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SOME EFFECTS OF PAVEMENT EDGE LINES ON DRIVER BEHAVIOR

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SOME EFFECTS OF PAVEMENT EDGE LINES ON DRIVER BEHAVIOR

STUDY 68-5

Prepared by

MISSOURI STATE HIGHWAY DEPARTMENT

Planning

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in cooperation with

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BUREAU OF PUBLIC ROADS

The opinions, findings, and conclusions expressed in this publication are not necessarily those of the Bureau of Public Roads.

ABSTRACT

The objective of this study was to determine some of the effects of edge line striping on driver behavior. This was accomplished through an analysis of lateral vehicular placement, vehicular speeds and driver comfort. To provide a basis for evaluating these effects, measurements of the above mentioned variables were made before and after placing edge lines on designated test sections. These sections were established on rural, 2-way highways having varying traffic volumes, surface types and roadway widths.

Placement measurements were made with the use of an electronic placement tape together with a 20-pen graphic recorder. Speed measurements were made using a radar speed meter. Measurements of driver responses to various stimuli (comfort level) were made using a galvanic skin response recorder.

The data were analyzed using the statistical techniques, analysis of variance and student's "t" test. Results indicate that vehicles generally tend to move closer to the centerline of the pavement after applying a 4" edge line during free-moving traffic conditions (no interference from other vehicles). The magnitude of the differences in average placement for free-moving conditions at individual locations ranged from no difference to 6". Although the difference in placement after edge lining was statistically significant, a difference this small probably would not indicate any practical significance. No significant difference in average placement was found after edge lining when the observed vehicles were meeting opposing traffic without the interference of leading, trailing or passing vehicles. The magnitude of the differences in placement under these conditions ranged from no difference to 4" at locations where a sufficient sample was available to produce reliable estimates of average placement.

Edge lines had no significant effect on average vehicular speeds. The results of the galvanic skin response analyses were inconclusive in proving a significant increase in driver comfort after edge lining.

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I. INTRODUCTION

The purpose of this study was to measure some of the effects of edge line striping on driver behavior through an analysis of each of the following areas of investigation:

1. Vehicular Placement
2. Vehicular Speeds
3. Driver Comfort

To provide a basis for evaluating these effects, measurements were made before and after placing edge lines at designated test locations established on 2-way, rural sections of highway in Missouri. These data were collected during the summer of 1968.

The data were analyzed using the statistical techniques, analysis of variance and student's "t" test. The results of analysis of variance were used to determine whether or not the effects of edge line striping vary significantly with changes in other influencing factors, and the relative importance of their effects. The student "t" test was used to test for significant differences in average vehicular speeds between edge line conditions.

Placement measurements were attempted during periods of rain, but unfortunately the equipment was not suitable for use under these conditions as the damp conditions caused the switches on the placement tape to short out intermittently.

It is anticipated that the results of this study will be utilized, together with accident and cost studies, to evaluate a program of edge line striping on the Missouri State Highway System.

As this report contains several terms requiring special definition, a terms and definitions section is included in the Appendix.

II. CONCLUSIONS

1. During free moving traffic conditions, there was a statistically significant shift in average placement toward the centerline of the pavement after applying a 4" edge line. When vehicles were meeting opposing traffic, Phase 2 - Appendix E, no significant change was found in average vehicular placement. Although the shift in placement due to edge lining was statistically significant under free moving conditions, a difference of only 1 inch, shown in Appendix D, does not indicate any practical significance. Due to the small number of vehicles during opposing traffic conditions on the 20-foot surface width pavement, Phase 3 - Appendix H, tests of significance are not valid.

Based on the over-all analyses of the data, there is no evidence that edge lining had any detrimental or adverse effect on the lateral placement of vehicles on tangent sections of rural, 2-lane highways in Missouri.

2. The over-all average placement values of the before and after edge line conditions using all data collected at Locations 3, 4, 5 and 6 (Phase 2 of study) are as follows:

No edge line = 5'8"

2" edge line = 5'9"

4" edge line = 5'7"

Vehicle placement, as used in this report, refers to the lateral position of a vehicle on the roadway measured from the center of the vehicle to centerline of the pavement.

This phase of the study was restricted to placement measurements taken on 2-lane, 2-way, rural roadways with a 24-foot surface

width. Locations 3 and 4 are asphaltic concrete and Locations 5 and 6 are portland cement concrete surface types.

The results of the data analysis indicated that a statistically significant difference exists between the averages using the 95% Confidence interval. Although the differences are statistically significant, a difference this small does not indicate any practical significance. The smaller averages show that the average vehicle was closer to the centerline of the pavement.

3. The over-all average placement values of both the before and after edge line conditions using all data collected at Locations 3, 4, 7, 8, 9 and 10 (Phase 3 of study) are as follows:

No edge line = 5'1"

4" edge line = 4'10"

This phase of the study was restricted to 2-lane, 2-way, rural roadways with bituminous mat and asphaltic concrete surface types. Locations 7 and 8 have a 20-foot surface width, 9 and 10 have a 22-foot width, and 3 and 4 have a 24-foot width.

The results of the analysis indicated a statistically significant difference between the average placement values using the 99% Confidence interval. It should be noted that after applying the 4" edge line, the average shifted 3 inches closer to the centerline of the pavement. The greatest difference in average placement between edge line conditions took place on the 20-foot pavement (See Table 3).

4. The major part of the variation in average placement between average daily traffic volume groups was due to the variation in average placement between free moving and opposing traffic conditions.

5. The summary of average vehicle placement (Appendix B) shows that the averages for free moving and opposing traffic conditions with no edge line are 5'4" and 6'1" respectively. Therefore, on the average, opposing traffic conditions have caused a lateral shift of 9 inches away from the centerline when compared to free moving traffic.

6. A highly significant difference (greater than 99% Confidence) exists between the average placement values for each of the following stratifications:

A. Free moving and opposing traffic

B. Average Daily traffic volume groups

C. Surface types

D. Locations

E. Pavement widths

7. With the absence of edge lines, drivers have a tendency to be guided mainly by the centerline; but with edge lines, drivers tend to center their vehicles between the centerline and the edge line stripes.

8. With the presence of an edge line, vehicles generally tend to move closer to the centerline of the pavement; during the darkness hours, this shift toward the centerline is generally more pronounced.

9. Edge line striping had no significant effect on overall average speeds.

10. The results of the Galvanic Skin Response analysis was inconclusive in proving a statistically significant increase in driver comfort level after edge lining with the procedures used. Nevertheless, there is a general consensus of opinion that edge lines do increase driver comfort especially where vision has been impaired by darkness or adverse weather conditions.

III. TEST LOCATIONS

The test sites were restricted to rural, two-lane, two-way highways having average daily traffic volumes generally within the range of 1000 to 5000. Altogether, ten locations were selected as test sites to represent varying traffic volumes, surface types and roadway widths. Each location is described in detail in Table 1. The geographical location of each test site indicating the sections of highway which were edge lined are shown in Figure 1.

The galvanic skin response (G. S. R.) measurements were made along some of the same sections of highway that were used to collect the placement and speed data. The various sections of highway which were used as test and control sections are shown in Figure 1.

IV. FIELD PROCEDURES

Vehicular placement and speed measurements were made at each location at a point where the roadway was as near tangent as possible, and the sight distance was adequate.

Measurement of placement was made through the use of an electronic placement tape which was connected to a 20-pen graphic recorder. The tape was placed across both lanes of the pavement and wired in such a manner that placement measurements were made in one lane (the lane of interest) and opposing or passing vehicles were recorded in the other lane. Each foot of the tape was an independent switch; and as vehicles crossed the tape, different combinations of switches were activated, depending on the lateral position of the vehicles. All vehicles were manually classified as either car or truck in the lane of interest or in the opposing lane at the moment the vehicles crossed the placement tape.

TABLE 1

TEST LOCATIONS

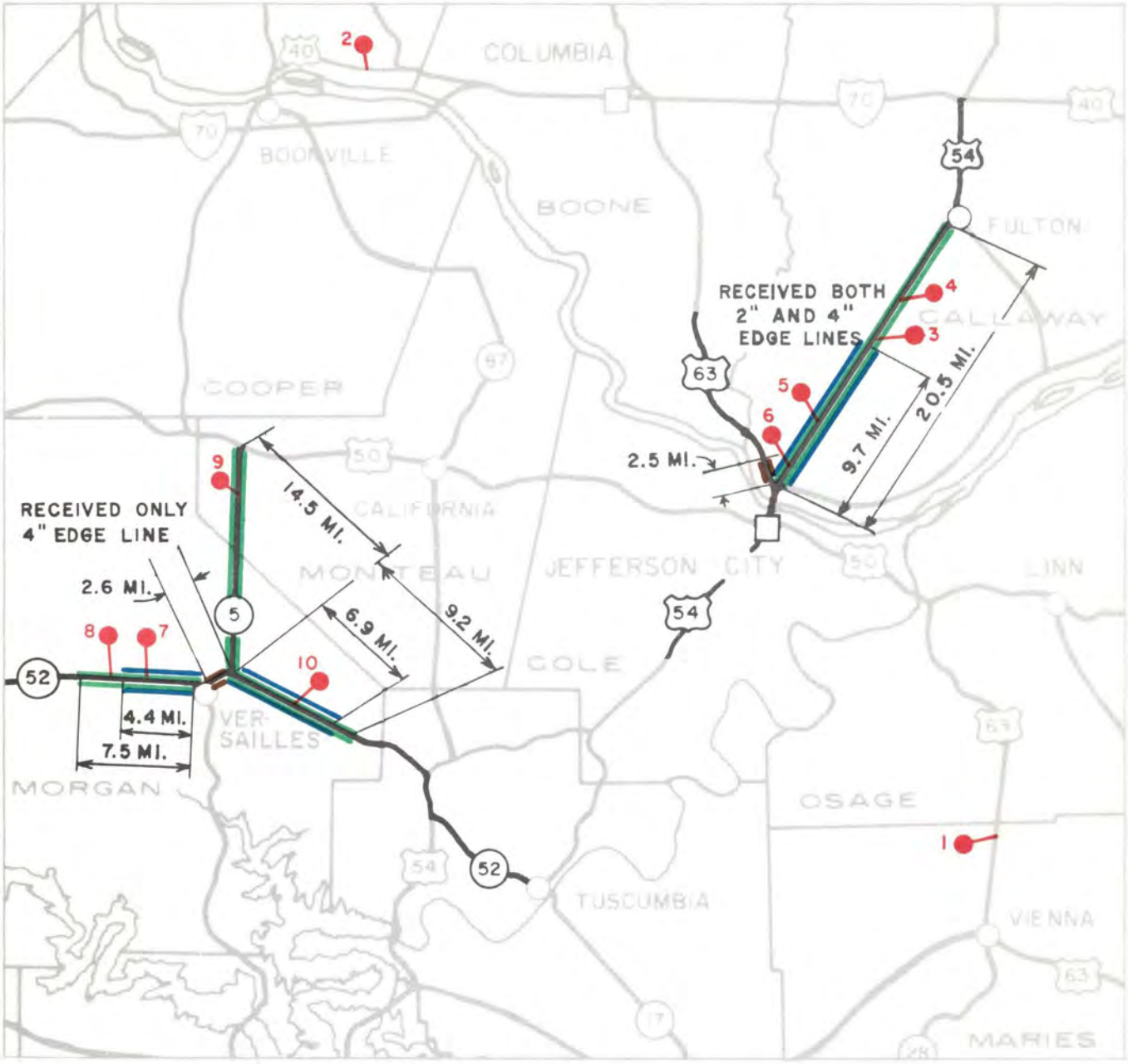
Location No.	Rte. No.	Directional Lane of Interest	Pavement Type	Pavement Width	County	Ave. Daily Traffic	Description
1	U.S. 63	SB	AC	24'	Maries	1815	1.3 Mi. S. of Osage County Line
2	U.S. 40	EB	AC	24'	Howard	695	0.9 Mi. W. of M.K.T. RR. W. of Rocheport
3	U.S. 54	SB	AC	24'	Callaway	3985	0.9 Mi. NE of Jct. of Rtes. 54 & Y NE of New Bloomfield
4	U.S. 54	SB	AC	24'	Callaway	3985	0.4 Mi. S. of Jct. of Rtes. 54 & BB
5	U.S. 54	SB	PCC	24'	Callaway	5350	0.2 Mi. S. of Jct. of Rtes. 54 & 00
6	U.S. 54	NB	PCC	24'	Callaway	5350	0.5 Mi. NE of Jct. of Rtes. 54 & AC
7	Mo. 52	EB	BM	20'	Morgan	1500	1.0 Mi. W. of Jct. of Rtes. 52 & T
8	Mo. 52	EB	BM	20'	Morgan	1500	0.1 Mi. W. of Jct. of Rtes. 52 & YY
9	Mo. 5	SB	BM	22'	Moniteau	1675	3.3 Mi. S. of Jct. of Rtes. 50 & 5 S. of Tipton
10	Mo. 52	WB	AC	22'	Morgan	1595	6.9 Mi. E. of E. Jct. of Rtes. 52 & 5

AC = Asphaltic Concrete

PCC = Portland Cement Concrete

BM = Bituminous Mat

GEOGRAPHICAL LOCATION OF STUDY AREA



PLACEMENT LOCATIONS

EDGE LINED SECTIONS OF HIGHWAY

GALVANIC SKIN RESPONSE TEST SECTIONS

GALVANIC SKIN RESPONSE CONTROL SECTIONS

FIGURE 1

Speed measurements were made using a radar speed meter which was set up at the test site and operated for approximately ten minutes each hour during which placement measurements were made. In most cases ten minutes was sufficient time to obtain enough sample data to get good estimates of average hourly speeds; however, due to the low traffic volume during the early morning hours, speeds were recorded continuously in order to get a large enough sample.

Measurements of driver response to various stimuli (comfort level) were made with a galvanic skin response recorder which measured the perspiration rate of the test driver and graphically recorded the fluctuations on a chart moving at a constant speed. The higher the perspiration rate due to nervous tension, the higher the traced responses became on the chart. The test drivers were college students who were not told specifically why the tests were being made or what they would be used for. Prior to making the test run, finger electrodes were connected to two fingers of the test driver's hand not used for driving, and he was instructed to drive in his normal manner. A second man operated the G.S.R. equipment from the rear seat. The sample designs for the G.S.R. analyses are illustrated in Appendices I, J and K.

All test runs were made using the same automobile which was equipped with power steering, power brakes and air-conditioning in order to minimize the effects due to humidity and physical exertion.

The G.S.R. recorder was adjusted to measure the cumulative responses to various stimuli over the entire test run. All test

runs consisted of a round-trip on the test sections as indicated in Figure 1. Because the tests were made over a period of days, it became necessary to make some type of adjustment to compensate for the difference in sensitivity level from day to day so that all samples would be comparable. The main reasons for getting daily variation in sensitivity level were due to various emotional reasons and difficulty in getting exactly the same finger electrode area contact from day to day. To compensate for this irregularity, the test run was divided into two sections. Prior and subsequent to driving over the test section, the test driver drove over an established control section which was held constant for all runs. The driver's responses to various stimuli were continuously recorded on a graph during each run, with the operator indicating on the chart the breaks between the test and control sections and any unusual occurrence which may have caused the driver to respond. The average ordinate under the traced curve for both the control and test sections for each run was computed separately. By forming ratios of the average ordinate for the test section to the average ordinate for the control section, the effects of differences in sensitivity level between days should have been eliminated.

V. ANALYSIS OF DATA

Analysis of variance technique was the main analytical tool employed in this study. The placement phase of the analysis was conducted in a step-wise fashion consisting of three phases, each of which constitutes a separate analysis. Although the placement data as shown in the various tables are in terms of feet and inches, all analyses were conducted with the data in feet to the

nearest hundredth of a foot to provide for greater accuracy. Generally, the number of vehicles measured under each condition was sufficiently large to provide reliable estimates of average placement; however, when the data was stratified by free moving and opposing traffic for analysis purposes, the number of vehicles observed was substantially reduced especially the number of vehicles being opposed (See Appendices N and P).

PLACEMENT ANALYSIS

PHASE 1

This step was designed to determine if there is a significant difference in the average placement of vehicles between roads of differing average daily traffic. The sample design and a summary of the average placement values for this phase are shown in Appendix A. In addition, average placement measurements for each observation period are given and include all vehicles measured in the lane of interest. The total sample consisted of eight twenty-four hour periods of measurement. This design utilized only the before edge line striping measurements.

It was noted that although Locations 1 and 2 are both in the 500-2000 average daily traffic (ADT) volume group, and have the same surface type and pavement width, there is approximately an 8" difference in their average placement values. Location 1, which has the higher ADT (Table 1) has a 5-foot average that is 8 inches closer to the center-line than the average at Location 2. As later deducted in Phases 2 and 3 of this study, this was contrary to what

normally occurs, because the higher ADT conditions usually causes the average placement to shift away from the centerline due to the higher probability of meeting opposing traffic. On an examination of the test location in an attempt to pinpoint a reason for the discrepancy, it was discovered that the pavement at Location 1 had been widened from 20 ft. to 24 ft. with a visable seam of asphalt. A possible explanation for the lower average at Location 1 is that drivers may tend to center their vehicles between the centerline stripe and the asphalt seam. The results of the data analysis conclusively indicated a highly significant difference between the means of both ADT volume groups and locations. Therefore, a substratification of design #1 was set up, as shown in Appendix B, to conduct an analysis to determine if the major part of the variation between roads of differing average daily traffic was attributable to the distribution of vehicles among the following classifications:

1. Daylight and darkness hours
2. Passenger cars and trucks
3. Free moving and opposing traffic

The results of the analysis indicated that there was a highly significant difference between the average placement values of each classification. The relative order of significance for each factor, as determined by the size of the "F" ratios, is as follows:

Source of Variation	"F" Ratio Computed	Needed to be Significant 5% level	1% level
Free moving and opposing traffic	244.9**	4.2	7.5
Daylight and darkness hours	143.3**	4.2	7.5
Location	55.6**	4.2	7.5
Passenger cars and trucks	28.1**	4.2	7.5
Average daily traffic volume group	22.6**	4.2	7.5

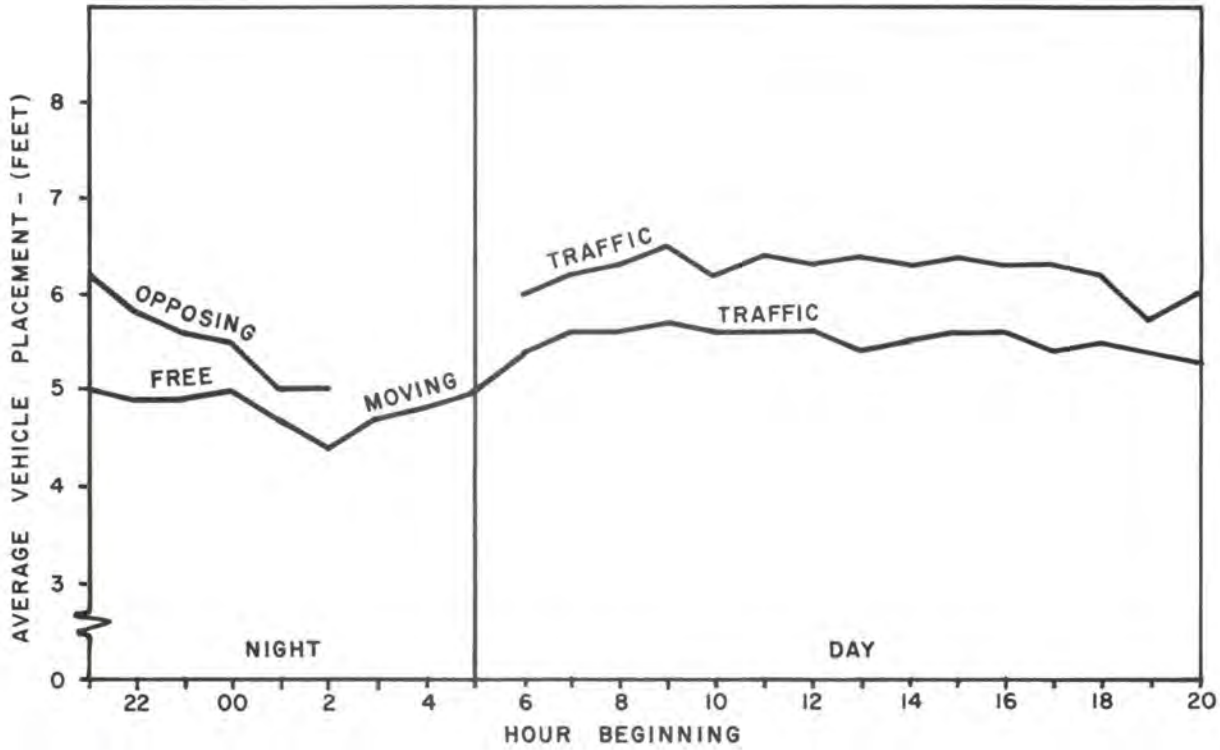
** Significant at 1% level (99% Confidence Interval)

The major part of the variation between ADT groups, therefore, was due to the variation between free moving and opposing traffic. Comparing the overall averages between free moving and opposing traffic (Appendix B) indicates a shift of nine inches on the average toward the shoulder when opposed with no edge line stripe. In addition, a plot of the hourly average placement values for Locations 1-4, shown in Figure 2, indicates that opposing traffic conditions causes the placement of vehicles to be considerable farther from the centerline of the roadway than free moving traffic conditions during each hour of observation. It can also be seen that there is a distinct break in the average hourly placement values between the daylight and darkness hours for both free moving and opposing traffic conditions.

GRAPHICAL COMPARISON OF AVERAGE PLACEMENT BY HOUR

(FREE MOVING VS. OPPOSING TRAFFIC)

NO EDGE LINE



NOTES

1. HOUR BEGINNING (00) IS MIDNIGHT.
2. OPPOSING TRAFFIC DATA IS NOT AVAILABLE FOR HOURS 3, 4 OR 5 DUE TO LOW TRAFFIC VOLUME DURING THESE HOURS.
3. THE ABOVE ARE PLOTS OF AVERAGE HOURLY PLACEMENT VALUES FOR ALL VEHICLES AT LOCATIONS 1 THRU 4 COMBINED.

FIGURE 2

PHASE 2

This step was designed to determine if there are significant differences in driver behavior due to variations of the following assumed influencing factors and combinations thereof:

1. Surface type
2. Daylight and darkness hours
3. Edge line conditions

For this phase of the analysis, the width of pavement was held constant at 24 feet and the before, 2-inch, and 4-inch edge line conditions were studied.

The sample design consisted of forty-eight periods of observations shown in Appendix C. In addition to the sample design, average placement measurements for each observation period are given and include all vehicles in the lane of interest regardless of the traffic conditions involved. All measurements were made during the 5 P.M. to 12 midnight shift which made it possible to sample both the daylight and the darkness periods during one shift. The hours used for daylight and darkness were from 5 p.m. to 9 p.m. and from 9 p.m. to 12 midnight, respectively.

The results of the analysis prove that there is a highly significant difference in the average placement values between surface types, between locations and between lighting conditions. In other words, the probability of getting averages that differ by these amounts due to chance alone is, for all practical purposes, equal to zero. This test also indicated that a true difference in average

placement values between edge line conditions can be expected approximately 95 percent of the time. Although the effect of an edge line on placement may be statistically significant, a lateral movement of one or two inches is of little practical significance. The overall averages for each strata and the resulting average placement values for each condition are shown in Table 2. It should be noted that on the average, the 4" edge line moved the traffic one inch closer to the centerline of the pavement and the 2" edge line moved the vehicles one inch closer to the shoulder. One possible explanation for this phenomena is that drivers have a tendency to drive closer to the centerline than the shoulder before edge lining because they are using the centerline stripe as a guide. After applying the edge line stripe the drivers tend to center their vehicles between the centerline and the edge line stripe. This causes a lateral shift in placement away from the centerline with a 2" stripe and toward the centerline with a 4" stripe, due to 2" less driving room. The order of significance of the variables used as design factors for this test is as follows:

TABLE 2

TABLE OF RESULTS — PHASE 2
AVERAGE VEHICLE PLACEMENT

(CARS AND TRUCKS — ALL TRAFFIC CONDITIONS)

DAYLIGHT HOURS

ASPHALTIC CONCRETE

EDGE LINE \ LOCATION	(3)	(4)
NONE	5' 7"	5' 10"
2"	5' 6"	5' 10"
4"	5' 4"	5' 9"

PORTLAND CEMENT CONCRETE

EDGE LINE \ LOCATION	(5)	(6)
NONE	6' 3"	5' 7"
2"	6' 2"	5' 9"
4"	6' 4"	5' 8"

DARKNESS HOURS

ASPHALTIC CONCRETE

EDGE LINE \ LOCATION	(3)	(4)
NONE	4' 10"	5' 6"
2"	5' 1"	5' 8"
4"	4' 9"	5' 7"

PORTLAND CEMENT CONCRETE

EDGE LINE \ LOCATION	(5)	(6)
NONE	6' 3"	5' 6"
2"	6' 1"	5' 8"
4"	6' 1"	5' 5"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

SURFACE TYPE	AVERAGE
ASPHALTIC CONCRETE	5' 5"
PORTLAND CEMENT CONCRETE	5' 11"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	5' 10"
DARKNESS HOURS	5' 7"

LOCATION	AVERAGE
(3)	5' 2"
(4)	5' 9"
(5)	6' 2"
(6)	5' 7"

EDGE LINE CONDITIONS	AVERAGE
NONE	5' 8"
2"	5' 9"
4"	5' 7"

Source of Variation	"F" Ratio		
		Needed to be Significant	
	Computed	5% level	1% level
Surface Type	196.5**	4.2	7.6
Daylight and Darkness hours	63.7**	4.2	7.6
Location	27.0**	2.1	2.9
Edge line conditions	3.8*	3.3	5.5

** Significant at 1% level (99% Confidence Interval)

* Significant at 5% level (95% Confidence Interval)

In addition to the analysis conducted for all vehicles under all conditions, an analysis was made for both free moving and opposing traffic conditions. "F" Ratios are not shown for these analyses, but a statement of results are given in the following paragraphs.

The results of the analysis of free moving conditions indicated a significant difference between surface types, between daylight and darkness hours and between locations. No significant difference was found between the before and after edge lining averages. Therefore, edge lines had little or no effect on average placement under free moving conditions for this phase of the analysis. A comparison of average placement measurements is made in Appendix D.

The results of the analysis of opposing traffic conditions for this sample design indicated a statistically

significant difference between surface types and between locations. No significant difference was found between the daylight and darkness hours or between edge line conditions. A comparison of average placement measurements is made in Appendix E.

PHASE 3

The purpose of this step was to determine if driver behavior varies significantly due to variations of the following factors:

1. Pavement widths
2. Daylight and darkness hours
3. Edge line conditions

During this phase only the before and 4" edge line conditions were analyzed. The surface type was restricted to asphaltic types only. The sample design for this step is shown in Appendix F. Table values are average placement measurements for each observation period and include all vehicles in the lane of interest. Altogether, this design is made up of forty-eight periods of observation. The criteria for determining daylight and darkness hours are the same as used in Phase 2.

The results of the analysis give conclusive evidence that a significant difference exists between the average placement values for all factors. The relative order of significance of these factors are as follows:

Source of Variation	"F" Ratio Computed	Needed to be Significant 5% Level	1% Level
Pavement width	233.5**	3.3	5.4
Daylight and darkness hours	49.0**	4.2	7.6
Edge line conditions	15.7**	4.2	7.6
Location	6.5**	2.1	2.8

**Significant at 1% level (99% Confidence Interval)

It is interesting to note that edge line conditions had very little effect on average placement when the pavement width was held constant at 24 feet and the surface types were variable (Phase 2); however, when pavement width was variable and the surface type held constant the effect of edge lining became important (Phase 3). It can be seen by examining the summary of average placement values in Table 3 that the greatest difference in the edge line effect takes place on the 20-foot pavement with an average shift of 3 inches towards the centerline after edge lining.

In addition to the analysis conducted on total vehicles for all conditions, an analysis was made for free moving and opposing traffic conditions. A comparison of the average placement data is made in Appendices G and H.

The results of the analysis of free moving vehicles are consistent with those obtained for total vehicles under all conditions.

TABLE 3

TABLE OF RESULTS — PHASE 3
AVERAGE VEHICLE PLACEMENT

(CARS AND TRUCKS — ALL TRAFFIC CONDITIONS)

SURFACE WIDTH

20'

DAYLIGHT HOURS

EDGE LINE	LOCATION (7)	LOCATION (8)
NONE	4' 4"	4' 8"
4"	4' 1"	4' 8"

22'

DAYLIGHT HOURS

EDGE LINE	LOCATION (9)	LOCATION (10)
NONE	5' 4"	5' 4"
4"	5' 4"	5' 2"

24'

DAYLIGHT HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	5' 7"	5' 10"
4"	5' 4"	5' 9"

20'

DARKNESS HOURS

EDGE LINE	LOCATION (7)	LOCATION (8)
NONE	4' 5"	4' 4"
4"	4' 0"	4' 0"

22'

DARKNESS HOURS

EDGE LINE	LOCATION (9)	LOCATION (10)
NONE	5' 2"	5' 4"
4"	5' 1"	4' 10"

24'

DARKNESS HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	4' 10"	5' 6"
4"	4' 9"	5' 7"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

SURFACE WIDTH	AVERAGE
20'	4' 4"
22'	5' 2"
24'	5' 5"

LOCATION	AVERAGE
(7)	4' 2"
(8)	4' 5"
(9)	5' 3"
(10)	5' 1"
(3)	5' 2"
(4)	5' 8"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	5' 1"
DARKNESS HOURS	4' 10"

EDGE LINE CONDITIONS	AVERAGE
NONE	5' 1"
4"	4' 10"

EDGE LINE	SURFACE WIDTH 20'	SURFACE WIDTH 22'	SURFACE WIDTH 24'
NONE	4' 5"	5' 3"	5' 5"
4"	4' 2"	5' 1"	5' 4"

The results of the analysis of opposing traffic conditions indicate that only the pavement width factor is significant. In summary, under free moving traffic conditions, there is a significant difference between the edge line effects; but under opposing traffic conditions, the effect of edge lining becomes insignificant.

VARIATION OF VEHICLE PLACEMENT

It becomes important not only to determine average placement, but also the degree of variation of individual placement measurements from their average. Therefore, standard deviations of lateral placement were computed for each station and edge line conditions shown in Appendix L. A comparison of the standard deviations for the before edge line to the after edge line conditions indicated that, for all practical purposes, the differences were not significant. In other words, variation from average vehicle placement was not significantly affected by the addition of an edge line stripe.

SPEED ANALYSIS

The purpose of the speed analysis was to determine if the effect of edge lining would significantly affect average vehicular speeds. The results of the student's "t" test for significant difference between means show that neither the 2 inch nor the 4 inch edge line stripe had a significant effect on the overall average speed of the vehicles measured. The speed data is tabulated in Table 4. Speed measurements are not shown for Locations 1 and 2 because these test sections were not edge lined. Speed

VEHICULAR SPEED MEASUREMENTS

(MILES PER HOUR)

LOCATION	LIGHTING CONDITION						OVERALL AVERAGE SPEEDS		
	DAYLIGHT			DARKNESS					
	EDGE LINE			EDGE LINE			EDGE LINE		
	NONE	2"	4"	NONE	2"	4"	NONE	2"	4"
3	58	60	58	57	55	55	58	58	56
4	57	60	57	60	59	54	58	60	56
5	58	56	60	56	54	58	57	55	59
6	55	55	52	53	55	58	54	55	55
8	53		52	51		51	52		52
9	57		61	58		60	58		60
AVG.	56	58	57	56	56	56	56	57	56

NOTE: THE TABLE VALUES ARE AVERAGE SPEEDS OF ALL VEHICLES MEASURED UNDER EACH ESTABLISHED CONDITION.

TABLE 4

data were not compiled for Location 7 because the data collected did not fall within an acceptable range. Measurements were not made at Location 10 because the radar meter was not in working order during the designated sampling periods.

G.S.R. ANALYSIS

Galvanic skin response measurements were made to determine the effect of edge lining on driver comfort. An analysis was conducted using the data shown in Appendices I, J and K. The unit of measurement shown is the ratio of the average ordinate under the traced curve for the test section to the average ordinate under the curve for the control section. If, after edge lining, the average ratio were significantly reduced, then it could be stated that the average response has been reduced, and the comfort level increased.

The results, however, indicated that it was impossible to prove a significant difference between the mean ratios due to edge lining. This does not prove conclusively that the edge lines have no significant effect on driver comfort level. Other influencing variables, such as traffic conditions, speeds, various noises, or various movements of the subject, may have caused more variation in driver response than the effect of edge lines. If this were true, then the edge line effects could be hidden by these outside factors. Theoretically, this phase of the study should have been performed under laboratory conditions so that these extraneous variables could have been reduced to a minimum. However, such tests would be unusable since the intent was to quantify the increase in driver comfort under actual operating conditions.

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VII. APPENDICES

A	Sample Design for Phase 1
B	Substratified Sample Design For Phase 1
C	Sample Design for Phase 2
D	Table of Results - Phase 2 (Free moving)
E	Table of Results - Phase 2 (Opposing)
F	Sample Design For Phase 3
G	Table of Results - Phase 3 (Free moving)
H	Table of Results - Phase 3 (Opposing)
I	Sample Design For Galvanic Skin Response Measurements - Route 54 East of Jefferson City
J	Sample Design For Galvanic Skin Response Measurements - Route 52 East of Versailles
K	Sample Design For Galvanic Skin Response Measurements - Route 52 West of Versailles
L	Standard Deviations of Lateral Vehicle Placement
M	Terms and Definitions
N	Number of Vehicles Observed - Phase 1
P	Number of Vehicles Observed - Phase 2 and 3

SAMPLE DESIGN FOR PHASE I

AVERAGE VEHICLE PLACEMENT

(NO EDGE LINE)

AVERAGE DAILY TRAFFIC VOLUME GROUP	500- 2000		3500-4000	
LOCATION	1	2	3	4
AVERAGE PLACEMENT FOR EACH 24-HOUR OBSERVATION PERIOD	5' 0" 5' 0"	5' 8" 5' 9"	5' 7" 5' 6"	5' 11" 6' 0"

SUMMARY OF AVERAGE VEHICULAR PLACEMENT

LOCATION	AVERAGE	A.D.T. VOLUME GROUP	AVERAGE
(1)	5' 0"	500-2000	5' 4"
(2)	5' 8"	3500-4000	5' 9"
(3)	5' 7"		
(4)	6' 0"		

NOTE: 1. SAMPLES ARE RESTRICTED TO 2-LANE, 2-WAY, RURAL ROADWAYS WITH A 24-FOOT SURFACE WIDTH AND ASPHALTIC CONCRETE SURFACE TYPE, WITH NO EDGE LINE STRIPING.

2. EIGHT 24-HOUR PERIODS OF SAMPLING WERE REQUIRED FOR THIS DESIGN AS INDICATED.

3. TABLE VALUES ARE AVERAGE PLACEMENT MEASUREMENTS FOR EACH OBSERVATION PERIOD AND INCLUDES ALL VEHICLES OBSERVED.

APPENDIX B

SUBSTRATIFIED SAMPLE DESIGN FOR PHASE I

AVERAGE VEHICLE PLACEMENT

(NO EDGE LINE)

ADT	LOCATION	VEHICLE TYPE	TRAFFIC CONDITIONS			
			FREE MOVING		OPPOSING	
			DARKNESS	DAYLIGHT	DARKNESS	DAYLIGHT
500 – 2000	1	TRUCK	4' 8"	5' 3"	5' 7"	6' 2"
			4' 9"	5' 4"	5' 6"	6' 0"
		CAR	4' 4"	5' 0"	5' 0"	5' 9"
			4' 6"	4' 11"	5' 2"	5' 11"
	2	TRUCK	5' 3"	5' 11"	6' 1"	7' 6"
			5' 3"	5' 11"	6' 1"	6' 11"
		CAR	5' 0"	5' 9"	6' 1"	5' 11"
			5' 0"	5' 8"	5' 10"	6' 8"
3500 – 4000	3	TRUCK	4' 9"	5' 11"	5' 9"	6' 2"
			5' 0"	5' 10"	5' 9"	6' 4"
		CAR	4' 6"	5' 7"	5' 6"	6' 3"
			4' 7"	5' 5"	6' 1"	6' 4"
	4	TRUCK	5' 8"	6' 1"	6' 4"	6' 3"
			5' 3"	6' 4"	6' 4"	7' 0"
		CAR	5' 3"	5' 10"	6' 6"	6' 6"
			5' 4"	5' 11"	5' 10"	6' 7"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

TRAFFIC CONDITIONS	AVERAGE
FREE MOVING AVERAGE	5' 4"
OPPOSING AVERAGE	6' 1"

VEHICLE TYPE	AVERAGE
PASSENGER CARS	5' 7"
TRUCKS	5' 10"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	6' 0"
DARKNESS HOURS	5' 5"

NOTES: DAYLIGHT HOURS 5 A.M. TO 9 P.M.
DARKNESS HOURS 9 P.M. TO 5 A.M.

SAMPLE DESIGN FOR PHASE 2

AVERAGE VEHICLE PLACEMENT

SURFACE TYPE				ASPHALTIC CONCRETE		P. C. CONCRETE	
LOCATION				3	4	5	6
LIGHTING CONDITION	DAYLIGHT	EDGE LINE	4"	5' 2" 5' 6"	5' 9" 5' 9"	6' 5" 6' 3"	5' 10" 5' 6"
			2"	5' 8" 5' 5"	5' 10" 5' 11"	6' 3" 6' 1"	5' 9" 5' 9"
			NONE	5' 7" 5' 6"	5' 10" 5' 10"	6' 2" 6' 4"	5' 8" 5' 7"
	DARKNESS	EDGE LINE	4"	4' 8" 5' 0"	5' 8" 5' 6"	6' 0" 6' 2"	5' 4" 5' 5"
			2"	5' 2" 5' 1"	5' 9" 5' 7"	6' 2" 6' 0"	5' 9" 5' 8"
			NONE	4' 9" 4' 10"	5' 8" 5' 6"	6' 3" 6' 3"	5' 7" 5' 5"

NOTES:
1. SAMPLES WERE RESTRICTED TO 2-LANE, 2-WAY, RURAL ROADWAYS WITH A 24-FOOT SURFACE WIDTH.
2. THE BASIC SAMPLING UNITS FOR DAYLIGHT AND DARKNESS HOURS RESPECTIVELY, ARE THE 4-HOUR PERIOD FROM 5 P.M. TO 9 P.M. AND THE 3-HOUR PERIOD FROM 9 P.M. TO 12 MIDNIGHT.
3. FORTY EIGHT PERIODS OF SAMPLING WERE REQUIRED FOR THIS DESIGN AS INDICATED.
4. TABLE VALUES ARE AVERAGE PLACEMENT MEASUREMENTS FOR EACH OBSERVATION PERIOD AND INCLUDES ALL VEHICLES OBSERVED.

APPENDIX D

TABLE OF RESULTS — PHASE 2
AVERAGE VEHICLE PLACEMENT

(CARS AND TRUCKS — FREE MOVING CONDITIONS)

ASPHALTIC CONCRETE

DAYLIGHT HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	5' 5"	5' 8"
2"	5' 6"	5' 9"
4"	5' 2"	5' 7"

DARKNESS HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	4' 9"	5' 5"
2"	5' 0"	5' 7"
4"	4' 9"	5' 5"

PORTLAND CEMENT CONCRETE

DAYLIGHT HOURS

EDGE LINE	LOCATION (5)	LOCATION (6)
NONE	6' 1"	5' 5"
2"	6' 1"	5' 7"
4"	6' 3"	5' 6"

DARKNESS HOURS

EDGE LINE	LOCATION (5)	LOCATION (6)
NONE	6' 3"	5' 5"
2"	6' 1"	5' 5"
4"	6' 0"	5' 3"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

SURFACE TYPE	AVERAGE
ASPHALTIC CONCRETE	5' 4"
PORTLAND CEMENT CONCRETE	5' 9"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	5' 8"
DARKNESS HOURS	5' 6"

LOCATION	AVERAGE
(3)	5' 1"
(4)	5' 7"
(5)	6' 2"
(6)	5' 5"

EDGE LINE CONDITIONS	AVERAGE
NONE	5' 7"
2"	5' 8"
4"	5' 6"

APPENDIX E

TABLE OF RESULTS — PHASE 2
AVERAGE VEHICLE PLACEMENT

(CARS AND TRUCKS — OPPOSING CONDITIONS)

ASPHALTIC CONCRETE

DAYLIGHT HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	6' 2"	6' 4"
2"	5' 11"	6' 4"
4"	6' 0"	6' 5"

DARKNESS HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	5' 10"	6' 4"
2"	6' 0"	6' 4"
4"	5' 10"	6' 3"

PORTLAND CEMENT CONCRETE

DAYLIGHT HOURS

EDGE LINE	LOCATION (5)	LOCATION (6)
NONE	6' 8"	5' 10"
2"	6' 8"	6' 2"
4"	6' 10"	6' 0"

DARKNESS HOURS

EDGE LINE	LOCATION (5)	LOCATION (6)
NONE	6' 10"	6' 3"
2"	6' 6"	6' 3"
4"	6' 7"	6' 2"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

SURFACE TYPE	AVERAGE
ASPHALTIC CONCRETE	6' 2"
PORTLAND CEMENT CONCRETE	6' 5"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	6' 3"
DARKNESS HOURS	6' 3"

LOCATION	AVERAGE
(3)	5' 11"
(4)	6' 4"
(5)	6' 9"
(6)	6' 1"

EDGE LINE CONDITIONS	AVERAGE
NONE	6' 3"
2"	6' 3"
4"	6' 3"

SAMPLE DESIGN FOR PHASE 3

AVERAGE VEHICLE PLACEMENT

SURFACE WIDTH				20 FEET		22 FEET		24 FEET	
LOCATION				7	8	9	10	3	4
LIGHTING CONDITION	DAYLIGHT	EDGE LINE	4"	4' 1" 4' 1"	4' 7" 4' 8"	5' 5" 5' 3"	5' 2" 5' 2"	5' 2" 5' 6"	5' 9" 5' 9"
			NONE	4' 4" 4' 5"	4' 9" 4' 6"	5' 4" 5' 5"	5' 4" 5' 4"	5' 7" 5' 6"	5' 10" 5' 10"
	DARKNESS	EDGE LINE	4"	4' 1" 3' 10"	3' 11" 4' 1"	4' 11" 5' 2"	4' 10" 4' 8"	4' 8" 5' 0"	5' 8" 5' 6"
			NONE	4' 6" 4' 4"	4' 4" 4' 3"	5' 2" 5' 3"	5' 0" 5' 5"	4' 9" 4' 10"	5' 8" 5' 6"

NOTE:
1. SAMPLES WERE RESTRICTED TO 2-LANE, 2-WAY, RURAL ROADWAYS WITH BITUMINOUS MAT AND ASPHALTIC CONCRETE SURFACE TYPES.
2. THE BASIC SAMPLING UNITS FOR DAYLIGHT AND DARKNESS HOURS RESPECTIVELY, ARE THE 4-HOUR PERIOD FROM 5 P.M. TO 9 P.M. AND THE 3-HOUR PERIOD FROM 9 P.M. TO MIDNIGHT.
3. FORTY EIGHT PERIODS OF SAMPLING ARE REQUIRED FOR THIS DESIGN AS INDICATED.
4. TABLE VALUES ARE AVERAGE PLACEMENT MEASUREMENTS FOR EACH OBSERVATION PERIOD AND INCLUDES ALL VEHICLES OBSERVED.

APPENDIX G

TABLE OF RESULTS — PHASE 3
AVERAGE VEHICLE PLACEMENT

(CARS AND TRUCKS — FREE MOVING CONDITIONS)

SURFACE WIDTH

20'

DAYLIGHT HOURS

EDGE LINE	LOCATION (7)	LOCATION (8)
NONE	4' 3"	4' 6"
4"	4' 0"	4' 6"

DARKNESS HOURS

EDGE LINE	LOCATION (7)	LOCATION (8)
NONE	4' 4"	4' 2"
4"	3' 10"	4' 0"

22'

DAYLIGHT HOURS

EDGE LINE	LOCATION (9)	LOCATION (10)
NONE	5' 4"	5' 4"
4"	5' 3"	5' 1"

DARKNESS HOURS

EDGE LINE	LOCATION (9)	LOCATION (10)
NONE	5' 1"	5' 3"
4"	5' 1"	4' 9"

24'

DAYLIGHT HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	5' 5"	5' 8"
	5' 2"	5' 7"

DARKNESS HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	4' 9"	5' 5"
4"	4' 9"	5' 5"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

SURFACE WIDTH	AVERAGE
20'	4' 2"
22'	5' 2"
24'	5' 4"

LOCATION	AVERAGE
(7)	4' 1"
(8)	4' 3"
(9)	5' 2"
(10)	5' 1"
(3)	5' 1"
(4)	5' 6"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	5' 0"
DARKNESS HOURS	4' 9"

EDGE LINE CONDITIONS	AVERAGE
NONE	5' 0"
4"	4' 9"

APPENDIX H

TABLE OF RESULTS — PHASE 3
AVERAGE VEHICLE PLACEMENT

(CARS AND TRUCKS — OPPOSING CONDITIONS)

SURFACE WIDTH

20'

DAYLIGHT HOURS

EDGE LINE	LOCATION (7)	LOCATION (8)
NONE	4' 11"	5' 4"
4"	4' 7"	5' 4"

DARKNESS HOURS

EDGE LINE	LOCATION (7)	LOCATION (8)
NONE	5' 11"	5' 4"
4"	5' 0"	4' 11"

22'

DAYLIGHT HOURS

EDGE LINE	LOCATION (9)	LOCATION (10)
NONE	6' 0"	5' 6"
4"	6' 0"	5' 11"

DARKNESS HOURS

EDGE LINE	LOCATION (9)	LOCATION (10)
NONE	5' 11"	5' 3"
4"	6' 0"	6' 2"

24'

DAYLIGHT HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	6' 2"	6' 5"
4"	6' 0"	6' 4"

DARKNESS HOURS

EDGE LINE	LOCATION (3)	LOCATION (4)
NONE	5' 10"	6' 4"
4"	5' 10"	6' 3"

SUMMARY OF AVERAGE VEHICLE PLACEMENT

SURFACE WIDTH	AVERAGE
20'	5' 1"
22'	5' 11"
24'	6' 2"

LOCATION	AVERAGE
(7)	5' 0"
(8)	5' 3"
(9)	6' 0"
(10)	5' 9"
(3)	5' 11"
(4)	6' 4"

LIGHTING CONDITIONS	AVERAGE
DAYLIGHT HOURS	5' 8"
DARKNESS HOURS	5' 9"

EDGE LINE CONDITIONS	AVERAGE
NONE	5' 9"
4"	5' 8"

APPENDIX I

SAMPLE DESIGN FOR GALVANIC SKIN RESPONSE MEASUREMENTS

(ROUTE 54 EAST OF JEFFERSON CITY)

TEST DRIVERS	LIGHTING CONDITION					
	DAYLIGHT			DARKNESS		
	EDGE LINE CONDITION					
	NONE	2"	4"	NONE	2"	4"
1	0.921	0.812	0.672	1.258	1.080	0.794
	0.832	1.101	1.267	0.863	0.716	1.046
	1.402	1.501	1.168	0.821	0.462	1.294
	1.333	0.698	1.092	0.834	1.718	0.819
	1.784	0.959	1.044	1.072	2.142	1.800
	1.274	0.271	1.304	1.023	1.423	0.929
2	1.169	0.772	0.623	2.343	1.170	2.050
	0.931	1.194	0.912	0.961	2.002	2.662
	1.568	0.596	1.369	1.454	1.052	1.409
	1.833	1.057	1.014	1.699	0.844	2.115
	1.580	0.971	1.268	2.580	0.936	1.095
	1.344	0.582	0.712	0.127	1.615	0.896
3	0.735	3.045	0.612	1.175	1.455	1.945
	1.067	1.123	1.292	1.473	1.089	0.961
	1.266	1.151	1.020	1.720	1.338	2.139
	2.190	0.387	1.051	1.153	1.160	0.816
	0.818	0.920	1.250	0.990	0.747	1.346
	1.355	0.815	1.138	1.085	1.185	1.256
4	1.092	0.172	0.765	0.613	0.681	1.056
	0.373	0.881	0.685	0.234	1.427	0.477
	1.508	0.819	0.273	2.078	0.849	0.989
	0.743	1.329	0.353	1.897	0.509	2.808
	0.474	0.228	0.301	0.319	1.303	0.169
	0.447	0.528	0.832	1.010	0.270	1.200

SUMMARY OF AVERAGE RATIOS

TEST DRIVERS	AVERAGE	EDGE LINE	AVERAGE	LIGHT. COND.	AVERAGE
1	1.098	NONE	1.182	DAYLIGHT	1.000
2	1.292	2"	1.023	DARKNESS	1.223
3	1.230	4"	1.127		
4	0.825				

NOTES: 1. THIS SAMPLE DESIGN CONSISTS OF 144 TEST RUNS OR 6 RUNS PER DRIVER WITHIN EACH COLUMN STRATIFICATION, AS INDICATED.

2. TABLE VALUES ARE RATIOS OF THE AVERAGE ORDINATE UNDER THE TRACED CURVE FOR THE TEST SECTIONS TO THE AVERAGE ORDINATE UNDER THE TRACED CURVE FOR THE CONTROL SECTIONS.

APPENDIX J

SAMPLE DESIGN FOR GALVANIC SKIN RESPONSE MEASUREMENTS

(ROUTE 52 EAST OF VERSAILLES)

TEST DRIVERS	LIGHTING CONDITION			
	DAYLIGHT		DARKNESS	
	EDGE LINE CONDITION			
	NONE	4"	NONE	4"
1	0.782	1.831	0.652	1.159
	0.873	0.846	0.861	0.966
	1.329	2.511	1.052	0.587
	1.783	1.166	0.229	1.593
	0.884	1.517	1.347	0.897
	1.494	0.533	0.976	1.127
2	0.906	0.418	0.802	0.526
	0.253	0.868	0.746	1.022
	0.401	0.987	1.114	0.844
	0.210	0.969	0.536	1.354
	0 378	0.712	1.378	0.792
	0.438	0.658	0.462	0.658
3	1.070	1.084	2.051	1.342
	1.384	1.026	0.572	1.039
	1.172	0.727	1.061	1.495
	1.239	1.366	0.604	1.221
	1.068	1.316	1.886	0.388
	1.202	1.189	1.438	0.716
4	0.661	1.877	1.038	0.550
	0.778	0.206	1.157	0.397
	1.478	0.838	0.658	1.111
	1.188	0.582	0.419	1.278
	0.358	0.921	0.439	0.770
	0.386	0.556	0.307	0.761

SUMMARY OF AVERAGE RATIOS

TEST DRIVERS	AVERAGE	EDGE LINE	AVERAGE	LIGHT. COND.	AVERAGE
1	1.124	NONE	.906	DAYLIGHT	.967
2	0.726	4"	.985	DARKNESS	.925
3	1.152				
4	0.780				

NOTES: 1. THIS SAMPLE DESIGN CONSISTS OF 96 TEST RUNS OR 6 RUNS PER DRIVER WITHIN EACH COLUMN STRATIFICATION, AS INDICATED.

2. TABLE VALUES ARE RATIOS OF THE AVERAGE ORDINATE UNDER THE TRACED CURVE FOR THE TEST SECTIONS TO THE AVERAGE ORDINATE UNDER THE TRACED CURVE FOR THE CONTROL SECTIONS.

APPENDIX K

SAMPLE DESIGN FOR GALVANIC SKIN RESPONSE MEASUREMENTS

(ROUTE 52 WEST OF VERSAILLES)

TEST DRIVERS	LIGHTING CONDITION			
	DAYLIGHT		DARKNESS	
	EDGE LINE CONDITION			
	NONE	4"	NONE	4"
1	0.702	1.152	0.780	0.740
	0.740	0.924	1.470	0.824
	0.608	1.300	0.944	0.835
	1.197	0.755	0.744	1.140
	1.079	2.189	0.703	1.301
	0.472	0.999	0.454	2.872
2	1.494	0.425	0.492	0.357
	1.070	1.454	0.846	0.683
	0.676	0.786	0.961	0.151
	0.747	0.419	1.748	0.828
	0.336	0.441	2.266	0.839
	0.482	0.553	1.028	0.947
3	0.691	0.707	0.493	0.774
	0.768	0.750	1.316	0.582
	1.126	1.214	1.616	2.178
	0.572	0.952	1.357	2.388
	1.161	1.795	0.483	0.574
	0.998	1.037	0.877	0.760
4	1.664	0.437	0.523	0.405
	0.659	0.994	0.834	0.304
	1.485	0.897	0.704	1.565
	1.094	1.447	0.488	0.863
	0.635	1.114	0.549	0.792
	0.552	1.499	0.912	0.789

SUMMARY OF AVERAGE RATIOS

TEST DRIVERS	AVERAGE	EDGE LINE	AVERAGE	LIGHT. COND.	AVERAGE
1	1.039	NONE	.908	DAYLIGHT	.943
2	0.835	4"	.994	DARKNESS	.960
3	1.049				
4	0.884				

NOTES: 1. THIS SAMPLE DESIGN CONSISTS OF 96 TEST RUNS OR 6 RUNS PER DRIVER WITHIN EACH COLUMN STRATIFICATION AS INDICATED.

2. TABLE VALUES ARE RATIOS OF THE AVERAGE ORDINATE UNDER THE TRACED CURVE FOR THE TEST SECTIONS TO THE AVERAGE ORDINATE UNDER THE TRACED CURVE FOR THE CONTROL SECTIONS.

APPENDIX L

STANDARD DEVIATIONS OF LATERAL PLACEMENT
(Total Vehicles - All Traffic Conditions)

	Edge Line Condition		
Station	None	2"	4"
1	11.1	-	-
2	10.0	-	-
3	12.3	12.8	11.7
4	11.5	11.2	11.6
5	10.7	10.5	11.6
6	11.2	11.7	12.0
7	8.9	-	8.5
8	9.6	-	10.2
9	9.5	-	9.5
10	11.9	-	11.7

Note: Table values are in inches

APPENDIX M

TERMS AND DEFINITIONS

All Traffic Conditions: Refers to the grouping of all observations which are free moving, being opposed, leading, being passed, trailing or any combination of these conditions at the moment of observation.

Edge Line Stripe: A white reflectorized stripe that has been applied to the edge of the pavement for the purpose of delineation.

"F" Ratio: A statistic derived by an analysis of variance that was used to test for significant differences between the effects of the variables involved. The larger the ratio the higher the significance between the means of the factors.

Free Moving Traffic: When there are no passing, opposing, leading, or trailing vehicles within a 5-second interval of time from the vehicles being observed.

Leading Vehicle Condition: When the observed vehicle is leading one or more vehicles within a 5-second interval of time.

Observed Vehicles: All vehicles recorded as they pass over the placement tape in the lane of interest during the study period.

Opposing Traffic: When the observed vehicles meet traffic within a 5-second interval of time without the interference of leading, trailing or passing traffic.

Passing Vehicle Condition: When the observed vehicle is being passed by another vehicle within a 5-second interval of time.

Significant: Statistically significant.

Trailing Vehicle Condition: When the observed vehicle is trailing one or more vehicles within a 5-second interval of time.

Vehicle Placement: The lateral position of a vehicle on the roadway measured from the center of the vehicle to the center of the pavement.

APPENDIX N

NUMBER OF VEHICLES OBSERVED
SAMPLE DESIGN FOR PHASE I
(NO EDGE LINE)

AVERAGE DAILY TRAFFIC VOLUME GROUP	500-2000		3500-4000	
LOCATION	1	2	3	4
VEHICLES MEASURED FOR EACH 24-HOUR OBSERVATION PERIOD	761	225	1671	1296
	1083	298	1507	1438

NUMBER OF VEHICLES OBSERVED
SUBSTRATIFIED SAMPLE DESIGN FOR PHASE I
(NO EDGE LINE)

ADT	LOCATION	VEHICLE TYPE	TRAFFIC CONDITIONS			
			FREE MOVING		OPPOSING	
			DARKNESS	DAYLIGHT	DARKNESS	DAYLIGHT
500 - 2000	1	TRUCK	8	38	169	4
			7	37	*	5
		CAR	63	361	1	46
			95	409	7	80
	2	TRUCK	*	17	*	1
			*	*	*	2
		CAR	17	245	25	9
			15	*	*	10
3500 - 4000	3	TRUCK	20	40	*	12
			18	59	*	8
		CAR	76	465	2	124
			81	487	5	104
	4	TRUCK	15	55	*	3
			23	43	*	13
		CAR	115	439	8	91
			93	485	7	118

* NO VEHICLES FOR THESE CONDITIONS WERE OBSERVED DURING THESE SAMPLE PERIODS. THE AVERAGE PLACEMENT VALUES FOR THESE CELLS (APPENDIX B) WERE DETERMINED BY LINEAR REGRESSION ANALYSIS.

APPENDIX P
NUMBER OF VEHICLES OBSERVED
PHASE 2 AND 3

		EDGE LINE	LOCATION							
			3	4	5	6	7	8	9	10
DAYLIGHT	ALL CONDITIONS	NO	258	209	751	575	147	393	505	108
		2"	316	266	432	653	-	-	-	-
		4"	586	273	382	559	375	146	226	127
		NO	270	290	377	550	136	157	149	161
		2"	326	309	487	682	-	-	-	-
		4"	316	344	423	595	139	218	604	119
	OPPOSING CONDITIONS	NO	20	22	72	90	18	19	36	5
		2"	28	18	58	108	-	-	-	-
		4"	48	25	63	79	27	10	26	11
		NO	21	24	71	68	17	16	16	17
		2"	38	35	68	127	-	-	-	-
		4"	29	36	53	82	8	18	24	12
	FREE MOVING CONDITIONS	NO	127	116	176	198	113	173	217	93
		2"	110	123	160	182	-	-	-	-
		4"	169	142	166	181	181	91	145	104
		NO	141	143	129	198	103	102	101	109
		2"	138	137	171	186	-	-	-	-
		4"	147	169	164	230	93	129	238	96
DARKNESS	ALL CONDITIONS	NO	81	86	389	205	35	245	251	26
		2"	113	118	197	268	-	-	-	-
		4"	225	80	123	201	193	56	71	38
		NO	98	89	200	184	48	65	52	63
		2"	100	116	167	273	-	-	-	-
		4"	92	142	99	197	51	95	309	26
	OPPOSING CONDITIONS	NO	2	8	25	26	3	7	15	1
		2"	9	8	17	39	-	-	-	-
		4"	7	7	7	22	12	1	3	*
		NO	6	7	17	24	*	3	3	7
		2"	9	12	12	55	-	-	-	-
		4"	7	9	11	19	1	2	12	3
	FREE MOVING CONDITIONS	NO	54	63	145	120	24	111	132	23
		2"	73	75	121	141	-	-	-	-
		4"	108	58	74	132	96	48	58	38
		NO	66	65	130	114	36	54	46	47
		2"	70	74	104	142	-	-	-	-
		4"	54	92	70	135	42	74	153	23

* SEE FOOTNOTE - APPENDIX N

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