



Project Summary

Texas Department of Transportation

0-5840: Development of Left Turn Operations Guidelines at Signalized Intersections

Background

The left-turn operation is a critical component for the safe and efficient operation of a signalized intersection. The use of a proper type of left-turn phasing will result in reduced traffic delay, improved traffic progress, as well as decreased accident rates. In the design of left-turn signal phasing, traffic engineers face the following critical questions: (1) How to determine the mode of left-turn operation, (2) How to determine the sequence of left-turn signal phasing, and (3) How to display the left-turn signal appropriately. Currently, there exist no uniform methods of applying the left-turn signal phasing throughout the state. In addition, the consistency in the left-turn signal control is another concern for traffic engineers. Therefore, this research is to develop guidelines for recommending the most appropriate left-turn phasing treatments and to evaluate the benefits of regional standardization of left-turn operations.

What the Researchers Did

To reach the goals of the research, we have accomplished the following research activities: (1) conducted operational and safety impacts analysis of left-turn signal phasing, (2) developed guidelines for left-turn signal phasing selection, (3) developed guidelines for signal displays, (4) evaluated the benefits of regional standardization of left-turn signal operation, and (5) conducted case studies. In addition, to facilitate the implementation of the developed guidelines, training strategies and materials were developed for providing training sessions to TxDOT and Traffic Management Center (TMC) personnel.

What They Found

Our research has resulted in the following key findings:

In the operational impacts analysis, based on the results of traffic simulation, we found that for the selection of left-turn signal control mode:

- At intersections with one opposing through lane, the protected-permissive left turn (PPLT) mode should be selected when the CPOV (cross products of left-turn and opposing through volume) value is equal to or less than the threshold of 133,000.
- At intersections with two opposing through lanes, the PPLT mode should be used when the CPOV value is equal to or less than the threshold of 93,000.

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For the selection of left-turn signal phasing sequence:

- At an intersection in a two-way coordinated arterial, the signal phasing sequence that maximizes the through-bandwidth should be selected.
- At an intersection in a one-directional coordinated arterial during the peak hour periods, Lead-Lag sequence should be considered because it can cause less delay for the subject left-turn movements than other signal phasing sequences.

In the [safety impacts analysis](#), by analyzing the historical accident data collected from more than 100 intersections, we found that for left-turn signal control mode:

- Protected-only (PO) is the safest signal control mode.

For signal phasing sequence:

- Under PO mode, lead-lag is the safest, followed by lead-lead and lag-lag.
- Under PPLT mode, lead-lead and lag-lag are safer than lead-lag when left-turn volume is low, and lead-lag is safer than lead-lead when left-turn volume is high.

Split signal phasing results in lower accident rates than non-split signal phasing.

The five-section cluster signal display is associated with less accident risk than five-section horizontal signal display.

In the [evaluation of the benefits of regional standardized left-turn signal operations](#), by comparing the accident rates at four different corridors with different mix-levels of left-turn signal operations, we found that the mixed application of left-turn signal operations, including signal control modes, phasing sequences and displays, will increase the accident risk at intersections. It is suggested that the regional standardization of left-turn signal operation is needed for increasing the consistency in left-turn operations in a region.

What This Means

According to the findings of this research, it is recommended that regional standardized guidelines be used for left-turn operations at signalized intersections to improve intersection safety. By combining the findings from this research and the results from literature, comprehensive guidelines for left-turn signal phasing and signal displays were developed. These guidelines can be used for selecting the proper type of left-turn phasing and determining the left-turn signal displays at signalized intersections.

For More Information:

0-5840-1 [Development of Left-turn Operations Guidelines at Signalized Intersections](#)

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