Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-07/5-4196-01-2		

4. Title and Subtitle	5. Report Date
RED-LIGHT-RUNNING HANDBOOK WORKSHOP SERIES: YEAR 2 SUMMARY REPORT	September 2006 Published: October 2006
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
James A. Bonneson, Karl H. Zimmerman, and Michael P. Pratt	Report 5-4196-01-2
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135	11. Contract or Grant No. Project 5-4196-01
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas Department of Transportation Research and Technology Implementation Office P.O. Box 5080 Austin, Texas 78763-5080	Implementation Report: September 2004 - August 2006
	14. Sponsoring Agency Code

15. Supplementary Notes

Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.
Project Title: Red-Light-Running Handbook Training

16. Abstract

A recent analysis of Texas crash data indicated that there are about 121 fatal crashes each year in Texas that are attributable to red-light violations. It was also found that about 37,702 red-light-running-related crashes occur each year in Texas. These crashes have a societal cost to Texans of about $2.0 billion dollars each year. Engineering and enforcement countermeasures have been shown to reduce red-light violations, related crashes, or both by at least 10 to 30 percent. If even a 10 percent reduction in crashes were obtained by the use of one or more countermeasures, Texas motorists could save $140 million annually.

This report describes the activities undertaken to conduct a series of intersection safety workshops. The focus of the workshop is on countermeasures intended to treat intersections with frequent red-light violations and related crashes. The activities undertaken include developing the workshop training materials, identifying the workshop venues, scheduling the workshops, encouraging attendance by city and county engineers, conducting workshops, and administering a course evaluation form.

A ten-workshop series was completed during the project. The course evaluations completed by the participants indicate a high degree of satisfaction with the course content and format. Recommendations are made regarding the need for additional research to quantify the effect of some engineering countermeasures.

17. Key Words	18. Distribution Statement
Signalized Intersection, Red-Light-Running, Right Angle Collisions	No restrictions. This document is available to the public through NTIS: National Technical Information Service Springfield, Virginia 22161 http://www.ntis.gov

19. Security Classif.(of this report)	20. Security Classif.(of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	18	

RED-LIGHT-RUNNING HANDBOOK WORKSHOP SERIES: YEAR 2 SUMMARY REPORT

by

James A. Bonneson, P.E.
Research Engineer
Texas Transportation Institute

Karl H. Zimmerman, P.E.
Assistant Research Engineer
Texas Transportation Institute

and

Michael P. Pratt
Assistant Transportation Researcher
Texas Transportation Institute

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Project 5-4196-01
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September 2006
Published: October 2006

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

DISCLAIMER

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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.

ACKNOWLEDGMENTS

This research project was sponsored by the Texas Department of Transportation and the Federal Highway Administration. The implementation workshops were conducted by Drs. James A. Bonneson and Karl Zimmerman with the Texas Transportation Institute (TTI).

The project team would like to acknowledge the support and guidance provided by the implementation director, Mr. Henry Wickes. We would also like to acknowledge the TxDOT engineers who served on the original research project (i.e., Project 0-4196) and supported the development of the *Red-Light-Running Handbook*:

- Mr. Richard Kirby, project coordinator, TxDOT
- Mr. Wade Odell, project director, TxDOT
- Mr. Punar Bhakta, TxDOT
- Mr. Michael Jedlicka, TxDOT
- Mr. Danny Magee, TxDOT
- Mr. Walter Ragsdale, City of Richardson, Texas
- Mr. Ismael Soto, TxDOT

The authors extend a special thanks to these gentlemen. Their keen interest in the project and confidence in the research team is greatly appreciated.

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INTRODUCTION

A recent analysis of Texas crash data indicated that there are about 121 fatal crashes each year in Texas that are attributable to red-light violations (*1*). This analysis also found that about 37,700 red-light-related crashes occur each year in Texas. These crashes have a societal cost to Texans of about $2.0 billion dollars each year. Moreover, two-thirds of the crashes and associated costs related to red-light violations occur in five of the largest cities in Texas: Houston, Dallas, San Antonio, Austin, and Fort Worth.

A wide range of countermeasures exists for treating red-light-running problems. These countermeasures are generally divided into two broad categories: engineering countermeasures and enforcement countermeasures. Research has shown that countermeasures in both categories are effective in reducing the frequency of red-light violations. In fact, many of these countermeasures have been shown to reduce red-light violations, related crashes, or both by at least 10 to 30 percent (*2*). If even a 10 percent reduction in crashes were obtained by the use of one or more countermeasures, Texas motorists could save $140 million annually.

This report describes the activities undertaken to conduct a series of intersection safety workshops. The focus of the workshop is on describing countermeasures for treating intersections with frequent red-light violations and related crashes. The activities undertaken included:

- developing the workshop training materials,
- identifying the workshop venues,
- scheduling the workshops,
- encouraging attendance by city and county engineers,
- conducting the workshops, and
- administering the course evaluation form.

The next section of this report describes the research background that underlies the workshop information content. The section that follows summarizes the workshop objectives, content, venues, and participant evaluations. The last section identifies some additional research that is needed to fill gaps in the information about the effectiveness of specific countermeasures.

BACKGROUND

Guidelines were developed for TxDOT Project 0-4196 to help engineers treat intersections with a red-light-related safety problem (*2*). The guidelines were documented in the *Red-Light-Running Handbook: An Engineer's Guide to Reducing Red-Light-Related Crashes* (*3*). Separate guidelines are presented for the treatment of individual intersections and entire cities. The guidelines address countermeasures in both the engineering and the enforcement categories.

Nineteen engineering countermeasures are identified in the *Handbook*. These countermeasures typically include some type of modification to the signal operation, signal visibility

or conspicuity, regulatory or warning signs, traffic operation, or intersection geometry. All of these countermeasures have been documented as having the potential to reduce red-light violations, related crashes, or both. Some of the documentation reports only anecdotal information, or information based on non-scientific studies. Other documents cite quantitative information about the effectiveness of one or more countermeasures.

Enforcement countermeasures are also discussed in the *Handbook.* These countermeasures are categorized as one of two types: officer enforcement or camera enforcement. The *Handbook* describes the characteristics of both enforcement types as well as their effectiveness at reducing red-light violations and related crashes.

The *Handbook* describes a detailed procedure for identifying and treating locations with the potential for safety improvement. The steps that comprise the procedure are outlined below.

1. Conduct an engineering study to confirm the nature and extent of the problem.
2. Identify and implement viable engineering countermeasures.
3. Evaluate the effectiveness of the implemented countermeasures.
4. If red-light-running problems still exist, consider implementation and evaluation of additional (or other) engineering countermeasures until all viable countermeasures have been tried.
5. If red-light-running problems still exist, consider the implementation of an officer enforcement program that targets intersection traffic control violations and includes a public awareness campaign.
6. If officer enforcement is determined to be unsuccessful or ineffective, then camera enforcement can be considered (provided that it is approved by controlling legal statutes). If camera enforcement is implemented, it should be accompanied by a public awareness campaign. Also, rear-end crashes should be monitored and remedial action taken if a sustained increase in rear-end crashes is observed.

The *Handbook* provides the technical guidance needed to implement the aforementioned procedure. The analytic procedures in the *Handbook* are automated in an Excel® spreadsheet called the Texas Red-Light-Running Evaluation and Analysis Tool (TREAT).

WORKSHOPS

This section provides an overview of the workshop and a review of highlights from its presentation at ten locations in Texas. The first subsection to follow provides an overview of the workshop. It is followed by a review of the workshop learning objectives. Then, the workshop format and schedule are outlined. Finally, the participant evaluations are summarized in the last subsection.

Overview

The objective of this implementation project was to improve intersection safety by informing engineers about how to use a newly developed procedure for identifying and treating locations with red-light-related problems. The procedure is documented in the *Handbook*, as described in the previous section. Both the workshop and the *Handbook* are written for use by engineers and technicians. The workshop instructors were James A. Bonneson and Karl Zimmerman.

A two-year workshop series was established for the implementation project. This report describes the activities undertaken to achieve the project objective. Specifically, the following three activities were successfully completed:

- Develop workshop training materials (i.e., visual aids, handouts, participant exercises, software, etc.) that impart to workshop participants the information needed to effectively evaluate intersections, identify safety problems, diagnose the problems, and select countermeasures.

- Conduct one one-day workshop in each of five Texas cities during the first year.

- Conduct one one-day workshop in each of five Texas cities during the second year.

Workshop Learning Objectives

The workshop 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, flow charts, and example applications. The visual aids were supplemented with printed materials that included a course workbook (that included a print copy of the visual aids) and a copy of the *Handbook*. The computations associated with the evaluation of an intersection were automated using the TREAT spreadsheet, a copy of which was provided to each workshop participant.

The following learning objectives were established to guide the development of the workshop training materials:

- Solving red-light-related safety problems requires an approach that includes the "3-E's" (i.e., engineering, education, and enforcement).

- The focus of the evaluation is on red-light-related crashes and their reduction. Red-light violation frequency is an important clue to the nature of the red-light problem but frequent violations do not always result in increased crashes. Hence, efforts focused on reducing red-light violations may not always yield a significant reduction in crashes.

- An intersection must be determined to have a significant red-light-related problem before effort is expended to treat it. "Problem" intersections are defined as those intersections that exhibit an above-average frequency of red-light-related crashes (i.e., right-angle and left-turn-opposed crashes).

- When treating a problem intersection, the goal should be to reduce the red-light-related crash frequency to average levels. A goal of eliminating red-light-related crashes is likely to be difficult to achieve and unjustifiably expensive to undertake.

- Only after all feasible engineering countermeasures have been evaluated should officer enforcement be considered. Implementation of a heightened enforcement activity (especially on an area-wide basis) should be accompanied by a public awareness campaign. TxDOT's Selective Traffic Enforcement Program (STEP) has been successfully used by several cities as a means of funding additional officer enforcement and public education activities.

Each of these learning objectives was repeated throughout the workshop to emphasize their importance and ensure their retention by participants.

Workshop Format

The workshops consisted of approximately seven hours of instruction that included a presentation, a demonstration of the TREAT software, and two interactive participant exercises. The visual aids used in each workshop consist primarily of 147 PowerPoint slides. The workbook also includes two self-paced exercises for the participants to work on in an independent manner. The goal of these exercises was to help the participants gauge their level of understanding of the course content. During the first year of the project, an additional 18 slides were added to the presentation (to yield the present total of 147 slides) and an additional exercise was prepared in response to comments received from the workshop participants.

The workshop agenda is provided in Table 1. It consists of seven sections that comprehensively describe the safety problem and its treatment. The first two sections were presented in the morning half of the workshop. These sections quantify the adverse impact of red-light violations on motorists in Texas, examine the characteristics of red-light violations and crashes, and identify a range of countermeasures that have been used to treat red-light-related problems.

The last five sections listed in Table 1 were presented in the afternoon half of the workshop. Section C describes the procedure for identifying intersections that are likely to have safety problems related to red-light violations. Section D describes a technique for evaluating countermeasures at these intersections. Section E is devoted to an open-ended example problem to be completed by each participant. At the conclusion of this section, participants discuss their findings and share solution strategies. Section F is similar to Section D; however, it is focused on the evaluation of an entire city or urban area. Section G is similar to Section E and provides an open-ended example problem for the participants to evaluate their understanding of the material presented in Section F.

Table 1. Workshop Agenda.

Section	Description
A. Safety Impact of Red-Light Violations and Crashes	Frequency of red-light-related crashes that occur annually on Texas streets and highways. Examination of the societal cost of red-light-related crashes.
B. Red-Light Violations, Crashes, and Countermeasures	Discussion of intersection signalization features and their correlation with red-light violations and crashes. Examination of various engineering countermeasures (e.g., signal timing, visibility enhancements, etc.). Overview of enforcement options and the need for public awareness campaign.
C. Engineering Approach to the Problem	Overview of the procedure for identifying and treating locations with potential for safety improvement. Introduction to the TREAT software.
D. Procedure for Local Intersection Evaluation	Discussion of the individual steps that comprise the evaluation procedure, as applied to an individual intersection approach.
E. Participant Exercise 1	Open-ended problem for workshop participants to exercise their understanding of the procedure, as applied to a local intersection evaluation.
F. Procedure for Area-Wide Evaluation	Discussion of the individual steps that comprise the evaluation procedure, as applied to a city or municipality.
G. Participant Exercise 2	Open-ended problem for workshop participants to exercise their understanding of the procedure, as applied to an area-wide evaluation.

Workshop Venues

Five workshops were conducted during the each year of the two-year implementation project. A total of 145 persons attended the ten workshops. Table 2 summarizes the locations, dates, and attendance numbers for each workshop during the first year. The cities selected for the workshops were among those identified in Project 0-4196 as having an unusually large incidence of red-light-related crashes. All workshops were held at TxDOT district training facilities.

Table 2. First-Year Workshop Venues and Attendance.

Agency Participation	Number of Participants by Workshop Location and Date					
	Austin	Corpus Christi	Houston	Laredo	Dallas	Total
	12/9/2004	5/2/2005	6/21/2005	7/26/2005	8/19/2005	
TxDOT	8	20	12	10	9	59
City	14	6	0	1	12	33
Total:	22	26	12	11	21	92

With the assistance of TxDOT, the instructors invited traffic engineers from both TxDOT and local municipalities to attend the workshops. Local law enforcement officials were also invited to the Austin and Corpus Christi workshops. City and county engineers in the vicinity of the Houston workshop inadvertently did not receive an invitation to the workshop due to an unfortunate breakdown in communication among the course instructors.

Five additional workshops took place during the second year of the implementation project. Table 3 summarizes the attendance at each of these workshops. One of the city representatives in Waco was a law enforcement officer. Seven attendees in San Antonio were not from TxDOT or a city. Of these seven, four were private consultants who work with the San Antonio District.

Table 3. Second-Year Workshop Venues and Attendance.

Agency Participation	Number of Participants by Workshop Location and Date					
	Atlanta	Waco	Lubbock	San Antonio	El Paso	Total
	3/13/2006	4/3/2006	5/9/2006	5/16/2006	8/17/2006	
TxDOT	9	9	5	9	8	40
City	1	5	3	3	4	16
Other/Private	0	0	0	7 [1]	0	7
Total:	10	14	8	19	12	63

Note:
1 - The breakdown of "other" attendees is: one from Bexar County, two from TTI-San Antonio, and four from private consulting firms that work with TxDOT's San Antonio District.

Workshop Evaluation

Participants were given evaluation forms near the end of each workshop 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 asked the participant to respond to each question using a scale of 1 to 5. A "1" was used to indicate "Yes" in response to the question. A "5" was used to indicate "No." Values of "2," "3," and "4" were used to indicate a response somewhere between "Yes" and "No" (e.g., "Maybe"). 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 4 for the first year's workshops, and in Table 5 for the second year's workshops.

The values in each cell of Table 4 and Table 5 represent an average of all the responses received from the course participants at the designated location for a common question. With a couple of exceptions, the average response ranged from 1.4 to 1.7 for each location and question.

Values in this range indicate a high level of satisfaction with the workshop content. One of the exceptions was at the Houston workshop. A couple of the participants at this location thought the material was a little too difficult to digest. The second exception was at the Laredo workshop. A few of the participants at this location thought that the TREAT software could be a little easier to use. The same was true at both the Atlanta and Waco workshops during the second year. Also, the Waco workshop was held in a room that was too small for the number of attendees and other amenities were lacking (such as nearby restrooms), which explains some of the generally lower scores for that venue. The average response values listed in the last column of both Table 4 and Table 5 indicate a generally high level of satisfaction with the workshop content.

Table 4. First-Year Participant Evaluation of Workshop Content.

Question	Average Participant Response by Workshop Location [1]					
	Austin	**Corpus Christi**	**Houston**	**Laredo**	**Dallas**	**Average**
1. Did the course meet your expectations?	1.4	1.4	1.7	1.5	1.4	**1.4**
2. Was the material presented at the correct level of difficulty?	1.4	1.7	2.1	1.5	1.5	**1.6**
3. Was the topic of red-light treatment covered adequately?	1.7	1.4	1.7	1.4	1.6	**1.5**
4. Was the TREAT software easy to use?	1.6	1.4	1.6	2.0	1.5	**1.5**
Average:	**1.5**	**1.5**	**1.8**	**1.6**	**1.5**	**1.5**

Note:
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").

Table 5. Second-Year Participant Evaluation of Workshop Content.

Question	Average Participant Response by Workshop Location [1]					
	Atlanta	**Waco**	**Lubbock**	**San Antonio**	**El Paso**	**Average**
1. Did the course meet your expectations?	1.3	1.8	1.6	1.7	1.6	**1.6**
2. Was the material presented at the correct level of difficulty?	1.7	1.8	1.4	1.6	1.6	**1.6**
3. Was the topic of red-light treatment covered adequately?	1.5	1.9	1.4	1.5	1.4	**1.6**
4. Was the TREAT software easy to use?	2.0	2.0	1.4	1.4	1.3	**1.6**
Average:	**1.6**	**1.9**	**1.4**	**1.6**	**1.5**	**1.6**

Note:
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, the second set of four questions was open-ended. The specific questions posed to the participants include:

- What did you like most about the course?
- What did you like least about the course?
- What can we do to improve this workshop?
- Do you have any other comments?

Of the 155 course participants, 120 provided responses to the four questions listed above. Thirty-five participants gave positive comments on the TREAT software, referring to it as "very useful" and "user friendly." An additional 18 participants gave positive feedback on the example problems and on the opportunity to get hands-on experience with TREAT. Another 30 participants gave generally positive comments about the course material, presentation, and organization.

Of the five law enforcement officials who attended a workshop, the two who attended the Austin workshop stated that engineers would benefit more from the material than police officers. Based on this observation, invitations to local law enforcement were discontinued after the first-year workshop in Corpus Christi. The other three law enforcement officials, one at the Waco workshop and two at the El Paso workshop, had similar comments.

One person in Houston suggested inviting more city traffic engineers to the workshops. As noted previously, a miscommunication between workshop instructors resulted in no invitations being sent to city engineers in the vicinity of the Houston workshop.

Other suggestions offered with some frequency include: increase the number of example problems, increase the opportunity for participant interaction, and provide additional information about the effectiveness of some of the countermeasures identified in the *Handbook* but not supported in TREAT. In response to the request for additional example problems, a third example problem was prepared. Also, the visual aids were modified slightly to induce discussion among the participants and, thereby, increase their level of participation.

Several countermeasures listed in the *Handbook* are reported to have some ability to reduce red-light violations or related crashes but their effectiveness has not been quantified through research. Participants at the workshop expressed some interest in implementing these countermeasures but would desire some sense of their effectiveness before proceeding with implementation. Some of the countermeasures of particular interest to the participants, but for which the effectiveness is not quantified, include:

- improve signal head visibility (via additional signal heads),
- improve signal conspicuity by upgrading to 12-inch signal heads,
- improve signal conspicuity by upgrading to yellow light-emitting diodes (LEDs),
- improve signal conspicuity by adding backplates,

- improve signal conspicuity by using dual-red indications,
- add an advance warning sign with flashers (with flashers connected to load switches),
- reduce delay through re-timing signal operation, and
- improve signal coordination.

Additional research will need to be conducted to satisfy the participant's request for information about the effectiveness of the aforementioned countermeasures.

A few participants commented that they were not sure how closely the reported countermeasure effectiveness would translate into real-world situations. This comment was made in light of the participant's experience with highly variable crash data and the challenges of observing the effect of a countermeasure in terms of a lower crash frequency in the year after its implementation.

RECOMMENDATIONS

The high level of satisfaction with the workshop content and the positive tone of the evaluation comments are evidence that the workshop content was effective. The participants indicate that the workshop was beneficial to their efforts to reduce red-light-related safety problems.

Many of the traffic signals with red-light-running problems are controlled by local city governments. Hence, city traffic engineers are in a good position to effectively reduce a majority of the red-light crashes occurring in Texas. TxDOT is encouraged to work with local governments to support their efforts to reduce red-light-related safety problems.

Finally, the instructors recommend that TxDOT consider the funding of additional research related to engineering countermeasures. The specific countermeasures for which research is needed are identified in the previous section.

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