SAFETY ISSUES RELATED TO TWO-WAY LEFT-TURN LANES

PROBLEM STATEMENT

State Departments of Transportation and other transportation agencies lack proper guidelines to effectively apply different median treatments. Often, only one factor might be taken into consideration in the decision-making procedure at the expense of other influential factors, chiefly because of the lack of information regarding other related factors. The factors that influence the safety of two-way left-turn lanes (TWLTL) need to be identified.

In the past, two-way left-turn lanes were frequently used in Florida to provide inexpensive improvement to motor traffic flow. While this approach may have been an appropriate application on low speed, low volume roadways with relatively few conflicts, the safety of this application is questionable on roadways with higher volumes, number of driveways (driveway density), and speeds. The Florida Department of Transportation (FDOT) does not employ two-way left turn lanes on multi-lane roadway sections with design speeds greater than 40 mph. An unresolved issue is whether traffic volumes and/or driveway density should also be limiting factors.

OBJECTIVES

The purpose of this research was to develop a tool for identifying TWLTL locations that present safety concerns and that might need improvement based on factors that are influential in the safety experience of TWLTL sections. Specific objectives included the following:

- to obtain information for traffic volume, driveway density, posted speed, number of lanes, and other relevant information for select TWLTL sections
- to determine driveway density from video logs and verify that all locations considered were TWLTL
- to conduct detailed crash data analysis to establish factors influencing crashes and best-fitted distribution
- to develop statistical models for crash expectancy as a function of roadway traffic volume, driveway density, and posted speed at TWLTL

FINDINGS AND CONCLUSIONS

After reviewing over 1600 TWLTL sections located on Florida's State Highway System, researchers found that increases in Annual ADT or Average Daily Traffic (AADT), driveway density, number of lanes, and posted speed all influence the crash occurrence at TWLTL locations. Modeling results and percentile values obtained from crash distribution fitting could be used to select TWLTL locations for further analysis to determine if adding a restrictive median is desirable.

Negative binomial regression was the approach used to model because crash data showed extra-variation relative to Poisson distribution. All factors considered during modeling (AADT, driveway density, number of lanes, and posted speed) had estimated parameters at the 5% significance level for the developed model. This indicates that these factors influence the crash occurrence at TWLTL sections. Among these variables, the parameters for the variables AADT, driveway density, and

number of lanes had a positive sign. These findings suggest that an increase in any of these three variables increases the likelihood of crash occurrence on TWLTL sections. The sign for the parameter for posted speed was negative, which may be explained by the fact that motorists tend to drive speeds that feel comfortable given prevailing conditions. Thus, lower posted speeds may promote a speed differential that could be closely associated with crashes. Also, many of the high speed TWLTLs may have been eliminated through the 1992 multi-lane median policy.

Regarding goodness-of-fit, the statistical model developed has satisfactory capability with regard to fitting crash data and explaining the variation of the crash data, based on the four statistics considered: deviance, Pearson's Chi-square, Pearson's R- square, and likelihood ratio index (which indicated that the model explained more than 45% variation in the crash data).

The Chi-square tests indicated that the average number of crashes for six different categories selected according to posted speed levels and number of lanes followed either a negative binomial or log-normal distribution at a 95% confidence level. Then, the 50^{th} through the 95^{th} percentile values for every 5% increase were estimated for each category based on the crash distribution fitting.

Researchers estimated the critical values for AADT for different characteristics of TWLTL sections by plotting the percentile values of the distribution fitting for the six categories selected into the curves obtained from the average number of crashes estimated from the developed model. TWLTL sections that have an AADT higher than the critical value for specific characteristics of the section would be identified as needing further study to determine if improvements are necessary.

Based on the methodology developed in the research, locations for each of the FDOT districts of were identified on the basis of the critical values of AADT for different values of driveway density, number of lanes, and posted speed. The locations identified need further study in order to determine if adding a restrictive median is desirable at that time.

BENEFITS

Software was developed that can be used to identify TWLTL sections that may present safety concerns and that need further study to determine if adding a restrictive median is desirable. The ultimate benefit will be a correspondent increase in safety and reduction in crashes. The developed software addresses the following:

1. AADT of the Roadway: This function is used to estimate the critical AADT of a TWLTL section based on a selected percentile value and the existing and/or projected characteristics of the section (driveway density, posted speed, and number of lanes). If the actual AADT value of the section is higher than the estimated critical AADT value, the TWLTL section would be identified as critical.
2. Percentile Group: This function is used to determine the percentile group to which the TWLTL section belongs, based on its existing and/or projected characteristics (driveway density, posted speed, number of lanes, and AADT).
3. Crash Prediction: This function is used to estimate the average number of crashes per mile per year of a TWLTL section by means of a crash prediction model and the existing and/or projected characteristics of the section (driveway density, posted speed, number of lanes, and AADT).

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