



Project Summary

Texas Department of Transportation

0-6568: Use of Flashing Yellow Operations to Improve Safety at Signals with Protected-Permissive Left Turn (PPLT) Operations

Background

The 2009 edition of the federal MUTCD suggests the use of the flashing yellow arrow (FYA) indication in lieu of the green ball indication for permissive left-turn signals in the presence of separate signal heads. Currently, there are no clear guidelines on how to implement FYA with Protected-Permissive Left Turn (PPLT) operations in Texas. The objective of this research was to develop guidelines for the implementation of the FYA with PPLT operations that are suitable for statewide application in Texas.

What the Researchers Did

To fulfill this goal, the following key research tasks were conducted: (1) Reviewed and synthesized national and peer state practices on FYA PPLT; (2) Conducted surveys of traffic engineers and drivers; (3) Deployed FYA with PPLT operations at five selected intersections in Waco and Austin; (4) Identified software and hardware issues associated with the deployment of FYA with PPLT operations; (5) Analyzed historical crash data and performed a field traffic conflict study to evaluate the safety performance of FYA with PPLT operations; (6) Developed guidelines for the implementation of the FYA with PPLT display; and (7) Provided training strategies and materials for TxDOT personnel.

What They Found

Our research resulted in the following key findings: A review of existing literature indicated that FYA displays can improve the safety of intersections with PPLT signal operations. Both the survey of traffic engineers and the survey of drivers received good responses. Of the participating traffic engineers who had experience with FYA with PPLT operations, 42 percent thought that the implementation achieved “satisfactory” results, 35 percent rated their implementation as “acceptable,” and 10 percent redeemed it “risky” to use FYA. The 124 responses from the survey of drivers showed that the FYA indication was correctly understood by 92% of the drivers, and only 3.2% of them had an incorrect understanding that may lead to a “fail critical” situation.

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In field tests in the Waco and Austin Districts, FYA signals were successfully set up with an average of 3 hours of signal work for a pair of opposing approaches. Technical issues such as controller programming mode and method, and wiring problems were encountered and documented.

The safety performance analysis led to the following key findings:

- A majority of drivers had a good understanding of the FYA indication.
- Overall, FYA with PPLT operations improved intersection safety at most study intersections by reducing traffic crash or conflict rates.
- Drivers may become insensitive to the signal change from the FYA to a steady yellow arrow at the leading left-turn direction, and this could increase the risk of a crash. The field traffic conflict study showed that this problem caused increased “go through red ball” and “backing into left turn lane” events at intersections with high traffic volumes and lead-lead left-turn phasing.
- Two types of safety issues that were directly related to the use of FYA with PPLT signal operations were identified; (1) steady yellow arrow confusion; and (2) conflicting yellow sneakers problem. These problems were only significant at intersections with certain conditions, e.g., high traffic volume, high speed and lead-lag left-turn phasing.
- Converting signal operation from protected-only mode to FYA with PPLT mode may cause safety problems at some intersections since permissive left-turn phasing may not be safe due to some traffic (e.g. high traffic volumes), operational (e.g. high design speed), and/or geometric conditions (e.g. limited sight distance).

What This Means

Based on the results of this research, it is recommended that the FYA signal indication should be used at most signals with PPLT operations to improve intersection safety and to comply with the requirements of 2009 federal MUTCD. However, FYA with PPLT operations is not appropriate for all situations. It is not recommended for very busy intersections that have high left-turn volumes and high opposing volumes, and it should be implemented with great caution at intersections that use lead-lead left-turn phasing. In addition, before the installation of FYA signals at an intersection that was previously operated under protected-only mode, it is necessary to assess whether it is initially safe to allow permissive left-turns or U-turns at that intersection. Finally, traffic engineers can refer to the developed guidelines for the implementation of FYA with PPLT operations. Particularly, they can use the developed checklist to examine the existing hardware conditions to facilitate a smooth implementation, and they should contact equipment vendors before field implementation regarding the programming method of controllers and malfunction management units since the preferred methods are commonly quite different among various makes and models.

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