



Project Summary

Texas Department of Transportation

0-6402: Development of Pedestrian Safety Based Warrants for Protected or Protected/Permissive Left-Turn (PPLT) Control

Background

The objective of this two-year project was to incorporate pedestrian safety considerations into the guidelines for selecting left-turn operational mode. Typically, the choice of left-turn operational mode (protected, protected-permissive, or permissive) is based on vehicular considerations such as vehicle volumes and speeds, number of lanes, sight distance, and left-turn-related crash frequency. This project was conducted to identify the conditions when it would be cost-effective to choose protected or protected-permissive operational mode to reduce conflicts between pedestrians and left-turning vehicles.

What the Researchers Did

The researchers corresponded with practitioners in eight Texas cities, eight TxDOT districts, and six cities in other states to identify best practices for accommodating pedestrians at signalized intersections. They collected data describing the interactions between pedestrians and left-turning vehicles at 20 sites. They also obtained vehicle performance data from a traffic simulation program. The researchers then used these data to develop models that predict pedestrian-vehicle conflict frequency and intersection delay for a range of volumes and left-turn operational modes. After the models were calibrated, the researchers identified treatments that could improve pedestrian safety at six of the data collection sites, corresponded with local engineers to have these treatments implemented, and conducted before-after evaluations.

Using the findings from the data analysis, feedback from an expert panel, and the before-after evaluations, the researchers developed new guidelines for pedestrian safety treatments at signalized intersections. These guidelines include the following:

- Pedestrian safety guidelines: Choose the left-turn operational mode based on a balancing of pedestrian-vehicle crash costs and vehicular delay costs.
- Comprehensive guidelines: Choose the left-turn operational mode based on vehicle considerations. Choose intersections where an exclusive pedestrian phase is appropriate.
- Alternative treatment guidelines: Choose among alternative treatments to improve pedestrian safety with consideration of overall road-user costs.

What They Found

Pedestrian safety at signalized intersections is affected by various factors, including vehicle and pedestrian volumes, crosswalk length, median width along the crosswalk, cycle length, left-turn operational mode, and pedestrian change interval duration.

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Each crosswalk of interest should be analyzed individually, considering its specific conditions during peak pedestrian hours.

In terms of reducing pedestrian-vehicle crashes, protected or protected-permissive operational modes tend to be more cost-effective at sites with relatively high pedestrian and left-turning vehicle volumes and low-to-moderate total entering vehicle volumes. Alternative treatments can often yield benefits at sites where protected or protected-permissive operational modes are not likely to be cost-effective.

What This Means

The researchers drafted the guidelines for inclusion in the second edition of the *Traffic Signal Operations Handbook*. They also incorporated the guidelines into the *Texas Signal Coordination Optimizer (TSCO)* spreadsheet program to facilitate their implementation. TxDOT and city engineers responsible for signal timing can use the guidelines and the *TSCO* spreadsheet to evaluate signalized intersections that are believed to have pedestrian safety issues. These tools can help identify the most cost-effective treatments to address conflicts between pedestrians and left-turning vehicles.

The researchers also drafted a left-turn phase warrant for inclusion in Section 4E of the *Texas Manual on Uniform Traffic Control Devices*. This warrant is intended to help engineers identify locations where a protected left-turn phase may be needed. It incorporates considerations of vehicle and pedestrian volumes and left-turn-related pedestrian-vehicle crash counts. Application of the warrant requires vehicle and pedestrian volumes and three years of crash history.

With the tools developed in this project, an engineer can:

- Apply the left-turn phase warrant to determine whether a left-turn phase should be considered at a location believed to have pedestrian safety concerns.
- Estimate the road-user costs associated with the provision of a protected left-turn phase. These costs include vehicular delay and left-turn-related pedestrian-vehicle crashes.
- Quantify the expected benefits of a pedestrian safety treatment in terms of reduced left-turn-related pedestrian-vehicle crashes. The treatments addressed include:
 - Add protected left-turn phase.
 - Reduce cycle length.
 - Reduce crossing distance.
 - Invoke pedestrian recall.
 - Increase walk interval duration without increasing the cycle length.
- Identify intersections where an exclusive pedestrian phase may be appropriate.

The researchers recommend that the warrant and guidelines developed in this project be applied to all intersections that have high pedestrian volumes or that are believed to have the potential for pedestrian safety improvement. These intersections are likely to be located in central business districts or near significant pedestrian traffic generators such as schools and university campuses.

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