

Effect of Unmatched Longitudinal Construction Joints and Pavement Markings on Lateral Position of Vehicles

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ABSTRACT

Motorists generally follow the guidance provided by pavement markings, which are normally marked in coincidence with the longitudinal construction joints, when the joints are necessary. At some locations, however, there may be a mismatch between joints and markings, which may lead the motorists to follow joints instead of pavement markings. In the absence of detailed studies on this topic, an effort was made in this study to evaluate the effects of unmatched longitudinal construction joints and pavement markings on the lateral positioning of vehicles. Sites with such characteristics were identified, and detailed data were collected at one of the sites, using video camera technique to capture movements of vehicles for longer durations. The video tapes were later reduced to extract necessary information. Distance to the centerline of each vehicle, vehicle type, presence of vehicles in the adjacent lane, traffic volume, and vehicle movement were the main data parameters gathered while reducing the data. In addition, two surveys were also conducted to gather the opinions of practitioners.

Statistical analysis was carried out using Student's t-test to see the differences, if any. Several comparisons were made for various types of vehicles traveling under different weather conditions and vehicles going straight and turning right immediately after passing the location. The analysis results indicated that the distance to the center line of vehicles traveling in the target lane was statistically different from the expected lateral positioning of the vehicles if they were not affected by the joints.

Based on the survey and analysis of field data, drivers' lateral position seems to be affected by unmatched construction joints and pavement markings. It might be advisable to make efforts to avoid such occurrences.

Key words: driver confusion—lateral position of vehicles—longitudinal joints—pavement markings

INTRODUCTION

Drivers rely on a complex series of visual cues to safely navigate the roads. Longitudinal lines, transverse lines, arrows, words, symbol markings, and special markings constitute different types of pavement markings that guide the motorists in positioning the vehicles on the roads. Longitudinal lines, such as center lines, lane lines, and edge lines, delineate vehicular paths of travel along the roadway by marking the center of road, lanes of travel, and edges of the pavement, respectively. Pavement edge lines provide a visual guide in confining vehicles to a travel lane. Several factors, such as speed, traffic composition, weather conditions, roadway geometric design features, drivers' physical condition, and personal attributes, may also have an influence on the lateral position of vehicles.

In situations where the pavement is wider than the paving machine, longitudinal construction joints occur. These joints are normally expected to coincide with pavement markings. Sometimes, the joints are induced by sawing to prevent random cracking. In some circumstances, however, pavement markings do not exactly match the construction joints. Under these conditions, motorists may face difficulty in choosing between pavement markings and construction joints as guiding marks for their movement.

The study described in this paper has primarily been conducted to evaluate the effects of unmatched pavement markings and longitudinal construction joints on lateral position of vehicles. The research team undertook the activity of an extensive field study to locate the sites having such characteristics. Detailed field data were collected, and analysis was carried out based on data collected at one site that met the requirements. A questionnaire was also sent to transportation professionals and engineers of the state of Kansas and across the country to solicit their opinions on the unmatched joints and pavement markings. Through the evaluation of effects of mismatched joints and pavement markings on the lateral position of vehicles, this study is expected to provide transportation agencies with guidelines on the placement of longitudinal joints on the pavement.

LITERATURE REVIEW

Even though not much information is currently available on the research carried out on unmatched joints and pavement markings, some studies have been conducted to evaluate the effects of pavement edge lines on lateral position of vehicles. One such investigation was performed by the Missouri State Highway Department in 1969 to study the effect of pavement edge lines on the lateral position of vehicles on rural two-lane highways with widths between 20 ft. and 24 ft (Missouri State Highway Commission 1969). Vehicle placement was measured using an electronic placement tape with a 20-pen graphic recorder. The main finding was that vehicles generally tended to move closer to the centerline under free-flow conditions after applying the edge lines. In 1971, Hassan confirmed the results of the previous study by utilizing a mechanical traffic counter to measure the vehicles' lateral placement on two one-mile sections that were 18 ft. and 24 ft. wide in Maryland (Hassan 1971). The analysis found that, with edge lines, vehicle position was closer to the centerline of the roadway on both sections.

A research study was conducted by Steyvers and De Waard (2000) in the Netherlands using video recording equipment to observe vehicles' position changes before and after edge line markings on four narrow rural roadways with pavement widths between 13.5 ft. and 14.8 ft. (Steyvers and De Waard 2000). It was observed that drivers took a more central position after the edge line markings were incorporated on the road.

Sun et al. (2006) conducted a study in Louisiana to evaluate the effects of pavement edge lines on lateral position of vehicles. (Sun et al. 2006). After thoroughly experimenting with and evaluating several data

collection methods, Sun et al.'s research team used air switch devices (also known as road tubes) for collecting large number of samples, as this method was found to be more reliable, less intrusive, and easier to setup in the field. Three traffic counters were used, each connected with at least two tubes for collecting the data. The tubes were fixed in such a manner that the data for vehicles with their right tires touching the one ft. section of roadway next to the pavement edge, vehicles with their right tires touching the roadway section between one and two ft. from the roadway section, number of vehicles crossing the center line, hourly volume, and operating speed of vehicles were obtained. The data were collected at a total of ten sites on Louisiana rural two-lane highways for at least 24 hours before and after implementation of edge lines. It has been found that with the implementation of edge lines the vehicles followed a more centralized path, which indicates that there is an effect of pavement edge lines on the lateral position of vehicles.

Another study has been conducted in Tyler, Texas, to compare the edgeline effects on speed, lateral position, and human perception (Tsyganov et al. 2006). Three two-lane roads with lane widths of 9, 10, and 11 ft. were selected for collecting the data and carrying out the analysis. The lateral position of vehicles before and after the edge line treatments were observed under both the categories of stationary observation design and test driving design. On applying the edge line, drivers traveling on the 9 ft. lane width highways moved their vehicles closer to the roadway edge, with greatest movement on curved sections. While driving on 10 ft. lane width highways, the drivers tended to move slightly towards the center of the road. While traveling on the 11 ft. wide lanes, the drivers moved slightly closer to the centerline under all lighting conditions. These results indicate that as the lane width increases the drivers tend to be closer to the centerline under all lighting conditions upon the implementation of edge lines.

In summary, the majority of past studies confirm that there is a significant impact of the pavement edge lines on the lateral position of vehicles.

METHODOLOGY

Surveys

Transportation professionals and engineers from various agencies across the country and in the state of Kansas participated in two web-based surveys conducted through the Kansas Department of Transportation (KDOT). Participants expressed their views on the operational and safety problems that arise in sites having unmatched joints and pavement markings. The general policies of the corresponding agencies were also obtained from the survey. Thirty American Association of State Highway and Transportation Officials (AASHTO) members responded to the first survey. Transportation officials and engineers from different counties in the state of Kansas took part in the second survey. Mixed responses were received on the unmatched joints and pavement markings. Some departments of transportation (DOTs) preferred to match the joints and markings, whereas a few of them were concerned about the maintenance of the pavement and hence were willing to offset the joints from the pavement edge lines. A summary of the survey results from the AASHTO responses are reported in Table 1.

Table 1. Summary of survey results from the AASHTO responses

State	Operational/Safety Problems due to unmatched joints and pavement markings	General policy of the transportation agency on unmatched joints and pavement markings
Alabama	Operational problems arise if the joints are in the lane as the longitudinal joint (LJ) is typically the weakest area of the lane. They expressed that if wheel path runs along that LJ, failure is most likely to occur. They stress this point in Hot Mix Asphalt (HMA) Lay down training.	It is not a good practice. Their specifications state that ‘LJ’s in the wearing layer shall conform with the edges of the proposed traffic lane, in so far as practical.’
Arizona	One of the four regional traffic engineers and one of the maintenance engineers expressed safety concern if the joint falls in the wheel path.	Differing opinion based on pavement types: if asphalt there may be no safety or operational issues; if undoweled concrete there is the issue of vertical misalignment; with doweled concrete there may not be safety or operational issues.
Arkansas	Neither operational nor safety problems.	They try to avoid unmatched joints and pavement markings. However, they have not found that unmatched joints and pavement markings are a problem if the pavement is built correctly.
Colorado	Neither operational nor safety problems.	They have not had a problem as long as the longitudinal joints are within a foot of the pavement marking for HMA. For PCCP, they have placed 14 foot driving lanes with the pavement marking placed at 12 feet. These widened lanes have been observed to perform well with no adverse traffic problems.
Connecticut	Operational and safety problems arise from those situations.	They allow an offset of 6 inches to the joint from the marking in order to avoid the failure of either of them due to the failure of the other.
Delaware	Operational problems arise when the longitudinal joint is in the wheel path.	They try and match the joints and markings so they do not have wheel paths at longitudinal joints. They observed that the wheel path at longitudinal joint causes premature failure and raveling of joints.
Florida	Neither operational nor safety problems.	They felt that the joints in the wheel path create roughness and pavement performance issues.
Georgia	Operational and safety problems arise from such a situation as the drivers perceive the joints as lane markings after the markings are worn.	They felt that unmatched joints are acceptable on ramps and intersections. In the past their agency used unmatched joints and markings in a couple of areas and the results were not satisfactory. They do not prefer to use the unmatched joints within interstate travel lanes or within lane shifts.
Iowa	Operational problems arise from such a situation.	They felt that was not a good practice.
Kentucky	No comments.	No comments.
Louisiana	Operational problems arise from such a situation. They have observed lateral movement of vehicles when markings have substantially faded.	The operational effects of not aligning joints and pavement markings were found to be minimized by reconstructing the portions of the road so as to break up the continuous joint.
Maine	Operational and safety problems arise from such a situation.	As per their specifications, they do not accept unmatched joints and pavement markings.
Maryland	Safety problems might arise from such a situation.	He didn’t know of a significant problem.

Table 1. Continued

State	Operational/Safety Problems due to unmatched joints and pavement markings	General policy of the transportation agency on unmatched joints and pavement markings
Michigan	Operational and safety problems arise from such a situation. It is felt that the situation causes confusion to the driver.	Their standards require joint lines and pavement marking to match with rare exceptions.
Mississippi	Neither operational nor safety problems.	Markings were much more visible than the joints and have never caused problems. They offset the joints by one inch from the markings for a better appearance.
Nebraska	Neither operational nor safety problems.	Mismatched joints and markings are less than desirable.
Nevada	Operational and safety problems arise from such a situation. While raining or when the pavement markings are almost worn out, drivers tend to follow joint line thinking it as an edge line.	The agency does not allow unmatched joints and pavement markings.
New Hampshire	Operational problems which lead to a failed pavements.	Not a good idea.
New Jersey	Neither operational nor safety problems.	The agency prefers to offset pavement joints from traffic stripes by approximately 6 inches
New York	Operational and safety problems.	They prefer to keep them together wherever possible. Else, they wish to position them in the middle.
North Dakota	Operational and safety problems. Crash analysis indicates side-swipe crashes in these areas.	They believe that there is a safety problem due to the mismatch.
Pennsylvania	Operational and safety problems. Some accidents have been reported in these locations which have been attributed to confusion in lane assignments.	Avoid unmatched joints and markings at all costs.
South Carolina	Neither operational nor safety problems.	They prefer to match joints and markings.
Tennessee	Neither operational nor safety problems.	No exact comment on the mismatch.
Texas	Neither operational nor safety problems.	Placing pavement markings over the joints is detrimental to the durability of the markings. They were not aware of the safety issues at locations where they had a mismatch.
Virginia	Safety problems arise. Virginia DOT has safety concerns regarding motorcycles traversing joints. They require signs noting wide joints to alert motorists of a possible safety hazard.	For concrete pavements, longitudinal joints need to be located at the edge of the travel lane. For asphalt pavements, they need to be located at the center of the travel lane.
West Virginia	Operational and safety issues arise due to the mismatched joints and markings, especially under wet weather conditions.	Do not allow this to happen if at all possible.
Wisconsin	Operational problems arise under wet weather conditions and also during nights.	From maintenance point of view, it is advisable to offset joints from markings at least by 3 to 4 inches.
Wyoming	Operational and safety problems arise in areas when the pavement markings fade off.	They prefer to match joints and markings wherever possible. They feel that they can mitigate the problem to a certain extent by keeping the joint lines fresh.

The second survey, involving transportation engineers in Kansas, was mainly targeted to gather local opinions and identify suitable sites. After careful evaluation of available information, one site was selected, as it was suitable for detailed data collection (Figure 1).

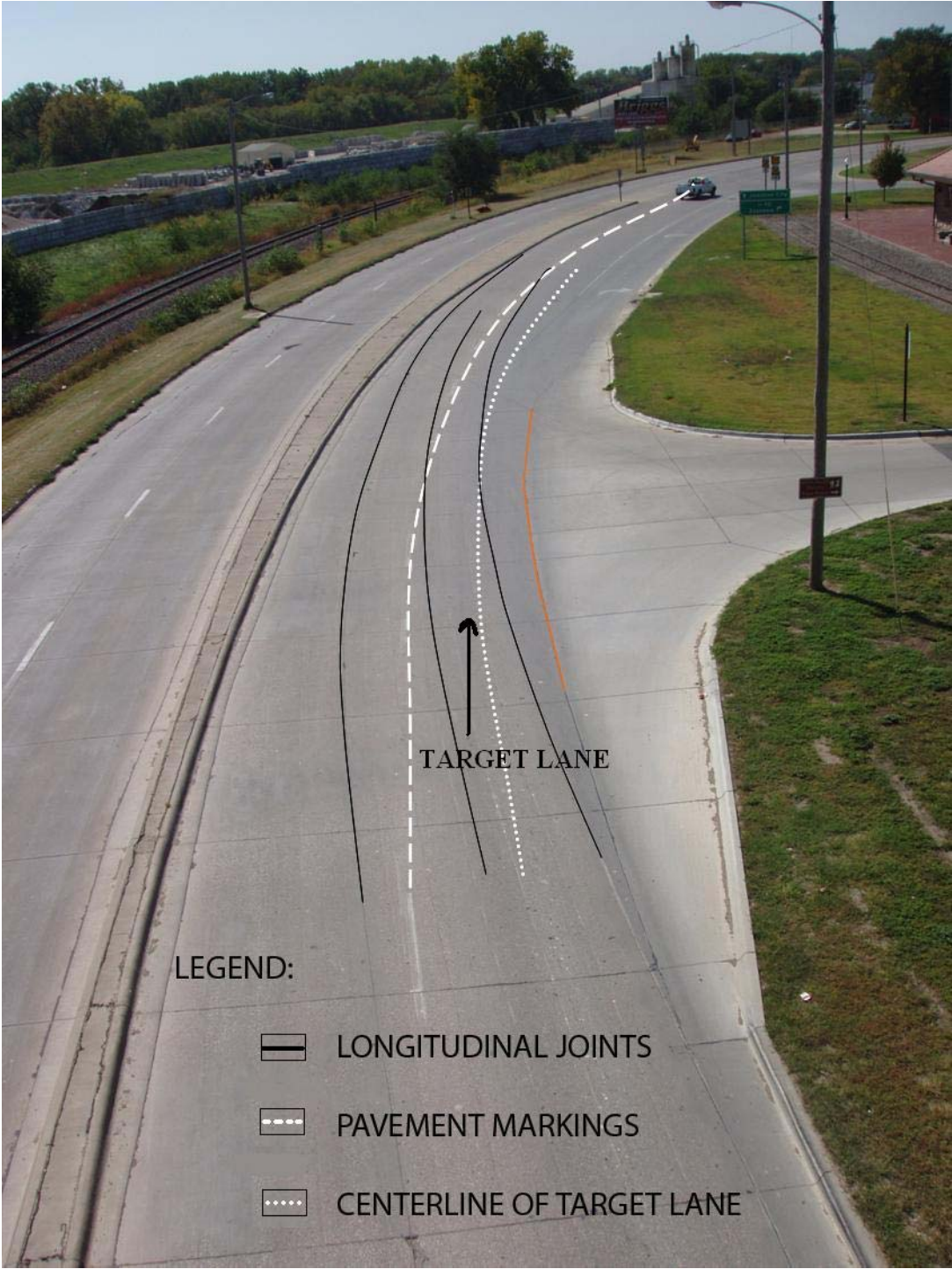


Figure 1. Photograph of the data collection site

Field Study

The site selected for field data collection is a four-lane road having two lanes in each direction. The widths of the two lanes of the road were measured as 12.40 ft. and 11.85 ft., respectively. Longitudinal joints were located at 5 ft. away from edge of the road, as shown in the Figure 1. A video camera (fisheye camera) was set up on a utility pole with a recorder at its bottom in order to capture the movement of vehicles for an extended period of time. Data were collected for longer durations at the site, which had the characteristics of unmatched longitudinal joints and pavement markings. The data recorded were then extracted in the laboratory from the video tapes.

The width of two lanes of the road was measured as 24.25 ft. A scale was marked in divisions of inches that had one inch divided into sixteen divisions. A straight portion of the section of road was chosen and a scale was then set up (fixed) on the television screen, such that its 0 value started at the right curb of the road. The distance to the front right (passenger side) of the vehicle traveling in the target lane from the right curb was measured using this scale. For all vehicles, a similar method was adopted. The widths of the vehicles were also calculated. Thereby, the distance to the centerline of the vehicles from the right curb was computed. These distances were then converted to the real-world dimensions with the help of Excel spread sheets by applying the corresponding scale factor. In addition to the distance to the right passenger side of the vehicle in the target lane, other details, such as the type of vehicle, whether there was a vehicle traveling in the adjacent lane, and the movement of the vehicle right after passing the location (i.e., right turn on to the ramp vs. straight), were extracted from the video tapes. Also recorded was the weather condition at the time of the data collection to see whether it affects driver performance.

Data related to a total of 14,050 vehicles was extracted from the video tapes. Vehicles were classified on the basis of weather conditions and movement. Vehicles traveling under good and bad weather, i.e., rainy, snowy, and wet pavement conditions were observed. From the total vehicles extracted from the video tapes, 8,518 and 5,532 vehicles were observed to be traveling under good and bad weather conditions, respectively. Vehicles that were going straight and those making right turns immediately after the portion of the road that had unmatched joints and pavement markings have been observed as 8,714 and 5,336 vehicles, respectively.

DATA ANALYSIS

The mean distance to the centerline of the vehicles from the right curb of the road was used as the variable for analyzing the data via Student's t-test using Statistical Analysis Software (SAS). The command "PROC TTEST" computes the t-statistic by using the following formula:

$$t = \frac{X - \mu}{\left(\frac{s}{\sqrt{n}} \right)} \quad (1)$$

Where,

t =t-value

X =The mean distance to centerline of vehicles from the right curb of road

μ = Expected position of centerline of vehicles, which is the centerline of the target lane

s =Standard deviation of distance to the centerline of vehicles

n =Number of observations

The null hypothesis is the mean distance to the centerline of the vehicles from the right curb of the road and is the same as the expected position of the centerline of the vehicles in the target lane. The α value has been assumed as 0.05. The SAS software directly gives the probability value, i.e., p -value. If the p -value associated with the t -test is small ($p < 0.05$), there is evidence that the mean is different from the hypothesized value. If $p > 0.05$, then the null hypothesis is not rejected and it can be concluded that the mean is not different from the hypothesized value.

The independent group t -test is used for comparing the means of two groups of data. The command “PROC TTEST COCHRAN” was used for analyzing the data by independent group t -test. It reports two t -statistics: one under equal variance assumption and the other under unequal variance. It also reports an F -value, which helps identify the type of t -test used in analyzing the data. The F -statistic is computed to check the equality of variance, which uses the following formula:

$$F' = \frac{\left(\text{larger of } s_1^2, s_2^2\right)}{\left(\text{smaller of } s_1^2, s_2^2\right)} \quad (2)$$

The SAS program displays the F -statistic along with a p -value. If the p -value associated with the F -test is greater than 0.05, the null hypothesis that the variances of two samples are equal can be accepted, and t -statistic is computed by pooled method of equal variance by using the following formula:

$$t = \frac{(x_1 - x_2)}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad (3)$$

Where,

t = t -value

x_1 = Mean of the first group

x_2 = Mean of the second group

s^2 = Pooled variance

n_1 = Sample size of the first group

n_2 = Sample size of the second group

The value of pooled variance, s^2 , is calculated under the assumption that the population variances for two samples are equal using the following formula:

$$s^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 + n_2 - 2)} \quad (4)$$

where

s_1^2 = Sample variance of the first group

s_2^2 = Sample variance of the second group

If the p -value associated with the F -test is less than 0.05, we reject the null hypothesis and the t -statistic is computed under the assumption of unequal variance by using the following formula:

$$t = \frac{(x_1 - x_2)}{\sqrt{w_1 + w_2}} \quad (5)$$

Where,

x_1 = Mean of the first group

x_2 = Mean of the second group

and where w_1 and w_2 are computed using

$$w_1 = \frac{s_1^2}{n_1} \quad (6)$$

$$w_2 = \frac{s_2^2}{n_2} \quad (7)$$

The Cochran and Cox Approximation or Satterthwaite's Approximation is used for computing the t -statistic under the assumption of unequal variance, in which case SAS output reports both values.

The degrees of freedom for Satterthwaite's Approximation is computed as follows:

$$df = \left(\frac{(w_1 + w_2)^2}{\frac{(w_1^2)}{(n_1 - 1)} + \frac{(w_2^2)}{(n_2 - 1)}} \right) \quad (8)$$

In summary, if the probability value (p -value) for the computed F statistic is greater than 0.05, the method of equal variance is accepted. Otherwise, the t -statistic corresponding to Satterthwaite's or the Cochran and Cox Approximation is used for analyzing the data (Steel and Torrie 1960).

DATA ANALYSIS

A histogram was plotted, with the cumulative percentage of vehicles on the y-axis and distance to the centerline of the vehicles from the right curb of the road on the x-axis. The best fitted curve represented a bell shape, similar to that of normal distribution. As the data came from normal distribution, a t -test was applied for analyzing the data.

Initially, the entire dataset of 14,050 vehicles extracted from the video tapes was analyzed by Student's t -test using SAS software. If the vehicles are assumed to be guided by the pavement markings alone, the expected position of the centerline of the vehicles from the right curb of the road should have been

located at 6.2 ft., which is half the width of the target lane, and which is the distance to the centerline of the target lane. The calculated mean and standard deviation of distance to the centerline of the vehicles from the right curb of the road were 7.06 ft. and 1.61 ft., respectively. The null hypothesis has been assumed as the calculated mean distance to the centerline of the vehicles from the right curb of the road is same as half the width of the target lane (6.2 ft.). The t -value was calculated using the formula from equation (1), by substituting the values as follows:

$$\begin{aligned} X &= 7.06 \text{ ft.} \\ \mu &= 6.20 \text{ ft.} \\ s &= 1.61 \text{ ft.} \\ n &= 14,050 \end{aligned}$$

The value of the t -statistic was obtained as 63.72. The probability value has been reported in the SAS output as $p < 0.0001$. As the p -value reported in the output is less than 0.05, with 95% confidence, it can be said that the mean distance to the centerline of the vehicles from the right curb of the road is significantly different from 6.20 ft. It implies that the null hypothesis can be rejected. The t -values and p -values corresponding to the t -tests are reported in Table 2.

Table 2. Summary statistics based on type of vehicle

Description	Sample Size	Mean (ft.)	Std. Dev. (ft.)	t -value	p -value
All vehicles	14,050	7.06	1.61	63.72	<0.0001
Passenger cars	5,878	6.36	1.44	8.36	<0.0001
Vans	4,055	7.42	1.49	51.85	<0.0001
Pick-ups	3,352	7.55	1.48	52.92	<0.0001
Heavy vehicles	765	8.50	1.61	39.55	<0.0001

An independent group t -test was carried out to analyze the vehicles traveling under good and bad weather conditions. This test was also applied for vehicles going straight and those taking a right turn. The procedure used for performing the analysis can be explained by considering vehicles traveling under good and bad weather conditions. It has been observed that 8,519 vehicles (n_1) were traveling under good weather conditions, with a mean (x_1) and standard deviation (s_1) of 7.23 ft. and 1.71 ft., respectively. It was also observed that 5,531 vehicles (n_2) were traveling under bad weather conditions, with a mean (x_2) of 6.72 ft. and a standard deviation (s_2) of 1.37 ft. The “PROC TTEST COCHRAN” command computes the folded-form F -statistic to check the equality of variances using Equation (2). The F -value and corresponding p -value were displayed in the SAS output as 1.57 and $p < 0.0001$, respectively. It implies that the method of unequal variance is used for computing the t -statistic.

The t -statistic was computed under the assumption of unequal variance by Equation (5), taking the values of x_1 and x_2 to be 7.23 ft. and 6.72 ft., respectively. w_1 and w_2 were computed using Equations (6) and (7) as 0.000347 and 0.000339. The t -statistic was calculated as 19.62. In addition to this, the “PROC TTEST COCHRAN” also displayed the t -value calculated under the assumption of equal variance by substituting the corresponding values in Equations (3) and (4) respectively. However, the t -statistic computed under the assumption of unequal variances has been reported as the test value, as the method of equal variance had been rejected by the F -test.

As the p -value corresponding to the t -test is less than 0.05, the null hypothesis, that the mean distance to the centerline of the vehicles under good weather is the same as that under bad weather can be rejected.

Hence, with 95% confidence, it can be said that the mean distance to the centerline of vehicles under good weather conditions is different than that of vehicles under bad weather conditions.

The vehicles were classified into two different categories, vehicles classified on the basis of movement and vehicles traveling under different weather conditions. The summary statistics, i.e., the mean and standard deviation of vehicles traveling under different weather conditions, is reported in Table 3. In addition to these, the p -values corresponding to the independent t -tests, along with the F - statistic and t - statistic values, are also reported. The t -test has also been applied to the vehicles classified on the basis of movement, and its details are reported in Table 4. Since the p -value corresponding to the F - statistic for different vehicles under good and bad weather conditions has been found to be less than 0.0001, the method of unequal variance was used for analyzing the data, and hence the t -value calculated using this method is reported as the test value. In terms of the t -test carried out upon classifying the vehicles on the basis of movement, since the p -value associated with the F -statistic is greater than 0.05, the method of equal variance was used for analyzing the data. Hence, the t -value corresponding to that method is reported as the test value.

All the results were found to be statistically significant, except for the heavy vehicles tested with respect to movement. The computed p -value, corresponding to the t -test, was found to be greater than 0.05, which implies that the result is not statistically significant.

Table 3. Summary statistics of vehicles under good and bad weather conditions

Description	Weather Condition	Sample Size	Mean (ft.)	Std. Dev. (ft.)	F-test		t-test	
					F value	Pr.>F	t-value	Pr.>t
All vehicles	Bad	5,532	6.76	1.37	1.57	<0.0001	19.62	<0.0001
	Good	8,518	7.27	1.72				
Passenger cars	Bad	2,290	6.10	1.23	1.55	<0.0001	11.70	<0.0001
	Good	3,588	6.52	1.53				
Vans	Bad	1,773	7.10	1.26	1.62	<0.0001	12.47	<0.0001
	Good	2,282	7.66	1.61				
Pick-ups	Bad	1,210	7.21	1.26	1.69	<0.0001	11.09	<0.0001
	Good	2,142	7.75	1.62				
Heavy vehicles	Bad	258	8.13	1.27	1.82	<0.0001	5.47	<0.0001
	Good	507	8.79	1.71				

Table 4. Summary statistics of vehicles going straight and making a right turn

Description	Movement	Sample Size	Mean (ft.)	Std. Dev. (ft.)	F-test		t-test	
					F value	Pr.>F	t-value	Pr.>t
All vehicles	Right	5,336	6.90	1.61	1.02	0.34	9.40	<0.0001
	Straight	8,714	7.16	1.60				
Passenger cars	Right	2,221	6.14	1.44	1.02	0.52	9.10	<0.0001
	Straight	3,657	6.49	1.42				
Vans	Right	1,503	7.16	1.45	1.07	0.12	6.07	<0.0001
	Straight	2,552	7.47	1.51				
Pick-ups	Right	1,295	7.42	1.46	1.04	0.46	4.21	<0.0001
	Straight	2,057	7.64	1.49				
Heavy vehicles	Right	317	8.58	1.48	1.30	0.01	1.19	0.2455
	Straight	448	8.44	1.69				

CONCLUSIONS

Based on the survey and analysis of field data, the lateral position of vehicles seems to be affected by unmatched pavement markings and longitudinal construction joints. All the results were found to be statistically significant, except those for the heavy vehicles tested on the basis of movement.

If the position of vehicles is assumed to be guided by pavement markings alone, the mean distance of vehicles would have been 6.2 ft. Since the longitudinal joint was located 5 ft. away from the right curb of the pavement, the drivers would have followed the joints instead of the markings. The mean distance of travel was observed as 7.06 ft., which could be due to the drivers' confusion resulting from the mismatch between longitudinal joints and pavement markings. It should be noted that the detailed data collection was limited to just one site because of the difficulty in identifying more sites with similar characteristics. This research needs to be expanded by identifying and collecting more sites with similar characteristics to make the findings more reliable.

The standard specifications of 35 states have provisions concerning unmatched joints and pavement markings. Some states do not have any information regarding the positioning of longitudinal construction joints with respect to pavement markings. It would be better if the standard specifications of all the states had provisions pertaining to the mismatch.

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