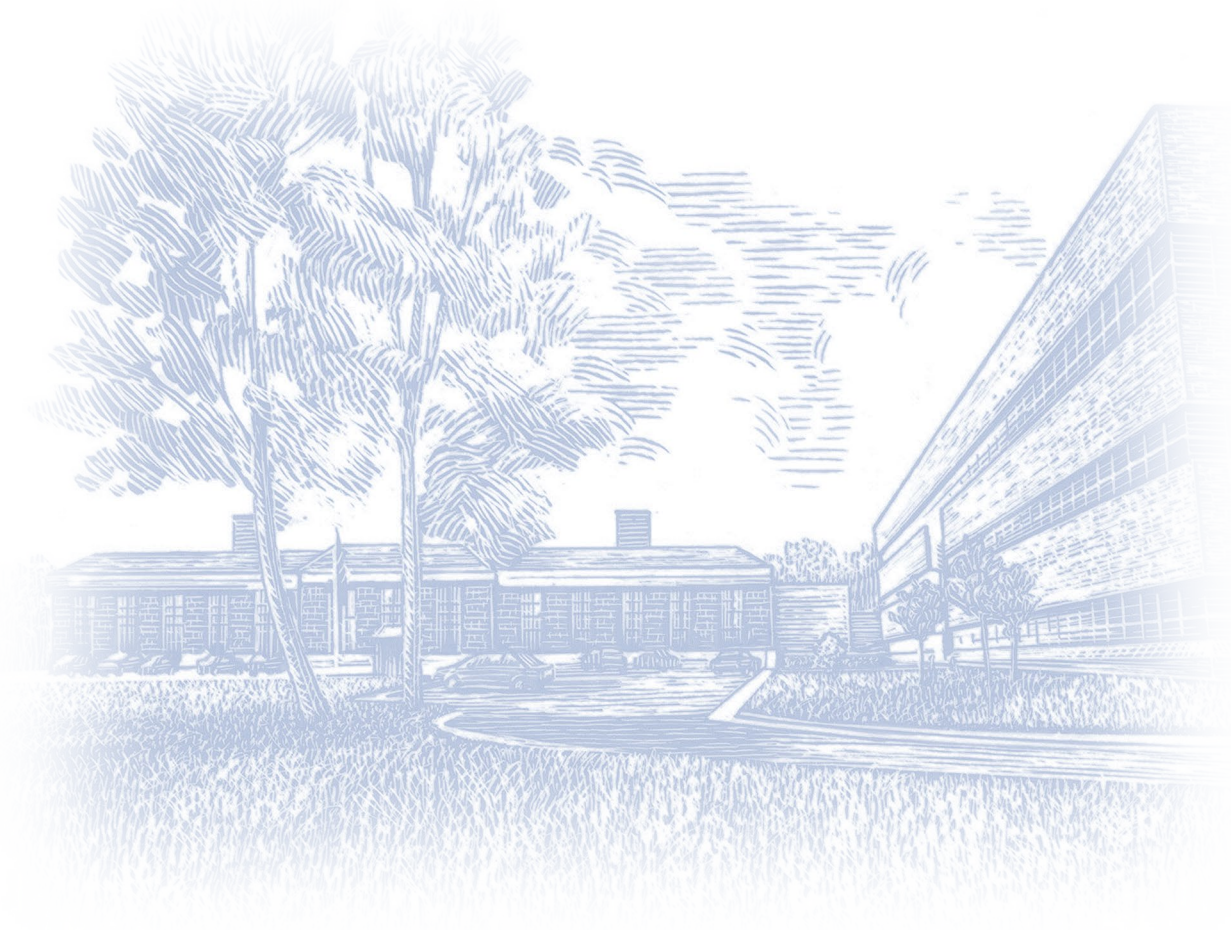
The Magnitude and Severity of Passing Accidents on Two-Lane Rural Roads

Publication No.: FHWA-RD-94-068 **November 1994**



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Foreword

An important safety issue on rural, two-lane roads relates to crashes involving passing maneuvers, where one vehicle attempts to pass a slower vehicle traveling ahead in the same direction. The danger occurs largely from the passing vehicle occupying the opposing lane of travel, making sufficient passing sight distance critical in such a passing situation. Thus, highway engineers need to know how much passing sight distance exists on rural, two-lane roads, and also whether no-passing zones are marked adequately to discourage unsafe passingmaneuvers.

Questions have been raised concerning the marking criteria for no-passing zones as found in the Manual on Uniform Traffic Control Devices (MUTCD), particularly since such distances differ considerably from passing sight distance design criteria as given in the American Association of State Highway and Transportation Officials (AASHTO) "Green Book" (A Policy on Geometric Design of Streets and Highways). In fact, the MUTCD distances are approximately one-half those of the AASHTO values for a given vehicle design speed, as shown in Tables 1 and 2.

Table 1. AASHTO minimum passing sight distances for design of two-lane highways.

Design Speed (ft)	Minimum Passing Distance (ft)
20	800
30	1,100
40	1,500
50	1,800
60	2,100
65	2,300
70	2,500

Source: AASHTO Policy, 1990 Ed.

Table 2. MUTCD's minimum passing sight distances for marking no-passing zones.

85th Percentile Minimum Speed or Posted Passing Speed Limit (mi/h) whichever is higher	Minimum Passing Sight Distance (ft)
25	400
30	500
35	550
40	600
45	700
50	800
55	900
60	1,000
65	1,100

70	1,200
Source: MUTCD for Streets and Highways, 1988 Ed.	
1 mi/h = 1.61 km/h 1 ft = 0.305 m	

In response to these questions, the Federal Highway Administration (FHWA) initiated a research effort to identify the critical issues and to develop experimental designs for research to address these issues.[1] From this research, the highest priority research problem statement was the need to study the magnitude of the passing-accident problem. Based on this recommendation, two separate studies were conducted. The first study developed the methodology for identifying passing accidents and analyzed data from one State, while a later study applied this same methodology in an analysis of data from two additional States.[2,3] Both efforts also examined the severity of passing accidents and the types of collisions that result from these accidents.

State Data Bases Used

The data in the two studies referenced above were obtained from the FHWA Highway Safety Information System (HSIS). Accident data from 1985 to 1989 for two-lane roads were used for each of three States, designated as States A, B, and C, respectively.

Analysis Methods

The first step in developing a final data set for passing accidents for the three States was to merge the accident, vehicle, and roadway files of all accidents occurring on two-lane roads in the 5-year period. Accidents on unpaved roads were eliminated from the final data set.

The next step was to separate the file into passing and non-passing accidents that occurred on two-lane roads in each State. This process entailed selecting the specific variables in each State that were needed to identify a passing accident. Since the focus of this study was on passing accidents related to the design and marking of passing zones, turning accidents and pedestrian and bicycle accidents were deleted from the final file. To compare the passing accidents within each State and between States, two indicator ratios were developed. These ratios, recommended in the experimental plan for this effort, were the ratio of passing accidents on two-lane roads to all accidents on two-lane roads and the ratio of passing accidents on two-lane rural roads to all accidents on two-lane rural roads. In addition, the analysis focused on quantifying the type and severity of passing accidents.

Results

For the three States, the percentage of total passing-related accidents ranged between 0.76 percent and 2.31 percent on all two-lane roads and between 1.43 percent and 2.63 percent on two-lane rural roads. Combining the data across States, the overall percentage of passing to total accidents was only 1.30 percent on all two-lane roads and 2.01 percent on two-lane rural roads, as shown in Table 3.

Table 3. Summary of passing accidents for the three States.				
	All Two-Lane Roads			
	State A	State B	State C	Total
All Accidents	198,185	68,489	100,776	367,450
Passing Accidents	1,516	922	2,325	4,763
(percentage of total accidents)	(0.76%)	(1.35%)	(2.31%)	(1.30%)
	Two-Lane Rural Roads Only			
	State A	State B	State C	Total
All Accidents	69,104	21,407	54,113	144,624
Passing Accidents	986	495	1,422	2,903
(percentage of total accidents)	(1.43%)	(2.31%)	(2.63%)	(2.01%)

The analysis of the severity of passing accidents revealed that passing accidents are somewhat more severe than non-passing accidents. In all three States, the percentage of fatal and incapacitating passing accidents is higher than that of non-passing accidents, as shown in Figures 1, 2, and 3.

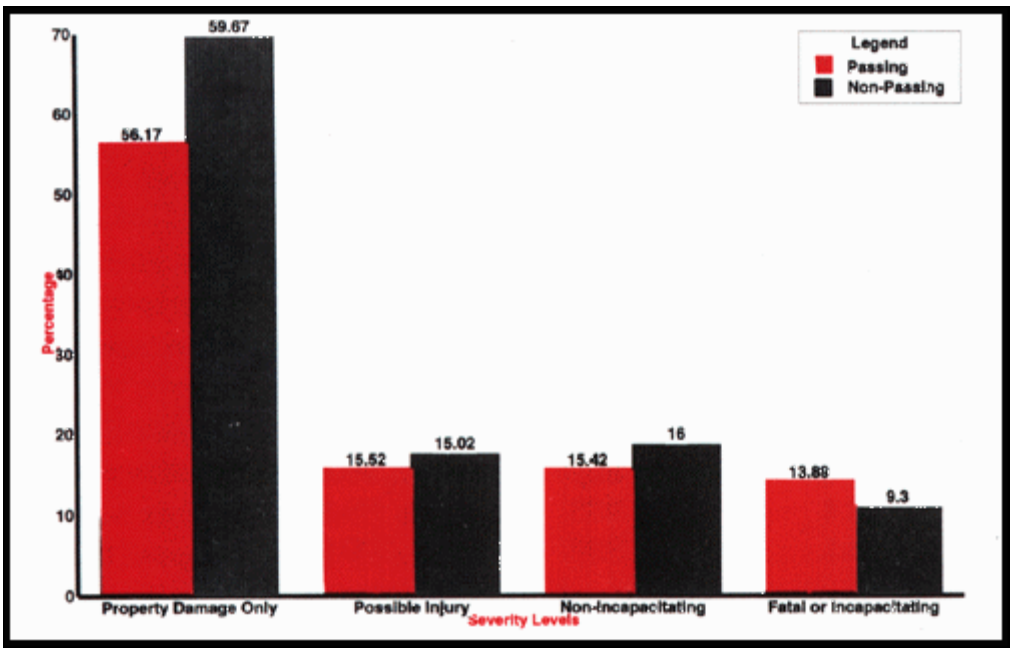

Figure 1. Comparison of the severity of passing and non-passing accidents in State A.

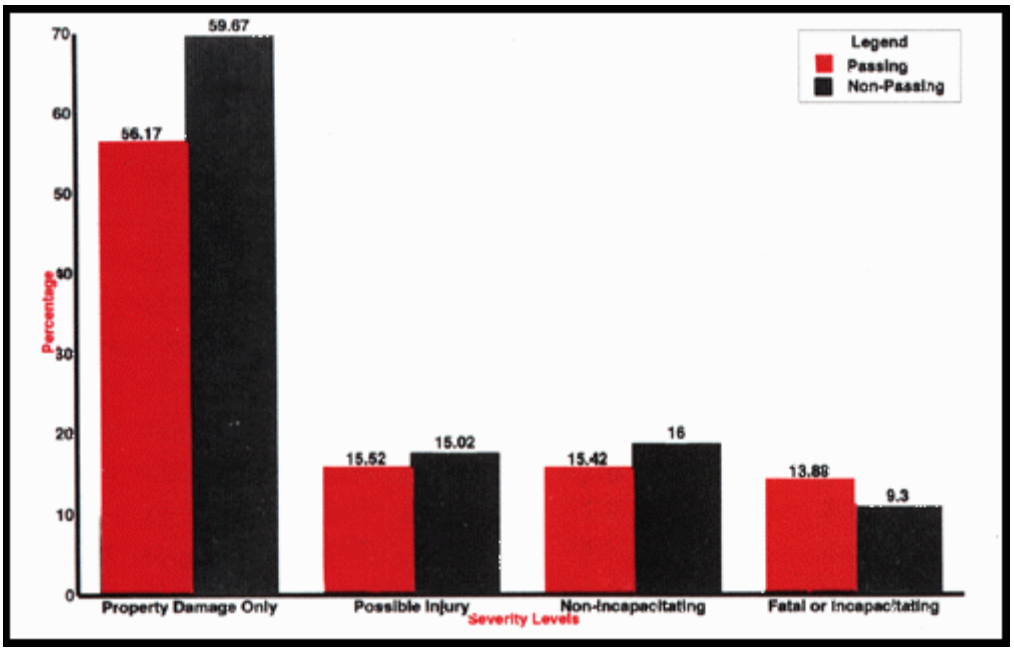

Figure 2. Comparison of the severity of passing and non-passing accidents in State B

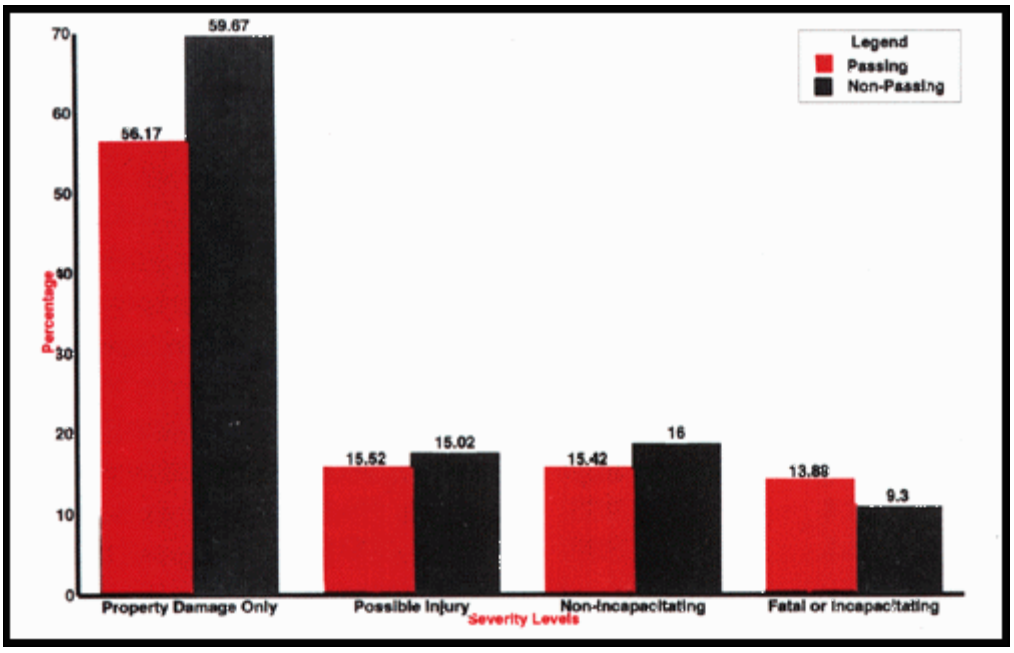

Figure 3. Comparison of the severity of passing and non-passing accidents in State C.

The types of collisions resulting from passing accidents were examined. Of particular interest was the proportion of passing accidents that resulted in head-on collisions. In State A, sideswipe passing

accounted for the largest proportion of passing accidents (31.9 percent) on two-lane rural roads, while head-on passing accidents were only 6.4 percent of all passing accidents on two-lane rural roads.

In State B, one-third of the passing accidents on two-lane rural roads were single-vehicle, while 6.7 percent were head-on. Rear-end/sideswipe accidents predominated (40.4 percent) in State C, and about 18 percent of the accidents were classified in the combined head-on/sideswipe category. A summary of accident types involving passing accidents is given in Tables 4, 5, and 6 for the three States. The findings contradict the common belief that passing accidents on two-lane rural roads are more commonly head-on. One might speculate that if trouble develops during a passing maneuver, the passing driver will opt for almost anything to avoid a head-on crash.

Table 4. Accident type for passing-related accidents on two-lane, rural roads for State A, 1985 through 1989.

Collision Type	Accident Numbers	Percentage	Cumulative Frequency	Cumulative Percentage
Sideswipe passing	315	31.9	315	31.9
Ran-off-road, right	134	13.6	449	45.5
Other	125	12.7	574	58.2
Rear-end	120	12.2	694	70.4
Ran-off-road, left	117	11.9	811	82.3
Sideswipe opposite	81	8.2	892	90.5
Head-on	63	6.4	955	96.9
Unknown	31	3.1	986	100.0

Table 5. Collision type for passing-related accidents on two-lane, rural roads for State B, 1985 through 1989.

Collision Type	Accident Numbers	Percentage	Cumulative Frequency	Cumulative Percentage
Any single vehicle	169	34.1	169	34.1
Rear-end	125	25.2	294	59.3
Sideswipe	75	15.2	369	74.5
Same, turning	67	13.6	436	88.1
Head-on	33	6.7	469	94.8
Opposite turning	16	3.2	485	98.0

Approach angle	5	1.0	490	99.0
Approach turning	3	0.6	493	99.6
Other	2	0.4	495	100.0

Table 6. Accident type for passing-related accidents on two-lane, rural roads for State C, 1985 through 1989.

Collision Type	Accident Numbers	Percentage	Cumulative Frequency	Cumulative Percentage
Rear-end/sideswipe	575	40.4	575	40.4
Ran-off-road	436	30.7	1,011	71.1
Head-on/sideswipe	258	18.1	1,269	89.2
Rollover	79	5.6	1,348	94.8
Fixed object	34	2.4	1,382	97.2
Intersection	27	1.9	1,409	99.1
Other	10	0.7	1,419	99.8
Jackknife	2	0.1	1,421	99.9
Submersion	1	0.1	1,422	100.0

As a final analysis, the passing accidents in State A were examined to determine the percentage of passing accidents occurring outside passing zones. The locations of the passing zones were obtained using videodisc photologs for State A and the HSIS Photolog Laser Videodisc Retrieval System. This analysis was limited to U.S. and State routes since they are the only routes that are photo-logged. From this analysis, it was found that 90 percent of passing accidents on these two-lane rural roads occurred within the passing zone, and 10 percent occurred outside the passing zone.

Study Implications

These two studies provided detailed information on the magnitude, severity, type, and location of passing accidents based on data from three HSIS States. While the large percentage of passing accidents occurring within the passing zone may indicate that some improvements in safety could be made by revising the marking criteria for no passing zones, the overall effect is expected to be small due to the low percentage of passing accidents found in these studies. Currently, FHWA has no plans for conducting additional research on the procedures for marking passing zones.

For More Information

For more information, contact **Jeffrey F. Paniati**, HSIS Program Manager, HSR-30, (703) 285-2568.

References

[1] Hughes, Warren, E.; Joshua, Sarath; and McGee, Hugh W. Study Designs for Passing Sight Distance Requirements. Publication No. FHWA-RD-91-078. U.S. Department of Transportation, Federal Highway Administration, Washington, DC, April 1992.

[2] Alexander, Henrietta B. and Pisano, Paul A. "An Investigation of Passing Accidents on Two-Lane, Two-Way Roads." Public Roads, 56(2):49-60.

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