FEASIBILITY OF USING NO-PASSING-ZONE SIGNS ON TWO-LANE HIGHWAYS IN VIRGINIA

by

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Assistant Head

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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INTRODUCTION

The Virginia Department of Highways and Transportation maintains and operates 5,622 miles of two-lane primary highways throughout the state.(1) Unfortunately, these two-lane roadways are the most accident prone and lethal of any type in the primary system, as is indicated in Table 1.(2) The majority of the 43,400 miles of secondary highways are two-lane and the Department's 1978 summary of accident data indicates that the accident problems on the secondary system are 90% higher than those on the primary system and 486% higher than those on the interstate. Forty-six percent of the fatal collisions and 33% of all crashes on the secondary system occur at night. Similar statistics for the primary system are 59% and 32%, respectively.(2) Passing maneuvers are a major cause of accidents on two-lane roads and the statistics shown in Table 2 were taken from the 1978 Crash Facts published by the Virginia Department of State Police.(3)

Currently it is estimated that there are 11,000 no-passing zones on the primary system. In 1965 the Office of Research of the Federal Highway Administration conducted a passing maneuver research project on Rte. 7 in Loudoun and Clarke counties.(4) This study was conducted prior to the reconstruction of Rte. 7 while it was still a rural two-lane highway. Data were acquired from the Virginia Division of Motor Vehicles accident reports and the analysis indicated that 23% of the total accidents involved an overtaking maneuver and 20% involved a passing maneuver. The report on the project concluded that over 6,000 accidents involving overtaking and passing vehicles occurred annually on the Virginia two-lane primary highway system.

The Manual on Uniform Control Traffic Devices allows the use of a no-passing-zone sign to warn the motorist overtaking another vehicle of the approaching no-passing zone.(5) The Manual states that "because of the demonstrated target value given by this sign in critical passing maneuvers, the No Passing Zone sign should be used on two lane roads to warn of the beginning of no passing zones identified by either conventional pavement markings or Do Not Pass signs or both. When used, it shall be erected on the left side of the roadway at the beginning of the no passing zones." The use of the sign is not mandatory; however, the term "No Passing Zone sign should" caused an assistant attorney general in

1979

New Mexico to make the following statement: "Therefore, if the expense is not prohibitive, the best practice is to place the sign everywhere we have a no passing zone. This may save us money and problems in the future".(6) The legal opinion which led to the adoption of the no-passing-zone sign in New Mexico is in Appendix A.

Table 1

Accidents on Arterial and Primary Systems - 1978

Type of Highway	No. of Accidents	Percentage of Total	Persons Killed	Percentage of Total	Death Rate
2-Lane	15,678	42	308	60	5.2
3-Lane	987	3	9	2	2.1
4-Lane undivided	3,671	10	37	7	4.4
4-Lane divided	12,763	33	148	29	2.5
Other	4,441	12	10	2	2.5
Total	37,540	100	512	100	3.8

Table 2

Accidents in No-Passing-Zone Areas

Location	Number of Accidents	Number of Fatal Crashes	Number of Injury Crashes
Rural	7,702	144	2,988
Urban	1,426	16	511
Total	9,128	160	3,499

PURPOSE

The Virginia Department of Highways and Transportation has installed no-passing-zone signs on selected routes throughout the state and at numerous isolated locations under recent narrow bridge delineation projects (a listing of the selected routes is in Appendix B), and consideration is being given to the use of no-passing-zone signs on all two-lane primary highways in the state. The purpose of this study was to gather information and statistics relative to the cost-effectiveness of the sign. Because accident and cost data are limited in Virginia, the study used evaluations conducted in other states.

EXPERIENCES IN OTHER STATES

As shown in Table 3, 16 states have adopted use of the no-passing-zone pennant sign on a statewide basis, and many other states use the pennant signs at railroad grade crossings, narrow bridges, high hazard locations, work sites, etc. North Carolina and Mississippi are installing the pennant signs on all new highway projects and West Virginia and Washington are evaluating the device for adoption on a statewide basis.

The literature review revealed that six major studies have been conducted on the feasibility of using the no-passing-zone pennant sign and these are summarized in the succeeding sections.

Table 3

States Using the No-Passing-Zone Sign

Use Statewide	Use at Selected Locations
Kentucky	Maryland
Tennessee	Nevada
Arizona	Rhode Island
South Dakota	Georgia
Nebraska	Ohio
Minnesota	Montana
New Mexico	Idaho
Iowa	Wyoming
Michigan	Utah
Wisconsin	North Dakota
Illinois	New York
Indiana	Kansas
Alabama	Texas
Pennsylvania	New Jersey
New Hampshire	Connecticut
Massachusetts	Mississippi
	Louisiana
	California
	Virginia

1972

Texas Transportation Institute

The most recent study of the pennant sign was conducted by the Texas Transportation Institute (TTI) of the Texas A&M University and a report on it was published in January 1979.(7) This study was basically an economic analysis that attempted to determine what benefits could be expected from the installation of the pennant signs and dotted yellow pavement markings in advance of no-passing zones. As pointed out in the report on the study, in many cases the administrative decision to adopt the concept of advance warning for the no-passing zone appears to have been made not on detailed benefit-cost analyses, but rather on a conviction that driver conditioning to potential hazards is in itself beneficial and the cost of implementing such a system will be offset by improved operations and safety and a lessening of the potential for litigation.

In an attempt to determine the cost-effectiveness of the system, the approach adopted by the TTI to compare expected benefits to expected costs on a nationwide basis entailed the following tasks.

1. Estimate costs of proposed no-passing-zone advance treatment nationwide.
2. Estimate number of no-passing zones nationwide.
3. Estimate number of passing maneuvers executed annually on two-lane highways nationwide.
4. Estimate number of passing maneuvers involving "clipping" (completing the pass beyond the start of the solid yellow line).
5. Estimate number of accidents involving sight-restricted passing maneuvers.
6. Estimate accident reduction due to application of advanced treatment.
7. Estimate number of lives saved.
8. Estimate reduction in injury and property damage accidents.
9. Estimate dollar savings of advanced treatment.
10. Determine expected benefit-cost ratio.

It was concluded that the average sign would cost $51 with an annual cost of $10.46 per no-passing zone. In a previous study, Byington had reported that there were approximately two no-passing zones per mile of two-lane highways in Virginia, and this statistic was used in the Texas study.(8) O. K. Normann had previously determined that 59.7% of all passing maneuvers were performed in the absence of an opposing vehicle,(9) while a Michigan Highway Department study had revealed that clipping occurred in 14% to 17% of the total number of passing maneuvers on a two-lane highway.(10) Another statistic used in the cost analysis, one that was developed by the Franklin Institute Research Laboratories, held that approximately 10% of the accidents on two-lane roads were passing related.(11)

The report on the TTI study concluded by presenting the low, the high, and the most probable estimates of the expected benefit-cost ratio for the system of signs and markings, determined as the ratio of the savings to the annual cost of treatment. The benefit-cost ratios computed indicate a most probable value of 6.1, which indicates that the advance treatment system has a high probability of being cost-effective if used nationwide. The low estimate was 3.2 and the high estimate was 19.6.

Michigan Department of State Highways

The Michigan Department of Highways installed pennant signs on U. S. 12 in July and August 1964. An evaluation of the effectiveness of the signs was completed in 1968 and revised in June 1970. The final report on the project gave a comparison of before and after accident rates and presented criteria for justifying the use of the pennant.(12)

The comparison of the accident rates indicated there was a relative improvement in the accident rate as compared with the rate of all accidents on the highway, and there was a mean decrease of 28% in the number of passing accidents in the no-passing zones after the installation of the pennant sign.

The criteria developed for justifying the use of the pennant are shown in Figure 1, where it can be noted that the costs of fatalities are not included. Utilizing the cost of installation and the number of passing accidents observed during one year where the signs are to be installed, the cost feasibility can be easily determined by using the graph shown in Figure 1. Specific examples of the use of the graph are given in Appendix C.

1974

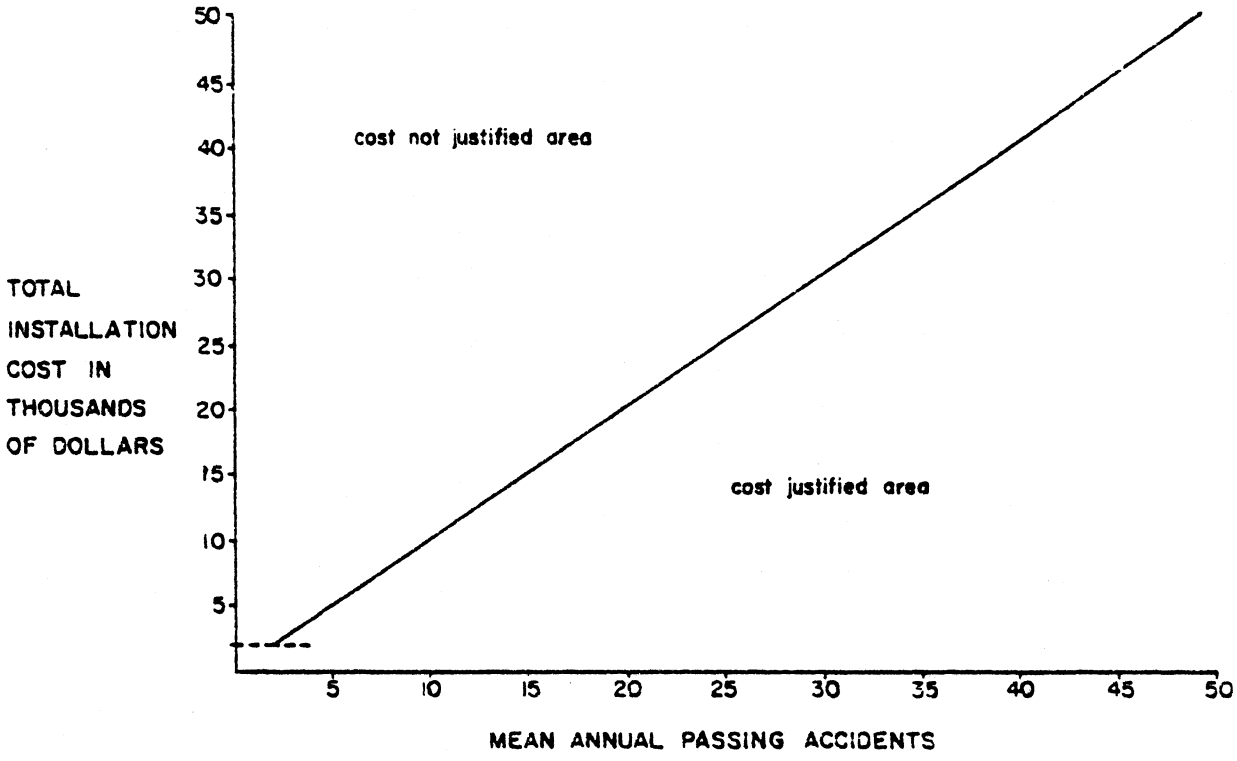

Figure 1. Michigan's cost justification criteria for no-passing-zone signs.

Colorado

The Colorado Highway Department installed no-passing-zone signs on Rte. 82 between Basalt and Aspen during October 1974. Before and after accident data revealed a reduction of 57.9% in passing maneuver accidents.(13) The reductions in injury accidents and persons injured were 66.7% and 87.5%, respectively. One year prior to the installation of the pennant signs, the property damage and injury accidents amounted to $39,100; during the after period the cost was $7,700. The cost of installing the signs was $4,000; therefore, the net savings was $27,400 during the first year after the pennants were installed.

University of Kentucky

In 1967 the University of Kentucky published a report on research focused in large part upon the visibility of the no-passing-zone sign and means of delineating the beginning of the zone for the motorist.(14) It was noted in the report that markings have their limitations in that they are easily obliterated by ice and snow, they are not clearly visible under certain weather conditions (rain), and the durability of those made with certain materials is limited under exposure to heavy traffic loads. They also may be obscured by vehicles immediately ahead of the observer.

The report concluded that accidents on two-lane roads are five times as numerous as those on four-lane roads, and the accident frequencies show that the number of nighttime accidents per vehicle mile is approximately three to four times the number of daytime accidents. Two-thirds of all fatal accidents take place on rural roads. The Kentucky study also concluded that the increased target value of the beginning of the no-passing zone accounted for the reduction in violations of the prohibition against passing in the marked zones.

Indiana State Highway Commission

In 1968 the Indiana Highway Commission conducted an evaluation of the no-passing-zone sign which related to the visibility of the sign and to an analysis of driver behavior in attempted passing maneuvers.(15) It was found in the visibility study that the color and distinctive shape of the no-passing-zone pennant sign effectively drew the motorist's attention, especially at night. It was also found that a sign located on the left side of the roadway provided the motorist with a visibility distance approximately twice that provided by a sign located on the right side of the roadway. The analysis of driver behavior showed that the signs provided advance warning of the no-passing zones and improved driving behavior. After the installation of the pennant signs, the number of passes attempted reduced by 46.3%.

Iowa

Iowa was among the first states to use the pennant sign and their evaluations focused upon motorist reaction and acceptance.(16) The following conclusions were derived from interviews with motorists in Iowa.

1. Believe the concept of identifying the no-passing zone alerted the driver to refrain from making a passing maneuver that otherwise might have been attempted.

	Percent in Favor of Concept
Public Drivers	90.5
Commercial Drivers	92.1

2. Does the location of the no-passing pennant sign on the left side provide easier recognition of the no-passing zone.

	Percent Responding Yes
Public Drivers	90.1
Commercial Drivers	94.4

3. Would you recommend your state using Iowa's type signing for the no-passing zone?

	Percent Responding Yes
All out-of-state drivers	74.5

CONCLUSION

Two-lane roads make up approximately 71% of Virginia's primary highway system, and these roadways have approximately 11,000 passing zones. These 2-lane facilities account for 42% of all accidents and 60% of the persons killed on the primary system. Annually, over 9,000 accidents occur in no-passing-zone areas on 2-lane roads and these include 160 fatal crashes and 3,500 injury crashes.

Many states have adopted the use of the no-passing-zone pennant sign on a statewide basis under various justifications. It appears that in many cases the administrative decision has been made on the conviction that driver conditioning to potential hazards is, in itself, beneficial and that the cost of implementing such a system would be offset by improved safety and a reduced potential for litigation.

In New Mexico the concept was adopted on the basis of an assistant attorney general's opinion and interpretation of the word "should" as used in the Manual. Evaluations conducted in Iowa revealed that the motorist liked the sign and readily accepted its use. Studies in Indiana and Kentucky showed that the no-passing-zone sign erected on the left side of the roadway provided improved visibility of the approaching no-passing zone and that the number of attempted passes decreased after the installation of the sign. In Michigan it was determined that there was a decrease of approximately 28% in the number of passing accidents in no-passing zones after the installation of the pennant sign. Utilizing the cost of signs and the number of passing accidents, Michigan also developed criteria for justifying the use of the pennant. Although Colorado has not adopted the use of the pennant on a statewide basis, a before and after study revealed a reduction in passing maneuver accidents of 57.9% and a reduction in injury accidents and persons injured by 66.7% and 87.5%, respectively. A Texas Transportation Institute study focused upon the cost-effectiveness of using the pennant sign on a nationwide basis and concluded that the most probable benefit-cost ratio for implementing use of the sign nationwide would be 6.1. Finally, the literature survey did not reveal any evaluations showing the no-passing-zone pennant sign to be ineffective in reducing accidents nor a negative benefit-cost ratio.

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APPENDIX A

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NEW MEXICO STATE
HIGHWAY DEPARTMENT

INTRA-DEPARTMENTAL CORRESPONDENCE

UBJECT Change in use of "No Passing Zone" Pennants DATE December 30, 1976

FILE REFERENCE: M-LEGAL-Gen.

O G. PARKER BELL
Traffic Engineer

ATTENTION OF

ROM REESE C. JONES
State Highway Department
Assistant Attorney General

I have reviewed the material that has been submitted, and I am of the opinion that there are two courses of action which we could take which would satisfy the recent changes in the Manual on Uniform Traffic Control Devices concerning the use of "No Passing Zone" pennants.

The official ruling is vague on the guidelines to be followed in deciding whether to use the "No Passing Zone" pennant. However, it is apparent that they are somewhat enthralled with the benefits of using this type of sign and even though they have not made its use mandatory, they suggest that it would be best to use them whenever possible.

If we wish to follow their ruling strictly, we could use the following procedure. Since the use is not mandatory, but is a recommended use, it would behoove us to review those stretches of road which we have painted with the yellow marker and/or have the regular "Do Not Pass" sign and determine whether, in our opinion, the traffic would benefit from placing a pennant on the left side of the road. It would be necessary to keep records of the fact we undertook the study and in fact considered placing the sign. Thus, if we were challenged on our failure to place one of these signs, we could show we were in compliance with the federal mandate in that we considered the use of the sign at that particular location and acted as the situation indicated.

I can readily see, however, that that procedure would be complicated, time consuming, and in the long run cost as much as putting up the pennants; however, we have this alternative.

As is well known, the Department no longer has sovereign immunity as enjoyed in the past and under the new law is responsible for negligent maintenance of the highway. A question might be asked as to whether signing the highway is maintenance, where there is

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liability, or whether it is part of the design of the highway and thus, no liability. However there are no court determinations on this and I could see it quite easily going one way or the other. It is suffice to say that failure to follow federally recommended sign usage exposes us to liability.

Therefore, if the expense is not prohibitive, the best practice is to place the sign wherever we have a no passing zone. This may save us money and problems in the future.

If you have any further questions, please do not hesitate to call on me.

REESE C. JONES
State Highway Department
Assistant Attorney General

RCJ:cg

APPENDIX B

Routes Having No-Passing-Zone Signs

Route	County	Termini	Date Installed
50	Loudoun	Route 17 and Fairfax County Line	December 13, 1972
9	Loudoun	Route 7 and West Virginia Line	October 28, 1971
250	Albemarle	Route 22 and Fluvanna County Line	January 13, 1970
250	Fluvanna and Louisa	Albermarle and Goochland Counties	January 13, 1970
250	Henrico and Goochland	Fluvanna County Line and Route 271	September 1969
249	New Kent	Quinton and Route 30	NA
307	Amelia and Nottaway	Route 360 and Route 460	April 25, 1977
60	Powhatan	West of Route 522 and Cumberland County	September 1969
60	Buckingham and Cumberland	Route 24 and Powhatan County Line	September 1970
24	Appomattox and Buckingham	Route 460 and Route 60	September 1970
24	Campbell	Route 460 and Route 29	November 1978
307	Prince Edward	Route 460 and Nottoway County Line	December 1977
460	Prince Edward	Route 15 and Route 460 Bus	October 1978
501	Campbell	Lynchburg SCC and Brookneal	January 1978
501	Halifax	Brookneal and North Carolina Line	January 1979
11	Frederick	Route 277 and West Virginia Line	Summer 1976
58	Isle of Wight and Suffolk	Holland and Franklin	1973
17 & 258	---	James River Bridge	June 1, 1976
301	Caroline	Bowling Green and Hanover County Line	March 1979
58	Henry	West of Route 220 and Patrick County Line	1972

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APPENDIX C

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Explanation of Michigan's Cost Justification Criteria

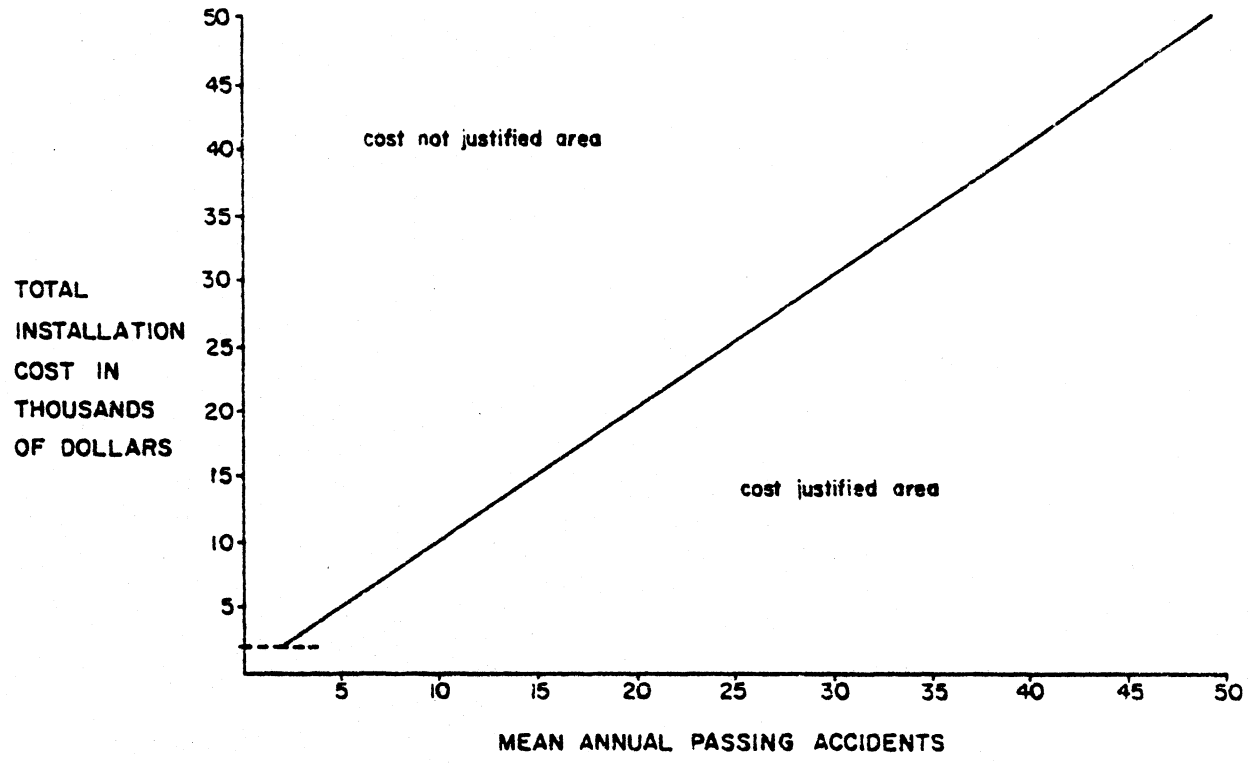

Figure C-1 Michigan's graph for justifying cost.

To use this graph, take the cost of installation and the number of passing accidents observed during one year where the sign is to be installed and plot this point. If the point lies above and to the left of the line on the graph, the installation is not cost-justified. The vertical height from the plotted line represents the five-year loss involved if the sign is installed.

If the point lies below and to the right of the line on the graph, the installation is cost-justified. The vertical distance from the plotted line represents the five-year return.

Since the graph is based on the total cost of the installation, it may be used for any price per pennant.

For US-12, 15 passing accidents were observed the year before the pennant was installed. The estimated installation cost was $11,060. If one enters the graph with the 15 accidents, he sees that a cost of $15,370 would be justified. Thus, having observed the 15 accidents, the installation of the pennant would have been recommended.

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Examples of Use of Graph:

Example 1: A trunk line has 80 passing zones in a 70-mile distance

Cost of installation

80	zones
2	pennants/zone
160	pennants
$ 40	cost per installed pennant
$6,400	

Going into the graph with the $6,400, it is seen that an annual mean of 7 or more passing accidents in these 80 zones during preceding years would justify the installation.

Example 2: In the 55 passing zones on a route, 18 passing accidents occurred during the preceding year.

Going into the graph at the 18 accidents and considering the cost of the 110 pennant signs, it follows that $13,900 would be the expected reduction in expected loss if the pennant was installed, inasmuch as an expenditure of $18,300 would be justified and the cost of installing the signs is $4,400.