal	Day	E in WBL	No	—	—	
58	621	Mecklenburg	10-71	Normal	Dark	W in EBL	No	—	—	
58	621	Mecklenburg	8-75	Drunk	Dark	W in EBL	Yes	0	2	
58	638	Brunswick	8-70	Drunk	Dusk	E in WBL	No	—	—	
58	638	Brunswick	6-72	Drunk	Day	E in WBL	No	—	—	
58	46	Brunswick	9-70	Drunk	Dark	E in WBL	No	—	—	
58	46	Brunswick	9-70	Drunk	Dark	E in WBL	No	—	—	
58	687	Southampton	10-72	Normal	Dark	E in WBL	No	—	—	
58	687	Southampton	8-72	Normal	Day	E in WBL	No	—	—	
60	033	New Kent	10-70	Drunk	Dark	E in WBL	No	—	—	
60	033	New Kent	4-73	Normal	Dark	W in EBL	No	—	—	
250	1426	Augusta	9-72	Confused	Dark	W in EBL	No	—	—	
250	1426	Augusta	7-73	Confused	Day	E in WBL	No	—	—	
301	614	King George	6-71	Drunk	Dark	N in SBL	No	—	—	
301	614	King George	8-72	Drunk	Dark	N in SBL	No	—	—	
301	035	Prince George	6-72	Drunk	Day	S in NBL	Yes	0	3	
301	035	Prince George	1-73	Drunk	Dark	S in NBL	Yes	0	1	
301	040	Sussex	9-70	Normal	Day	N in SBL	Yes	0	0	
301	040	Sussex	10-71	Drunk	Dark	N in SBL	No	—	—	
360	624	Richmond	8-70	Normal	Day	E in WBL	No	—	—	
360	624	Richmond	11-71	Normal	Day	E in WBL	No	—	—	
460	460 Bus.	Appomattox	8-70	Normal	Day	W in EBL	No	—	—	
460	460 Bus.	Appomattox	9-70	Drunk	Day	W in EBL				
460	460 Bus.	Appomattox	11-71	Drunk	Dark	W in EBL	No	—	—	
460	024	Appomattox	11-71	Drunk	Dark	W in EBL	No	—	—	
460	024	Appomattox	11-71	Drunk	Dark	E in WBL	No	—	—	
460	024	Appomattox	6-72	Normal	Dark	E in WBL	No	—	—	
460	226	Dinwiddie	12-72	Drunk	Dark	E in WBL	No	—	—	
460	226	Dinwiddie	9-73	Normal	Dark	W in EBL	No	—	—	
460	226	Dinwiddie	9-73	Normal	Dark	E in WBL	No	—	—	
460	685	Montgomery	10-73	Normal	Dark	S in NBL	Yes	0	0	
460	685	Montgomery	10-73	Normal	Dark	E in WBL	No	—	—	