



Pedestrian Safety Treatments for Signalized Intersections: Training Course Development

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16. Abstract When drivers make left turns during a permissive turn phase, they must yield to pedestrians as well as oncoming through vehicles. Left-turning drivers sometimes overlook pedestrians in the crosswalk while watching the opposing intersection approach. Implementing a protected left-turn phase can reduce or eliminate the potential conflict between pedestrians and left-turning vehicles, but is likely to increase vehicular delay. The potential benefit of reduced pedestrian-vehicle crash costs must be weighed against the expected increase in delay costs. The <i>Traffic Signal Operations Handbook, Second Edition</i> contains guidelines for choosing left-turn operational mode (protected, protected-permissive, or permissive) based on considerations of both pedestrians and vehicles. A spreadsheet program called Texas Signal Coordination Optimizer (TSCO) is available to assist practitioners in the application of these guidelines by automating the complex calculations. A training course was developed to facilitate implementation of these tools, and seven presentations of the course were provided at various TxDOT venues.					
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**PEDESTRIAN SAFETY TREATMENTS FOR SIGNALIZED
INTERSECTIONS:
TRAINING COURSE DEVELOPMENT**

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NOTICE

The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

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PEDESTRIAN SAFETY TREATMENTS FOR SIGNALIZED INTERSECTIONS: TRAINING COURSE DEVELOPMENT

INTRODUCTION

Signalized left-turn movements can be operated in protected, protected-permissive, or permissive operational mode. To choose the appropriate operational mode, the analyst must consider various factors, including volumes of vehicles and pedestrians, vehicle speeds, and intersection geometry. Historically, vehicle considerations have controlled the choice of left-turn operational mode.

Guidelines were developed in TxDOT Research Projects 0-5629 and 0-6402 for (1) choosing left-turn operational mode based on pedestrian and vehicle considerations, and (2) selecting pedestrian safety treatments for signalized intersections. These guidelines are contained in the *Traffic Signal Operations Handbook, Second Edition (Handbook) (1)* and a document titled *Pedestrian Safety Guidelines and Proposed Left-Turn Phase Warrant (2)*. The guidelines can be implemented using an Excel®-based spreadsheet program called the Texas Signal Coordination Optimizer (TSCO).

A training course was developed to demonstrate how to apply the guidelines through the conduct of example problems. The example problems involve applying the guidelines to an intersection for which hypothetical data are provided to describe volumes, geometry, crash history, and traffic control. Seven of the example problems involve using the TSCO program. Application of the guidelines will facilitate incorporation of pedestrian safety concerns into the timing and design of signalized intersections.

This report consists of two parts. The first part describes the training course that was developed and conducted. The second part recommends additional steps that can be taken to further facilitate implementation of the guidelines that are described in the training course.

TRAINING COURSE DESCRIPTION

This section provides a description of the training course content and a review of the course presentations at seven venues in Texas. The first subsection to follow provides an overview of the course. It is followed by a review of the learning objectives. Then, the course format and venues are outlined. The final subsection summarizes the participant evaluations.

Training Course Overview

The training course objectives were to: (1) inform participants about guidelines for choosing left-turn operational mode based on pedestrian and vehicle considerations, (2) inform participants about guidelines for selecting pedestrian safety treatments for signalized intersections, and (3) demonstrate the use of these tools. The procedures and guidance are documented in the *Handbook*. The training course and the *Handbook* are developed for engineers and technicians.

These two activities were undertaken to develop and present the training course:

- Develop training materials (i.e., visual aids, handouts, participant exercises, hands-on training sessions, software, etc.) that impart to participants the information needed to choose left-turn operational mode based on pedestrian and vehicle considerations, and select pedestrian safety treatments for signalized intersections.
- Conduct one, one-day training course in each of seven Texas cities.

Training Course Learning Objectives

The course content was tailored to facilitate participant learning. The visual aids were primarily in the form of a PowerPoint® presentation. This presentation included numerous photographs, illustrations, and example applications. The visual aids were supplemented with printed materials that included a *Student's Guide* that contained a print copy of the visual aids and a copy of the *Handbook*. The computations associated with the evaluation of several example intersections were automated using the TSCO program.

The following key points were emphasized throughout the training course:

- When left-turning drivers make permissive left turns, they must yield to opposing through vehicles as well as pedestrians. This type of left-turn operation leads to potential conflicts between pedestrians and left-turning vehicles.
- Implementing protected left-turn phases can reduce the frequency of conflicts between pedestrians and left-turning vehicles. However, the resulting reduction in pedestrian-vehicle crash costs must be weighed against the increase in vehicle delay costs that typically results from the addition of left-turn phases to the signal cycle.
- Alternative treatments may be used to improve pedestrian safety at a signalized intersection where implementation of protected left-turn phases would not likely reduce road-user costs. The *Handbook* and TSCO represent tools that can be used to quantify the road-user costs of pedestrian-vehicle crashes and vehicle delay, and consider them in treatment selection decisions.

Each of these key points was repeated throughout the training course to emphasize their importance and ensure their retention by participants.

Course Format

The training course presentations consisted of approximately 7 hours and 30 minutes of instruction, which included a presentation, a demonstration of the TSCO program, and 11 interactive example problems. The visual aids used in the course consist primarily of 150 PowerPoint® slides.

The course agenda is provided in Table 1. It consists of six lessons. These lessons comprehensively describe the issues associated with, and methods for, choosing left-turn operational mode based on both vehicle and pedestrian considerations. Lessons 3 through 6 contain self-paced example problems that incorporate the information presented and challenge

the participant to gauge their understanding of the concepts and procedures. These example problems involve the use of TSCO with example signalized intersection data.

Table 1. Course Agenda.

Start Time	Lesson	Objectives
9:00	Introduction	
9:20	Lesson 1: Signal Timing to Accommodate Pedestrians	Provide perspective by showing summary statistics on pedestrian-vehicle crashes. Establish a vocabulary by covering signal control concepts relevant to left-turns and pedestrians. Demonstrate examples of safety and operational issues with pedestrians and left-turning vehicles through the presentation of video clips.
10:00	Break	
10:15	Lesson 2: Treatment Evaluation and Guideline Development	Briefly explain the process that was used to develop the guidelines in Project 0-6402. Provide an overview of the three sets of guidelines, which will be covered in detail in the next three lessons. Introduce the students to the TSCO program and explain its organization and structure.
10:50	Lesson 3: Pedestrian Safety Guidelines	Introduce and demonstrate the application of the pedestrian safety guidelines and the road-user cost evaluation procedure. Show how to determine left-turn operational mode based on pedestrian considerations.
12:00	Lunch Break	
1:30	Lesson 4: Comprehensive Guidelines	Introduce and demonstrate the application of the comprehensive guidelines. Show how to determine left-turn operational mode based on vehicle considerations and how to identify locations where an exclusive pedestrian phase may be considered.
2:30	Break	
2:45	Lesson 5: Alternative Treatment Guidelines	Introduce and demonstrate the application of the alternative treatment guidelines. Show how to choose pedestrian safety treatments in cases where improved pedestrian safety is desired but a protected left-turn phase is not cost-beneficial.
3:30	Lesson 6: Comprehensive Exercise	Show how the three sets of guidelines may be used together to analyze an example intersection.
4:15	Wrap-Up, Complete Course Review Form	
4:30	Adjourn	

Course Venues

Seven training course presentations were conducted. Table 2 summarizes the locations, dates, and attendance numbers for each course presentation. All course presentations were held at TxDOT training facilities. Practitioners from 17 of the 25 TxDOT districts were able to attend, as well as two TxDOT divisions and 11 cities in Texas.

Table 2. Course Venues and Attendance.

Venue	Date	TxDOT Participants	City Participants
Austin (pilot)	1/18/2012	14	10 (Austin , Cedar Park, Georgetown, Pflugerville, Round Rock, San Marcos, Waco)
Fort Worth	6/27/2012	9	0
El Paso	8/8/2012	12	0
Dallas	9/6/2012	16	3 (Frisco, Tyler)
San Antonio	10/4/2012	12	3 (San Antonio)
Houston	3/13/2013	10	5 (Houston)
Corpus Christi	5/15/2013	14	0
Total:		87	21

Course Evaluation

Participants were given evaluation forms near the end of each course presentation and asked to comment on the course content and format. The evaluation form contained four questions about the course content and four questions about the participant’s general observations about the strengths and weaknesses of the course format.

The four questions that inquired about course content were the following:

1. Did the course meet your expectations?
2. Was the material presented at the correct level of difficulty?
3. Was the topic of the course covered adequately (nothing left out, no one topic overemphasized)?
4. Was the software easy to use?

Participants were instructed to respond to each question using a scale of 1 to 5, with “1” indicating “Yes” and “5” indicating “No.” Each question was posed such that a “Yes” response indicated a high degree of satisfaction. The responses to the first four questions are summarized in Table 3.

Table 3. Participant Evaluation of Course Content.

Course Venue	Number of Responses	Average Participant Response by Question ¹				Average
		1	2	3	4	
Austin (pilot)	19	1.5	1.9	1.8	1.4	1.7
Fort Worth	9	1.4	1.4	1.6	1.3	1.4
El Paso	12	1.3	1.4	1.2	1.2	1.3
Dallas	16	1.8	1.9	1.6	1.6	1.7
San Antonio	14	1.6	1.7	1.4	1.4	1.6
Houston	13	1.2	1.3	1.4	1.2	1.3
Corpus Christi	13	1.5	1.9	1.6	1.2	1.6
Average or total:	96	1.5	1.7	1.5	1.3	1.5

Notes:

1 – Scores of 1 to 5 were possible. A “1” indicates “Yes” in response to the question. A “5” indicates “No” and values of 2, 3, and 4 indicate somewhere between “Yes” and “No” (e.g., “Maybe”).

The second set of four questions inquired about the participant's general observations of course strengths and weaknesses. Unlike the first four questions, each of the questions in the second set was open-ended. The specific questions posed to the participants include:

5. What did you like most about the course?
6. What did you like least about the course?
7. What can we do to improve this course?
8. Do you have any other comments?

Of the 108 course participants, 82 provided responses to questions 5-8. When asked what portion of the training course the participant liked best, the most common responses were the participant exercises with TSCO (20 participants), The TSCO program itself (17 participants), and the video clips that were used in some of the presentation slides (6 participants). A total of 15 participants gave positive comments about the organization and presentation of the course, referring to the material as "easy to follow," "well-organized," "concise," or "interactive."

At the pilot course presentation, there was confusion about the flow of input data on the worksheet that is used to implement the pedestrian safety guidelines for choosing left-turn operational mode (i.e., the worksheet on page A-19 of the *Handbook*). In response to participants' questions during the course and comments on the evaluation forms, several slides were added to the course presentation to clarify the worksheet procedure. The revised material was understood more clearly at subsequent course presentations. Additionally, in response to questions during the pilot course presentation, slides were added to clarify the nomenclature used to refer to specific crosswalks at an intersection.

A small number of participants expressed concern about the pace of the course, but these comments were roughly balanced between those who thought the course was too fast or had too much material (3 participants) and those who thought the course was too slow or had too little material (4 participants).

On the evaluation forms as well as during course presentations, several participants observed that the course material addresses just one of a variety of issues that are potentially concerning at signalized intersections, and that issues involving pedestrians are of greater interest to practitioners in cities, where more intersections with high pedestrian volumes are located. The training course presentations were offered in several large cities, but relatively few city practitioners attended because the course participant slots were reserved for TxDOT practitioners until roughly a week prior to each offering.

SUMMARY AND RECOMMENDATIONS

The positive responses to the training course material suggest that the content is effective and its format is well-organized. Now that training courses have been offered at various TxDOT venues to cover all material in the *Handbook*, a follow-up survey of part participants may yield insight into the long-term value of the material, as well as determine what *Handbook* material is most commonly-used.

The course materials that were developed in TxDOT implementation project 5-5629 cover most of the material in the *Handbook*, and take two days to present in their entirety. If the aforementioned survey reveals need for additional training course presentations, the course materials developed in research projects 5-5629 and 5-6402 could be merged. It is likely that city practitioners, and possibly even consultants, could benefit from the material as well as TxDOT practitioners.

Use of the *Handbook* and the TSCO program could be further streamlined through the creation of a complete user's manual for TSCO. An appendix to the final report from research project 0-5629 (3) contains a brief user's manual for the portions of TSCO that were developed in that project. An expanded manual could be drafted to document the portions of TSCO that were developed in research project 0-6402, as well as explain more details in the TSCO worksheets that are addressed in the manual.

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