

Highway Worker Safety: Policies, Practices and Legal Issues

Requested by

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The Caltrans Division of Research and Innovation (DRI) receives and evaluates numerous research problem statements for funding every year. DRI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field.

Executive Summary

Background

In an ongoing effort to improve safety, Caltrans is investigating innovative practices and technologies to protect construction and maintenance workers on California's highways. The recently formed Safety Innovation Working Group will provide leadership and commitment to improving roadway safety across California through proven and ready-to-be-deployed innovations and technology, with a focus on three areas:

- Education and outreach (internal and external).
- Policy and legal options.
- Equipment such as warning devices and barriers to keep workers safe on the roadway.

This investigation focuses on work zone safety policies, practices and legal issues undertaken at the national, state and regional levels.

Summary of Findings

To gather information on the topic of work zone safety policies, practices and legal issues, we examined the web sites of state departments of transportation (DOTs) and compiled relevant research citations and other resources. We present our findings in six topic areas, summarized below:

Work Zone Traffic Laws

- The National Work Zone Safety Information Clearinghouse and Governors Highway Safety Association provide state-by-state compilations of work zone traffic laws. We summarize this information in [Appendix A](#). Observations include:
 - Wyoming is the only state to not apply enhanced traffic penalties in work zones.
 - More than half the states double fines in work zones.
 - Thirteen states apply fixed fines that range from \$50 to \$2,000.

- The laws of 24 states and the District of Columbia require the presence of workers for the enhanced penalties to apply.
- Eighty percent of the agencies require the presence of signs in the work zone for fines to apply.

National Guidance

- The online format of a 2007 FHWA guidebook of best practices allows for searching by topic area. Each best practice includes a description, the reason for use of the practice, benefits, the most applicable location and type of project where the practice is most effective, the state using the practice and contact information.
- FHWA’s Work Zone Mobility and Safety Self Assessment tool is designed to assist agencies in assessing their programs, policies and procedures against work zone best practices in use today.
- NCHRP reports provide guidance on work zone assessment and traffic enforcement in work zones.

Selected State Policies and Practices

- We provide a selection of state policies and practices to augment results from the proposed online survey of state practice, beginning with excerpts from Caltrans manuals that relate to worker safety. Among the other documents we include are:
 - Maryland State Highway Administration’s online Work Zone Safety Toolbox, which provides links to guidance on such topics as the inclusion of police traffic services in work zones and an alternative procedure for determining work zone speed limits.
 - Guidelines for determining work zone speed limits from Minnesota and Washington State DOTs. A Texas DOT report provides recommendations on establishing and managing work zone speed limits.
 - A 2009 report that provides results of Oregon DOT’s construction work zone tour.

Strategic Highway Safety Plans: Strategies to Enhance Work Zone Safety

- The Strategic Highway Safety Plans developed by state DOTs establish statewide goals and objectives in key emphasis areas, including work zone safety. We highlight a number of plans and their strategies and note some common themes:
 - Enhancing or reinforcing education and outreach efforts.
 - Drafting guidelines for and increasing the use of law enforcement in work zones.

Related Research

Models, Standards and Assessments

- Two of the research projects we highlight resulted in recommended standards for mobile lane closures and best practices to improve the safety of mobile and short duration maintenance operations.
- A 2009 report proposes the use of an integrated risk management model during the construction and administration of highway projects, and a conference paper, also published in 2009, presented guidelines for conducting work zone safety audits that are at the construction stage.

Work Zone Design

- Models are the topic of two of the publications we include in this section. Researchers used models to identify the work zone design and traffic control features that influence work zone safety and assess the relative benefits of four computer simulation models designed for work zone analysis.
- A 2010 Oregon DOT report considers ways to modify traffic control plans in the interest of decreasing the number of work zone fatalities and injuries.
- A 2002 NCHRP report provides guidelines for nighttime traffic control for highway maintenance and construction.

Risk Factors

- Conference papers and journal articles that span the period 2008 through 2011 consider factors that influence the incidence and frequency of crashes in work zones and crash severity.

Human Factors

- Driver behavior in response to different work zone configurations is examined in reports and conference papers published since 2007.

Speed Limits in Work Zones

- In conference papers, research reports and journal articles, researchers assessed speed limits from a variety of perspectives:
 - The impact of law enforcement activity.
 - Speed limit scenarios that have the greatest effect on reducing speeds.
 - The types of lane markers that are most effective in reducing vehicle speeds.
 - The effects of automated speed enforcement and police presence.
 - Guidelines for work zone speed control.

Research in Progress

We present three projects in process that are examining practices in typical and short duration work zones and are considering risk mitigation strategies to reduce property damage and improve safety for workers in construction and maintenance work zones.

Work Zone Traffic Laws

Below we highlight web-based compilations of work zone traffic laws that provide links to relevant statutes and provide a brief description of the law and how it is applied.

Work Zone Traffic Laws, Governors Highway Safety Association, July 2011.

http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html

This web site provides a state-by-state listing of work zone traffic laws, including the types of violations affected, whether the state enforces enhanced penalties, and whether workers and signs must be present for the enhanced penalty to apply.

Enhanced Fine Legislation in Work Zones, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011.

http://www.workzonesafety.org/laws/state_laws/fine_legislation

This web site provides a table that lists enhanced fines for speeding or other violations in traffic work zones by state. Find links here to the full text of the state laws.

See [Appendix A](#) for a summary of the enhanced fines applicable to work zones in the 50 states and District of Columbia that uses data from the web sites cited above. Observations from the summary include:

- Wyoming is the only state to not apply enhanced traffic penalties in work zones.
- The violations affected may be limited to speeding (66 percent of agencies); apply to all traffic violations (22 percent); or involve numerous violations (12 percent).
- Twenty-seven states and the District of Columbia apply fines in work zones that are at least double the original fines.
- Thirteen states apply fixed fines that range from \$50 to \$2,000.
- Laws in six states—Georgia, Nevada, New York, South Carolina, South Dakota and West Virginia—include the possibility of jail time for work zone violations.
- Twenty-four states and the District of Columbia require the presence of workers for the enhanced penalties to apply.
- Eighty-four percent of the agencies require the presence of signs in the work zone for fines to be applicable.

National Guidance

Scan 08-04: Best Practices in Work Zone Assessment, Data Collection, and Performance Evaluation, NCHRP, October 2010.

http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_08-04.pdf

This publication documents the best practices in work zone assessment, data collection and performance measurement employed by state DOTs to ensure safety and minimize congestion in work zones. Key recommendations include:

- Institutionalize the use of performance measures within the agency. This can encourage the allocation of resources, establishment of feedback communication loops, education of involved personnel, and support and buy-in of agency leadership.

- Collect quality data. Transportation management centers can play a key role in collecting data, identifying issues and providing information to the public with regard to current work zones within its surveillance zone.
- Scale a project's level of transportation management planning effort to the level of the anticipated impacts.

Work Zone Mobility and Safety Self Assessment: 2009 National Report, FHWA, October 2009.

http://www.ops.fhwa.dot.gov/wz/decision_support/2009/wzsa_2009.pdf

This report describes FHWA's Work Zone Mobility and Safety Self Assessment (WZ SA) tool, including an overview and detailed results of the 2009 WZ SA. The WZ SA tool consists of a set of 46 questions designed to assist those with work zone management responsibilities in assessing their programs, policies and procedures against work zone best practices in use today in state DOTs, metropolitan planning organizations and local municipalities.

Work Zone Operations Best Practices Guidebook, FHWA, Publication No. FWHA-HOP-07-131, October 2007.

<http://www.ops.fhwa.dot.gov/wz/practices/best/documents/bpguidebook.pdf>

This publication offers best practices in a range of categories. Each best practice includes a description, reasons the agency applied the best practice, primary benefits realized, the most applicable location and type of project where the practice is most effective, the state using the practice and contact information.

The guidebook is also available in a searchable online format at

<http://ops.fhwa.dot.gov/wz/practices/best/bestpractices.htm>. The online form of the publication indexes by topic and provides short descriptions of best practices, including contact information. Practice areas of interest include:

Policy and Procedures

<http://ops.fhwa.dot.gov/wz/practices/best/crossref.asp?ID=2>

Best practices in this section include high-quality design, construction and maintenance operations, minimizing disruption to the highway user and maintaining a safe, efficient roadway environment for the traveling public and the highway worker.

Enforcement

<http://ops.fhwa.dot.gov/wz/practices/best/crossref.asp?ID=10>

These best practices involve using full-time uniformed police officers who are trained, qualified and readily available for construction and maintenance operations.

Evaluation and Feedback

<http://ops.fhwa.dot.gov/wz/practices/best/crossref.asp?ID=12>

These best practices emphasize methods to collect and evaluate work zone data and feedback from motorists and others. Surveys, meetings and project hotlines allow motorists to provide their perspective on how well their demands for mobility and safety in work zones are being met.

Traffic Enforcement Strategies in Work Zones, NCHRP Project 03-80, Interim Report, May 2006.

<http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/Interim%20Report.pdf>

This interim report presents the summary of work conducted during Phase I of NCHRP Project 03-80. Guidelines to be developed in this project include:

- How should the effectiveness of traffic enforcement strategies be measured?
- How many enforcement officers should be used and where should they be located? If officers will be stopping motorists, where should that be done and how should that site be designed? When and how should alternatives to officers such as drone radars and automated enforcement be used?

- What types of communication and coordination structures among the transportation agency, contractor and enforcement work well?
- How could public awareness techniques be used to supplement the traffic enforcement activities?

This 2006 publication is the project's interim report. The final report and guide have been submitted; a publication decision is pending.

Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects, FHWA, Report No. FHWA-HOP-05-068, August 2006.
http://ntl.bts.gov/lib/25000/25200/25212/wzi_guide.pdf

This report is aimed at helping agencies implement the provisions of the Work Zone Safety and Mobility Rule, with a focus on work zone impacts assessment. Agencies can incorporate work zone impacts assessment into program delivery by:

- Conducting a first-cut work zone impacts assessment at the systems planning level.
- Conducting a preliminary project-level work zone impacts assessment during preliminary engineering; detailed project-level work zone impacts assessment is conducted during design.
- Incorporating work zone affects assessment procedures in ongoing systems management, maintenance and operations.

Appendices to the guide present a real-world example of how the work zone impacts assessment process can be applied to a project and an overview of different traffic analysis tools that may be used for analysis of work zone impacts.

Report 500: Volume 17, A Guide for Reducing Work Zone Collisions, NCHRP, 2005.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v17.pdf

Page 14 of the PDF provides a summary of the strategies explored in this report to address the following objectives for improving work zone safety. Strategies of particular interest include:

- Reduce the number, duration and impact of work zones (page 30 of the PDF).
- Improve work zone design practices (page 91).
- Enhance enforcement of traffic laws in work zones (page 104).
- Improve credibility of signs (page 111).
- Improve application of increased driver penalties in work zones (page 114).
- Develop procedures to effectively manage work zones (page 133).
- Improve coordination, planning and scheduling of work activities (page 136).
- Use incentives to create and operate safer work zones (page 138)
- Implement work zone quality assurance procedures (safety inspections or audits) (page 140).

Selected State Policies and Practices

To augment the proposed online survey of state practice, below we cite manuals, guidelines, research reports and web-based tools that describe selected state policies and practices related to work zone management and safety. We begin with an examination of guidance provided by Caltrans.

California

Chapter 8, Protection of Workers, Maintenance Manual, Caltrans, September 2010.

http://www.dot.ca.gov/hq/maint/manual/CHP-8_2010_Sept_and_T-Plates_01-24-11.pdf

This document includes a description of MAZEEP (MAintenance Zone Enhanced Enforcement Program). MAZEEP is used to reduce the potential for traffic collisions, reduce traffic speeds to the posted speed limits and increase the safety of workers and motorists.

Chapter 2, Safety and Traffic, Construction Manual, Caltrans, July 2004.

http://www.dot.ca.gov/hq/construc/manual2001/chapter2/chp2_2.pdf

This chapter provides information about speed management in construction zones.

Part 6, Temporary Traffic Control, California Manual on Uniform Traffic Control Devices, Caltrans, State of California Business, Transportation and Housing Agency, January 21, 2010.

<http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd2010/Part6.pdf>

Worker Safety Considerations begin on page 36 of the PDF.

Iowa

Work Zone Fines: Explanation of the New Law, Iowa Department of Transportation, undated.

<http://www.iowadot.gov/wzfinest/index.html>

This web site provides a summary of an Iowa law that took effect July 1, 2008, to protect the safety of highway workers, enforcement personnel and motorists. Under the law, the penalties for speeding in a work zone are:

- \$150 for up to 10 mph over the posted speed limit.
- \$300 for speeds from 11 mph through 20 mph over the posted speed limit.
- \$500 for speeds from 21 mph through 25 mph over the posted speed limit.
- \$1,000 for speeds in excess of 25 mph over the posted speed limit.

Prior to the enactment of the new law, scheduled fines for moving traffic violations committed in a work zone were doubled. Under the new law, doubled fines continue to apply for moving violations other than speeding. The law applies to state, county and city public roads.

Related Resource:

Work Zones Fact Sheet, Iowa Department of Transportation, undated.

http://www.iowadot.gov/wzfinest/fact_sheet.pdf

This two-page fact sheet provides background on the 2008 law on work zone fines and a new sign program to inform the traveling public.

Kentucky

Evaluation of Work Zone Safety Operations and Issues, Kentucky Transportation Center, Research Report KTC-06-8, March 2006.

http://www.ktc.uky.edu/Reports/KTC_06_08_SPR_287_05_1F.pdf

In their examination of work zone safety, researchers found that the largest reduction in speed is achieved with the presence of police enforcement at the work site. Researchers also noted that providing more specific guidance for routine short duration and mobile maintenance operations such as roadway surface

patching can provide significant safety benefits. The report's recommendations to improve work zone safety in Kentucky appear on page 17 of the PDF and include the following:

- Distribute a handbook providing guidelines for traffic control in work areas to maintenance and utility workers. *Guidelines for Traffic Control in Short Duration/Mobile Work Zones* is available at http://kyt2.evasiv.com/assets/files/uploads/08shortdurationmobile_final.pdf.
- Encourage the use of police enforcement officers for maintenance activities.
- Expand the use of signs doubling the fines in work zones to major maintenance work zones.
- Assign a statewide work zone safety coordinator to interact with enforcement personnel and contractors.
- Develop a certification process for all flaggers, including contractors, utility companies and state personnel.

Maryland

Work Zone Safety Toolbox, Maryland State Highway Administration (SHA), August 2005.

<http://www.sha.maryland.gov/index.aspx?pageid=405>

The Work Zone Safety Toolbox provides guidance and supplements practices and standards provided in the current edition of the specification documents used by Maryland SHA. Links on this web site provide guidance in a variety of areas, including police traffic services in work zones and an alternative procedure for the determination of work zone speed limits.

Minnesota

Work Zone Speed Limit Guidelines, Minnesota Department of Transportation, December 2010.

<http://www.dot.state.mn.us/speed/pdf/WZSpeedLimitGuideline.pdf>

This publication describes the application of three approaches used by Mn/DOT to control speeds in work zones: advisory speed limits (road conditions and worker safety), work zone speed limits and temporary construction speed limits. The document also includes relevant statutory provisions and a discussion of speed limits on detours, dynamic speed display signs and extraordinary law enforcement. Forms and layouts for application of the work zone speed limits are also included.

Oregon

Construction Work Zone Tour, Oregon Department of Transportation, Summary Report, November 2009.

<http://gspc.state.or.us/ODOT/HWY/TS/docs/2009WZTourSummaryReport.pdf?ga=t>

Participants of this 2009 tour of work zones scored 60 Oregon highway construction work zones on a wide range of categories. Scores and comments are designed to heighten the awareness of the standards, practices and procedures used in both the design and implementation of ODOT's traffic control plans. The report includes an assessment of work zone traffic control "pluses" and "minuses."

Texas

Studies to Improve the Management of Regulatory Speed Limits in Texas Work Zones, Texas Department of Transportation, Report No. FHWA/TX-09/0-5561-1, December 2008.

<http://tti.tamu.edu/documents/0-5561-1.pdf>

This project sought to improve existing procedures on establishing and managing work zone speed limits, and evaluate new technologies and strategies to better manage work zone speed limits. Researchers' recommendations include:

- A 5 mph maximum speed reduction for shoulder activity and lane encroachment conditions.
- A 10 mph maximum speed reduction for lane closures and temporary diversions.

- Speed limit reductions should be discouraged on roadways with existing speed limits less than 65 mph for all conditions except lane closures when workers are in a closed lane unprotected by barrier and only a single travel lane remains open.

Virginia

Use of Police in Work Zones on Highways in Virginia, Virginia Department of Transportation, FHWA, Report No. VTRC 04-R9, December 2003.

http://www.virginiadot.org/vtrc/main/online_reports/pdf/04-r9.pdf

Virginia DOT has an agreement with the Virginia State Police (VSP) for paying for and implementing police enforcement in VDOT work zones and a mutually developed set of guidelines for using police enforcement. In this project, researchers augmented a review of current practices regarding the use of police in work zones in Virginia with a literature review and survey of VDOT and VSP personnel. Respondents were almost unanimous in their conclusion that the use of police in work zones is effective in reducing speeds and improving safety in work zones, with few adverse effects. Recommendations include:

- Development and implementation of training in basic work zone operations.
- Development of a standard agreement for possible use with local police agencies.
- Use of more than one police officer in the work zone.
- Promotion of the maximum \$500 fine for speeding in work zones.
- A requirement that police officers wear safety vests when outside their vehicle in a work zone.

Washington

Appendix 5.B, Speed Limit Reductions in Work Zones, WSDOT Traffic Manual, Washington State Department of Transportation, October 2009.

<http://www.wsdot.wa.gov/publications/manuals/fulltext/M51-02/Appendix5B.pdf>

This publication provides procedures for the application of three types of speed reduction in work zones:

- **Advisory Speed Reduction.** A sign warning of the actual condition with an appropriate advisory speed is installed where drivers encounter work zone conditions such as rough road, bump or temporary alignment that require a specific safe speed message.
- **Variable Regulatory Speed Limit Reduction.** Effective where a temporary work zone condition (such as workers on foot close to live traffic or a short-term lane shift) requires a lower operational speed and in place only for the duration of the warranting condition—often a single work shift.
- **Continuous Regulatory Speed Limit Reduction.** A speed reduction effective 24 hours a day for the number of days that work zone conditions warrant; used only where construction elements cannot be mitigated by design elements.

Work Zone Traffic Control Guidelines, Washington State Department of Transportation, September 2009.

<http://www.wsdot.wa.gov/publications/manuals/fulltext/M54-44/Workzone.pdf>

Page 24 of the PDF addresses work zone speed limits.

Strategic Highway Safety Plans: Strategies to Enhance Work Zone Safety

State DOTs develop Strategic Highway Safety Plans (SHSPs) to meet a federal requirement. These plans provide a comprehensive framework for reducing highway fatalities and serious injuries on public roads, and establish statewide goals and objectives in key emphasis areas, including work zone safety. Below we highlight several state plans and the strategies proposed to increase work zone safety, beginning with publications related to Caltrans' plan.

California

California Strategic Highway Safety Plan, State of California, September 2006.

http://www.dot.ca.gov/hq/traffops/survey/SHSP/SHSP_Final_Draft_Print_Version.pdf

Page 38 of the PDF provides details of Challenge 14: Enhance Work Zone Safety. Strategies to reduce work zone fatalities include:

- Enhance safe driving through work zones with education and enforcement.
- Improve traffic control in work zones.
- Reduce worker exposure and improve worker visibility.
- Apply advanced technology to enhance work zone area.
- Improve data collection and analysis.

Related Resources:

SHSP Performance Tracking Details Report, Caltrans, June 2011.

http://www.dot.ca.gov/hq/traffops/survey/SHSP/SHSP_STATUS_REPORT.pdf

See page 16 of the PDF for the status of activities associated with Challenge Area 14: Enhance Work Zone Safety.

California Strategic Highway Safety Implementation Plan, Safety Needs Action Plan (SNAP) for Challenge Area 14: "Enhance Work Zone Safety," Caltrans, September 25, 2008.

http://www.workzones.ucdavis.edu/items/CA14_SNAP_080925.pdf

This document was presented to a Caltrans steering committee in July 2007 and revised in August 2008. Included are detailed action plans for the top 14 priorities, including improving enforcement (page 12), using public information to modify driver behavior (page 17), training workers (page 20) and developing new public information channels (page 25).

Implementation of the California Strategic Highway Safety Plan, State of California, April 2008.

<http://www.dot.ca.gov/hq/traffops/survey/SHSP/ISHSP-Final-04212008.pdf>

This document establishes a set of detailed actions for each of the strategies laid out in the SHSP. See page 37 of the PDF for the action items associated with Challenge Area 14: Enhance Work Zone Safety.

Connecticut

Strategic Highway Safety Plan, State of Connecticut, September 2006.

<http://www.ct.gov/dot/lib/dot/documents/dsafety/shsp.pdf>

Page 21 of the PDF begins the discussion of work zone safety. Strategies to improve work zone safety include:

- Increase motorist training and education related to work zones with the focus on younger drivers through partnerships with insurance companies, driver education schools, the department of motor vehicles and others.

- Establish a universal best practices guide for law enforcement, trade unions, associations for contractors, utility companies and insurance companies (risk management and safety oversight) in the implementation and proper use of work zone devices and traffic control patterns.
- Form a cross-functional committee (maintenance, construction) to review training content and establish uniform curriculum for an agencywide field training program.
- Enact legislation that would allocate funds from work zone enforcement activity to support the funding of safety outreach, in particular the funding of enforcement activity and training.

Florida

Strategic Highway Safety Plan, Florida Department of Transportation, February 2003.

<http://www.dot.state.fl.us/safety/TransSafEng/strategicplandocs/Strategic%20Hwy%20Safety%20Plan%2005-8-03.pdf>

Page 33 of the PDF provides FDOT's strategies to design safer work zones, including:

- Increase the usage of law enforcement officers to control speeds and enforce traffic laws in work zones.
- Continue strengthening and emphasizing training in work zone traffic control.
- Implement public information and educational activities during the annual National Work Zone Awareness Week.
- Implement improved methods to reduce the duration of work activities.

New York

New York State Strategic Highway Safety Plan, New York State Department of Transportation, 2007.

<https://www.nysdot.gov/divisions/operating/osss/highway-repository/SHSP.pdf>

A discussion of work zone safety begins on page 35 of the PDF. Strategies to reduce the number of fatal and injury crashes in work zones include:

Enforcement

- Pursue photo enforcement in work zones.
- Increase police presence in work zones (Work Zone Safety Act of 2005; see <https://www.nysdot.gov/main/business-center/consultants/forms-publications-and-instructions/engineering-information-issuance-system/ei-repository/ei06011.pdf> for a 2006 memo, Interim Implementation of Work Zone Safety Act of 2005).
- Track the effectiveness of speed trailers in the work zone.

Planning, Design and Assessment

- Increase review of work zone design.
- Continue quality assurance inspection team's rating of work zone safety.
- Improve quality control of work zone credibility (active versus inactive).
- Increase use of roadway closures and detours.
- Develop technologies to deliver real-time assessment of work zone performance.

Maryland

The Maryland Strategic Highway Safety Plan, 2006-2010, State of Maryland, September 2006.

<http://www.roads.maryland.gov/oost/SHSP.pdf>

Strategies to create safer work zones appear on page 30 of the PDF and include improving state and local collaboration and communication on work zone safety, and increasing speed enforcement in work zones.

Massachusetts

Massachusetts Strategic Highway Safety Plan, Massachusetts Highway Department, September 2006.
http://www.mhd.state.ma.us/downloads/MA%20Strategic%20Highway%20Safety%20Plan_Complete.pdf

Page 52 of the PDF addresses work zone safety for workers and drivers. Strategies described in this section include:

- Drafting standards of practice for law enforcement personnel based on construction work zone activity.
- Expanding the use of ITS technology for work zone coverage to provide more details to the motoring public and to track traffic capacity conditions.
- Developing an employee training program for field personnel on safe activity in the work zone.

Wisconsin

Wisconsin Strategic Highway Safety Plan: 2006-2008, Wisconsin Department of Transportation, October 2006.

<http://www.dot.wisconsin.gov/library/publications/topic/safety/hwy-strategic-safety-plan.pdf>

Issue Area 7: Design Safer Work Zones begins on page 35 of the PDF. This section of the document includes short- and long-term strategies that include updating guidelines, criteria and processes for work zone traffic law enforcement and deploying pilot projects sponsored by the Work Zone Management and Safety Advisory Group to collect traffic data and evaluate effectiveness of enforcement and traffic control.

Related Research

The research reports, articles and conference proceedings below consider policies and practices related to work zone safety from the following perspectives:

- Models, standards and assessments.
- Work zone design.
- Risk factors.
- Human factors.
- Speed limits in work zones.

Models, Standards and Assessments

“Improving the Safety of Mobile Lane Closures—Recommended Standards,” Douglas Steele, William R. Vavrik, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-1798, 2011. Citation at <http://trid.trb.org/view.aspx?id=1092126>

This conference paper described an investigation of driver behavior around and in moving lane closures and the effect of different components of current traffic control scenarios, including the number, configuration and spacing of shadow vehicles, and the effect of various traffic control devices and sign messages. This report, which presents results from Phase II of this project, includes recommendations for revising traffic control standards to improve the safety of mobile lane closures for highway workers and the traveling public.

Construction Project Administration and Management for Mitigating Work Zone Crashes and Fatalities: An Integrated Risk Management Model, Midwest Transportation Consortium, Iowa State University, MTC Project 2008-02, October 2009.

http://www.intrans.iastate.edu/reports/Shane_Work-Zone-Crashes_FINAL.pdf

Researchers sought to address the mitigation of work zone crashes through creation of a formal risk management model for use during the construction management and administration of highway projects for all stages of the project life cycle. Mitigation strategies may take the form of a mitigation method such as *alert motorist*, *assist worker/motorist*, *control motorist*, *inform motorist* and *protect worker/motorist*. The project produced a methodology for managers and decision makers and a checklist of hazards and mitigation strategies for each stage of the project life cycle. Researchers also provided a qualitative method to assess the likelihood and severity of a hazard or multiple hazards in a roadway work zone.

“Highway Work Zone Safety Audits at the Construction Stage,” Jonathan Shi, Zongzhi Li, Mark Snyder, *TRB 88th Annual Meeting Compendium of Papers DVD*, Paper #09-1513, 2009.

Citation at <http://trid.trb.org/view.aspx?id=881215>

This paper presented guidelines for highway work zone safety audits at the construction stage. The authors present an eight-step audit process after a brief description of the key features of a work zone safety audit. The article then focuses on the five key audit tasks performed in the audit process, including pre-audit reviews, audit meetings, audit field inspections, audit analyses and audit recommendations. Finally, a case study illustrates application of the proposed guidelines.

“Practices to Improve the Safety of Mobile and Short-Duration Maintenance Operations,” Melisa D. Finley, Brooke R. Ullman, *Transportation Research E-Circular*, No. E-C098, July 2006: 199-216.

<http://onlinepubs.trb.org/onlinepubs/circulars/ec098.pdf>

In this article, researchers examined the terminology currently used to define mobile and short-duration operations and recommended changes, developed maintenance traffic control plans for select mobile and short-duration operations, and developed guidance for choosing whether protection vehicles are needed based on roadway volume and posted speed limit. An implementation project improved and facilitated the adoption of these guidelines by the TxDOT districts by helping districts tailor the recommended maintenance traffic control plans and guidelines to characteristics of the roadways in their area.

Work Zone Design

“Exploring the Relationship between Macroscopic Speed Parameters, Road Geometrics and Traffic Control: An Empirical Study during Low-Volume Conditions in Construction Work Zones,”

Richard Jon Porter, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-1631, 2011.

Citation at <http://trid.trb.org/view.aspx?id=1092043>

In this paper, the authors described the use of a simultaneous equation modeling approach to explore the structural relationship between mean speed and standard deviation of speed while accounting for outside influences from work zone design and traffic control features. Researchers used data for model estimation collected from 17 work zones on four-lane divided freeways in Pennsylvania and Texas. Results indicate that a number of work zone design and traffic control features directly influenced both speed parameters, including work zone type, posted speed, type of roadway infrastructure, vertical alignment, total paved width, location in the work zone, presence of police enforcement, proportion of heavy vehicles, horizontal curvature and several variables reflecting roadside characteristics.

Evaluation and Implementation of Traffic Simulation Models for Work Zones, New England Transportation Consortium, Report No. NETC 05-8, June 2010.

http://www.ct.gov/dot/LIB/dot/documents/dresearch/NETCR80_05-8.pdf

Some computer simulation models used in transportation planning are specifically designed for work zone analysis, including QUEWZ, QuickZone, CORSIM and CA4PRS. This report presents case studies that compare simulation results of these models to actual work zone conditions in eight locations across

New England. Researchers use the case studies to illustrate and evaluate the models with regard to ease of use, data requirements, the ability to simulate and assess work zone strategies, reliability and accuracy, and user-friendliness. The report's summary, which begins on page 17 of the PDF, provides a detailed assessment of the benefits and challenges of the simulation tools, including areas requiring future research.

Work Zone Design and Operation Enhancements, Oregon Department of Transportation, FHWA, Final Report SPR 669, March 2010.

http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/2010/WorkZoneReport_Web.pdf?ga=t

This research aimed to identify ways to modify traffic control plans (TCPs) to improve their quality and consistency and develop suggested guidelines to follow to design, review, implement and inspect TCPs. Recommendations for modifications to the TCP process begin on page 133 of the PDF and include:

- Identify and/or place capable peer reviewers within each region.
- Maintain and enhance connections between the design teams and the regional construction offices.
- Emphasize the importance of designer experience and training.
- Formalize the review process for TCP designs that are modified in the field.
- Establish a formal process for identifying projects that have unique project features and warrant greater attention to the TCP.

The authors note that certain project characteristics present particular challenges. From page 136 of the PDF:

The research study revealed that when certain project characteristics are present, providing safety and effective traffic control is particularly challenging. Those features which had a significant impact on traffic control, in order of decreasing impact, were:

- Numerous or frequent stage changes.
- High speeds through the work zone.
- Multiple lane closures.
- Dense existing signage.
- Unique site features (i.e., horizontal or vertical curves in/before work zone).
- Traffic entering/leaving the work zone (intersections/ramps).
- Urban or night setting.
- Flagging and/or pilot car operation.
- Use of temporary striping.
- Multi-lane highways.

Improved Work Zone Design Guidelines and Enhanced Model of Travel Delays in Work Zones; Phase I: Portability and Scalability of Interarrival and Service Time Probability Distribution Functions for Different Locations in Ohio and the Establishment of Improved Work Zone Design Guidelines, Ohio Department of Transportation, Report No. FHWA/OH-2006/1, January 2006.

<http://www.dot.state.oh.us/Divisions/TransSysDev/Research/reportsandplans/Reports/2006/Traffic/14808-FR.pdf>

Researchers' nationwide survey of current work zone best practices netted responses from only two states and one Canadian province. Based on a review of the existing Ohio DOT guidelines, best practices identified in the survey responses, relevant research and the professional judgment of personnel involved in work zone activities, this report proposes a set of guidelines for work zone design. Each design element

is addressed by providing information and data on the basis for the recommendation, implementation, estimated costs, benefits and risks, and evaluations and research.

“A Simple Algorithm for Quantifying the Impact of Driver Behavior on Traffic Flow and Safety During Forced Merges in Work Zones,” Chuck Louisell, *TRB 85th Annual Meeting Compendium of Papers CD-ROM*, Paper #06-0125, 2006.

Citation at <http://trid.trb.org/view.aspx?id=776194>

This paper presented a simple and efficient algorithm that may support the advancement of microsimulation tools to assess the impact of driver behavior on traffic flow and safety in work zones. The structure of the algorithm is consistent with the approach taken in FHWA’s Interactive Highway Safety Design Model. The algorithm considers individual driver behavior from a wide range of demographic groups. The model makes use of strategic game theory to characterize the outcome of each driver-to-roadway and driver-to-driver interaction that takes place approaching and entering the work zone.

Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction, *NCHRP Report 476*, 2002.

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_476.pdf

This report provides guidelines to assist highway agencies in developing and implementing a plan for night work that will provide for public and worker safety while minimizing waste and other problems. Included are design requirements for traffic control options and the traffic control devices and safety features used in those traffic control plans.

Risk Factors

“Factors Influencing Injury Severity to Highway Workers in Work Zone Intrusion Accidents,”

Jessica M. Wong, Mary Catherine Arico, Bahram Ravani, *Traffic Injury Prevention*, Vol. 12, No. 1, 2011: 31-38.

Citation at <http://trid.trb.org/view.aspx?id=1091089>

Using 10 years of California work zone injury data, researchers conducted an analysis of highway worker injuries resulting from intrusion accidents to identify factors that would have a significant effect on injury severity. Research results indicate that work zone location, duration, time of day and worker activity can have the most significant impact on risk of injury to workers. Specific findings include:

- Work zones located on freeways/highways and stationary lane closures result in more severe injuries than work zones on city streets.
- Short-term stationary and short duration work zones had increased odds of nonminor injuries compared to mobile work zones.
- The odds of more serious injuries are higher during nonpeak hours than during peak rush hours.
- Workers on foot have greater odds of experiencing a more severe injury versus workers inside vehicles.

“Use of Empirical Bayesian Methods to Estimate Temporal-based Crash Modification Factors for Construction Zones,” Raghavan Srinivasan, Gerald L. Ullman, Melisa Dayle Finley, Forrest M. Council, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-2678, 2011.

Citation at <http://trid.trb.org/view.aspx?id=1092601>

This conference paper described the use of empirical Bayesian (EB) techniques to develop time-based construction zone crash modification factors (CMFs). Separate CMFs were estimated for various time-of-day (daytime, nighttime); work status (work activity occurring at the site, work area inactive); and temporary traffic control (temporary lane closure present, no lane closure present) conditions. Research findings include:

- Work activities requiring the temporary closure of one or more travel lanes resulted in the largest CMFs (that is, the largest increases in crashes), followed by periods of work activity that did not require a lane closure (work was occurring in the median or beyond the edge of the travel lanes).
- The lowest increase in crashes occurred during periods when work was not occurring at the project.
- The CMFs during work activity did not vary significantly between daytime and nighttime conditions when there was a lane closure.

“A Simulator Study of Precipitating Factors for Work Zone Crashes,” Deborah McAvoy, Stephen F. Duffy, Harry S. Whiting II, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-2693, 2011.

Citation at <http://trid.trb.org/view.aspx?id=1092611>

Researchers used a driving simulator to determine the impact of various factors on work zone crashes and driver performance. The primary factors included in the study were roadway type (undivided and divided); traffic density (low, moderate and high); and work zone type (lane closure and shoulder closure). Precipitating factors included elements that caused the driver behavior or the environment to change initiating the potential for a crash, near-crash or incident. Researchers exposed 45 participants to 24 different work zone configurations to collect data on performance measures of crash frequency, speed, lane deviation and deceleration. Researchers found that the most hazardous work zone configurations involves a divided roadway with a lane closure during low-density traffic conditions involving a stopped or braking truck or car.

“Characteristics of Work Zone Crashes in the SWZDI Region: Differences and Similarities,” Sunanda Dissanayake, Sreekanth Reddy Akepati, *Proceedings of the 2009 Mid-Continent Transportation Research Symposium*, August 2009.

<http://www.intrans.iastate.edu/pubs/midcon2009/DissanayakeZone.pdf>

In this conference paper, the authors summarized the work zone crash characteristics from the states currently included in the Smart Work Zone Deployment Initiative (SWZDI): Iowa, Kansas, Missouri, Nebraska and Wisconsin. Researchers gathered work zone crash data from the five states for the period 2002 to 2006, analyzing the data to identify important crash characteristics. Findings include:

- The majority of the work zone crashes occurred under clear daylight conditions and no adverse weather conditions.
- Most of the crashes in work zones occurred in the absence of traffic control devices.
- Crashes involving two vehicles are more predominant than single-vehicle crashes.
- The top three driver contributing circumstances for work zone crashes were inattentive driving, exceeding speed limit/driving too fast for conditions and failing to yield right of way.
- The majority of the work zone crashes:
 - Occurred within the posted speed limit range of 51 mph to 60 mph.
 - Resulted in property-damage-only crashes.
- At the time of the crash occurrence, the majority of the vehicles were going straight or following the road.

“Highway Work Zone Risk Factors and Their Impact on Crash Severity,” Yingfeng Li, Yong Bai, *Journal of Transportation Engineering*, Vol. 135, No.10, October 2009: 694-701.

Citation at [http://dx.doi.org/10.1061/\(ASCE\)TE.1943-5436.0000055](http://dx.doi.org/10.1061/(ASCE)TE.1943-5436.0000055)

Researchers examined work zone risk factors that could increase the probability of causing fatalities when severe crashes occur. Data examined in the study are taken from severe crashes (including fatal crashes) between 1998 and 2004 and injury crashes between 2003 and 2004 in Kansas highway work zones. Risk factors included variables describing driver characteristics, environmental conditions, crash road conditions and other crash information.

“Environmental, Driver and Vehicle Risk Analysis for Freeway Work Zone Crashes,” Rami C. Harb, Essam Radwan, Xuedong Yan, Mohamed Abdel-Aty, Anurag Pande, *ITE Journal*, Vol. 78, No. 1, January 2008: 26-30.

Citation at <http://trid.trb.org/view.aspx?id=844666>

In this article, researchers describe a project to identify the role of driver, vehicle and environmental characteristics on work zone crashes on freeways in Florida using data from the Florida crash records database. Results show that roadway geometry, cloudy weather, age, gender, lighting conditions, residence and driving under the influence of alcohol and/or drugs are significant risk factors correlated with work zone crashes.

Human Factors

Examining Driver Behavior in Response to Work Zone Interventions: A Driving Simulator Study, University of Iowa, Smart Work Zone Deployment Initiative, June 2011.

http://www.intrans.iastate.edu/smartwz/reports/WZ_DriverBehavior_June2011.pdf

Researchers demonstrated the use of driving simulators in evaluating the effect of various work zone interventions on driver performance. Twelve middle-aged (35 to 50 years) and 12 senior (65 to 80 years) participants completed six 12-minute drives in a National Advanced Driving Simulator MiniSim. Researchers measured participants’ average speed, speed variability, average lane position and lane position variability. Specific findings include:

- Participants drove the fastest and with less variability in work zones with concrete barriers.
- Drums and channelizers affected driving performance differently depending on the work zone conditions. On-road evaluations are warranted to learn whether performance differences exist for drums and channelizers and how they might affect safety in actual work zones.
- Areas of high work zone activity led to slower average speed and increased speed variability compared to low-activity areas.
- Results suggest that work zones with lengthy longitudinal buffers or intermittent areas of work activity have the potential to increase crash risk by creating more opportunities for large speed differentials to develop.

“Driver Responses to Differing Urban Work Zone Configurations,” J. F. Morgan, A. R. Duley, P. A. Hancock, *Accident Analysis & Prevention*, Vol. 42, No. 3, May 2010: 978-985.

Citation at <http://trid.trb.org/view.aspx?id=917857>

This article describes results of a simulator-based assessment of driver response to two different urban highway work zone configurations: an existing design and a second configuration that presented a reduced taper length prototype work zone design. Twenty-one drivers navigated the two work zones in two different conditions: one with a lead vehicle (a bus) and one without a lead vehicle. Researchers found that drivers navigated significantly closer to the boundary of the work area in the reduced taper length design. Results suggest that reduced taper length poses an increased risk to both drivers and work zone personnel, primarily when driver anticipation is reduced by shortened viewing distances.

“Evaluation of Work Zone Design Strategies: Quantifying the Impact of Driver Behavior on Traffic Flow and Safety,” Kevin Heaslip, John Collura, Chuck Louisell, *TRB 86th Annual Meeting Compendium of Papers CD-ROM*, Paper #07-1604, 2007.

Citation at <http://trid.trb.org/view.aspx?id=801763>

In this project, researchers applied an algorithm that considers the influence of driver behavior on traffic flow and safety when drivers encounter and respond to changing roadway conditions found in work zones. The conditions modeled by the algorithm in this research effort are lane drops and the forced merges caused by the lane drop. Central to the algorithm is the integration of two concepts: driver familiarity and driver adaptability to the changing road conditions.

Speed Limits in Work Zones

“Evaluation of Spatial and Temporal Speed Limit Compliance in Highway Work Zones,” James S. Wasson, Guy W. Boruff, Alexander Michael Hainen, Stephen Matthew Remias, Eric A. Hulme, Grant D. Farnsworth, Darcy M. Bullock, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-0731, 2011.

Citation at <http://trid.trb.org/view.aspx?id=1091555>

In this conference paper, the authors described an evaluation of the temporal and spatial effects of work zone speed limit compliance techniques over a 12-mile segment in and adjacent to a suburban interstate construction work zone using vehicle probe data. A series of comparisons were computed using space mean speed data for a day with no enforcement activity and a day with exceptionally high enforcement activity with 12 enforcement vehicles in and adjacent to the work zone. Researchers note that this study is perhaps the largest of its kind and represents an upper bound on the impact of enforcement activity on work zone speeds. Findings include:

- Although space mean speed was reduced by approximately 5 mph over the 12.2-mile study segment during the enforcement activity, within 30 minutes of suspending the enforcement detail, space mean speeds increased and there was no statistically significant residual impact on the space mean speed in the 12.2-mile segment.
- Even at the absolute peak of enforcement, all but one of the posted 45-mph segments had 75 percent of probe vehicles exceeding the posted speed limit.
- Twenty-five percent of the probe vehicles exceeded the posted limit by more than 5 mph for all 45-mph segments during peak enforcement.

“Speed Limit Effectiveness in Short-Term Rural Interstate Work Zones,” Yi Hou, Praveen Edara, Carlos Sun, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-2771, 2011.

Citation at <http://trid.trb.org/view.aspx?id=1092660>

This conference paper described efforts to update the 1996 NCHRP Research Results Digest No. 192, *Procedure for Determining Work Zone Speed Limits*. Also included in the study were field studies on three I-70 maintenance short-term work zones in rural Missouri for three different speed limit scenarios: no posted speed limit reduction, a 10-mph posted speed limit reduction and a 20-mph posted speed limit reduction. Researchers concluded that a reduction in posted speed limit was effective in reducing prevailing speeds and speed variances in Missouri.

“Field Evaluation of Motorists’ Reaction to Reduced Work Zone Speed Limits and Other Work Zone Conditions,” Melisa Dayle Finley, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-3534, 2011.

<http://docs.trb.org/prp/11-3534.pdf>

Researchers conducted field studies in Texas work zones to determine motorists’ speed choice adjacent to the conditions currently used to warrant reduced speed limits. Research results reported in this conference paper included:

- When no work zone conditions are apparent, motorists only slightly decrease their speed downstream of the work zone speed limit signs.
- Motorists do decrease their speeds in work zones when they perceive a need to; however, the amount of the speed reduction appears to be dependent upon the normal operating speed of the roadway, the imposing nature of the situation and enforcement activities.
- Some work zone conditions used to justify reduced speed limits in work zones, (for example, construction entrances, turning traffic, crash history, etc.) are not adequately perceived by motorists. These conditions require enforcement since motorists are less likely to reduce their speeds voluntarily.
- Leaving reduced work zone speed limits in place when conditions do not warrant leads to high levels of noncompliance.

Evaluation of Work Zone Speed Limits: An Objective and Subjective Analysis of Work Zones in Missouri, Smart Work Zone Deployment Initiative, Iowa State University, Mid-America Transportation Center, University of Nebraska, Report No. FHWA MO-2011-00X, February 2011.

http://www.intrans.iastate.edu/smartwz/reports/WZ_SpeedLimit_Report_Feb2011.pdf

This study analyzed the effects of lane closures (closed versus open lanes within the work zone), construction activity and lane width on free-flow speeds of passenger cars and heavy vehicles in work zones. It also evaluated drivers' compliance with the posted speed limit, both objectively and based on drivers' perceptions of their own speeds. Researchers also surveyed state DOTs to identify common work zone practices related to the posted speed limit. Findings include:

- Reduced lane width using tubular markers was the most effective factor in terms of reducing the speeds of vehicles.
- Given the safety risks of low speed limits with no work zone activity, the use of variable speed limits is recommended since it adjusts the speed limit according to the state of traffic and may reduce the risk of crashes in work zones.
- Drivers' compliance with the speed limit dropped with lower speed limits.
- The subjective evaluation determined that drivers prefer to be informed of an upcoming work zone more than a mile in advance when workers are present.
- Researchers received 27 responses to the survey of state DOTs. Among the survey results:
 - Eight-six percent of responding DOTs reduce the speed limit for activities within 2 feet of the road edge. For activities between the centerline and the edge, 26 out of 27 agencies reduce the speed limit.
 - The dominant factors in determining the reduced speed limit were presence of workers, lane width, roadway alignment and type of activity.
 - Seventy percent of respondents indicated a maximum speed limit reduction of 10 mph in work zones.
 - Most DOTs agree that the best strategy to increase compliance with the speed limit in work zones is the use of police patrol. Only 25 percent of respondents found regulatory signs effective.

“Comparison of Effects of Automated Speed Enforcement and Police Presence on Speeding in Work Zones,” Ali Hajbabaie, Rahim F. Benekohal, Madhav Vijaya Chitturi, Ming-Heng Wang, Juan C. Medina, *TRB 88th Annual Meeting Compendium of Papers DVD*, Paper #09-3651, 2009.
Citation at <http://trid.trb.org/view.aspx?id=882395>

In this conference paper, the authors compared the effects of four speed reduction techniques on the speed of vehicles in a moderate and an excessive speeding work zone on Interstate highways. The techniques included a speed trailer, police car, speed trailer plus a police car and an automated speed photo-radar enforcement van.

Results showed that in both moderately and excessively speeding sites, all forms of law enforcement treatments reduced the mean speeds and speeding significantly. Specific findings include:

- In the moderate-speeding site, the speed trailer plus a police car reduced the mean speeds more than the other treatments in both lanes.
- In the extensive-speeding site, all the law enforcement methods were similarly effective in reducing the speeding; however, 11 percent to 16 percent of free-flowing cars were still excessively speeding in the median lane.

Work Zone Speed Control, Colorado Department of Transportation, Report No. CDOT-2009-3, January 2009.

http://www.coloradodot.info/programs/research/pdfs/2009/workzonespeed.pdf/at_download/file

This study found that the most dependable method of ensuring compliance with posted work zone speed limits is through the presence of law enforcement in the work zone, citing speeders. Other recommendations arising from the study include:

- As the reduction below the normal speed limit increases, the presence of law enforcement becomes more important.
- If a long work zone is necessary, more than one officer and patrol car may be needed to ensure compliance throughout the work zone.
- Speed reductions of more than 20 mph should be used only in extreme cases. The speed limit through the work zone should be raised to the highest safe speed as soon as is practical.
- Speed reductions should be established for the shortest distance that is practical to protect workers and drivers.
- If possible, speed reduction signs for work zones should be removed when no activity is ongoing in the work zone.

“Evaluation of Strategies to Manage Speed in Highway Work Zones,” Yali Chen, Xiao Qin, David A. Noyce, *TRB 86th Annual Meeting Compendium of Papers CD-ROM*, Paper #07-2468, 2007.

Citation at <http://trid.trb.org/view.aspx?id=802232>

Researchers evaluated the performance of several speed control strategies to identify the most effective strategies under specific work zone conditions. Speed control strategies including the use of dynamic speed display boards and three enforcement methods were evaluated at Wisconsin long-term highway work zones located on State Trunk Highway (STH) 29 and STH 164, respectively. Results are promising and indicate that time of day, truck percentage and free-flow speed affected the performance of speed control strategies in work zones.

Effectiveness of Increased Law Enforcement Surveillance on Work Zone Safety in Mississippi, Mississippi Department of Transportation, FHWA, Report No. FHWA/MS-DOT-RD-06-175, July 2007. <http://www.gomdot.com/Divisions/Highways/Resources/Research/pdf/Reports/InterimFinal/SS175.pdf>
This study summarizes Mississippi DOT's efforts to document in quantitative terms the safety impact of increased law enforcement surveillance on highway construction zones in Mississippi. Results of the project's statistical analysis indicate:

- The number of citations was significantly higher with permanent presence of law enforcement.
- The longer that law enforcement agencies were present in the studied area, the lower the number of citations issued.
- There was not a strong correlation between the number of citations issued by the law enforcement agencies and the number of crashes in the studied area.
- The higher the traffic volume, the higher the number of crashes in the studied area.
- There is no statistically significant difference in the number of crashes between the period with no permanent law enforcement and the period with permanent law enforcement in the studied area.

Effectiveness of Extra Enforcement in Construction and Maintenance Zones, Final Report, Midwest States Smart Work Zone Deployment Initiative, May 2003. http://www.intrans.iastate.edu/smartwz/reports/MwSWZDI-2003-Kamyab-Effectiveness_of_Extra_Enforcement.pdf

This report includes a state-by-state analysis of enhanced fine legislation for speeding and other violations in work zones. Findings from a survey of state DOTs, a literature search and interviews with practitioners include:

- The use of extra enforcement in work zones is a common practice in many states, and these activities appear to be increasing.
- The beneficial effects of focused enforcement have not been intensively quantified.
- The study found no consistency in procedures for the use of law enforcement officers in work zones, nor in the general implementation of specific legislation addressing work zone traffic violations.
- Training of law officers prior to work zone duty does not appear to be commonly required.

Research in Progress

The three projects below examine practices in typical and short duration work zones and consider risk mitigation strategies to reduce property damage and improve safety for workers in construction and maintenance work zones.

“Evaluation of Utah Work Zone Practices,” Utah Department of Transportation, expected completion date: June 30, 2011.

<http://rip.trb.org/browse/dproject.asp?n=26394>

In this project, researchers will gather information about the current best practices in work zone design and operations in work zones across the country; a field study of work zones in Utah will augment the data collected. The research team will develop recommendations for additions to UDOT standards for temporary traffic control to increase safety and provide clear guidance to contractors for implementation.

“Risk Mitigation Strategies for Operations and Maintenance Activities,” Iowa State University, Ames, expected completion date: October 31, 2011.

<http://rip.trb.org/browse/dproject.asp?n=27447>

This research will examine how an integrated risk modeling approach could be used to reduce the frequency and intensity of loss events (property damage, personal injury, fatality) during highway operations and maintenance activities.

“State of the Practice for Workers in Very Short Duration Work Zone Operations,” Texas Department of Transportation, expected completion date: August 31, 2012.

<http://rip.trb.org/browse/dproject.asp?n=27721>

In this project, researchers will identify technologies and methods for minimizing risk to workers in very short duration work zones. With this information, researchers will develop a matrix that will determine appropriate traffic control in multiple scenarios and the recommended worker response. Project results will also include an educational module for use in training TxDOT workers in a workshop session.

Appendix A: Enhanced Fines Applicable to Work Zones

State	Citation	Link to Full Text	Violations Affected	Workers Must be Present	Signs Must be Present	Type of Enhanced Fine	
						Fixed (\$)	Multiple of Original Fine
Alabama	Code of Ala. § 32-5A-176.1	http://alisondb.legislature.state.al.us/acas/codeofalabama/1975/32-5a-176.1.htm	Speeding	Yes	Yes	N/A	2X
Alaska	Alaska Stat. § 28.90.030	http://www.legis.state.ak.us/basis/folioproxy.asp?url=http://www.wjnu01.legis.state.ak.us/cgi-bin/folioisa.dll/stattx07/query=*/doc/%7bt12854%7d	All traffic violations	No	No	N/A	2X
Arizona	A.R.S. § 28-710	http://www.azleg.state.az.us/FormatDocument.asp?inDoc=/ars/28/00710.htm&Title=28&DocType=ARS	Speeding	Yes	Yes	N/A	2X
Arkansas	A.C.A. § 27-50-408	http://www.arkleg.state.ar.us/assembly/ArkansasCode/2/27-50-408.htm	All moving traffic violations	Yes	Yes	N/A	2X
California	Cal Veh Code § 42009	http://www.dmv.ca.gov/pubs/vc/top/d18/vc42009.htm	Numerous violations specified	Yes	Yes	N/A	2X
Colorado	C.R.S. 42-4-1701	http://www2.michie.com/colorado/lpext.dll/cocode/1/6d9fa/6ed2d/6ed2f/700fc/700fd?f=templates&fn=document-frame.htm&2.0	All traffic violations	No	No	N/A	2X
Connecticut	Conn. Gen. Stat. § 14-212a	http://www.cga.ct.gov/2011/pub/chap248.htm#Sec14-212a.htm	All moving traffic violations	Yes	Yes	N/A	2X
Delaware	21 Del. C. § 4105	http://delcode.delaware.gov/title21/c041/sc01/index.shtml	Numerous violations specified	No	No	N/A	At least 2X for a first offense

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

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						Fixed (\$)	Multiple of Original Fine
District of Columbia	D.C. Code § 50-2201.04c	http://www.michie.com/dc/lpext.dll/dccode/12b4f/15cd3/16405/16407/16409/1640b/1642f?f=templates&fn=document-frame.htm&2.0#JD_50-220104c	All moving vehicle violations	Yes	Yes	N/A	2X
Florida	Fla. Stat. § 318.18	http://archive.flsenate.gov/statutes/index.cfm?mode=View%20Statutes&SubMenu=1&App_mode=Display_Statute&Search_String=318.18&URL=0300-0399/0318/Sections/0318.18.html	Speeding	Yes	Yes	N/A	2X
Georgia	O.C.G.A. § 40-6-188 (Amended by HB 296)	http://www.lexis-nexis.com/hottopics/gacode/default.asp	Speeding	Either work zone personnel or barriers, work vehicles or shoulder or pavement drop-offs	Yes	\$100 to \$2,000, up to 12 months jail, or both	N/A
Hawaii	HRS § 291C-104	http://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0291C/HRS_0291C-0104.htm	Speeding	No	No	\$250	N/A
Idaho	Idaho Code § 49-657	http://www.legislature.idaho.gov/idstat/Title49/T49CH6SECT49-657.htm	Speeding	No	Yes	\$50	N/A
Illinois	625 ILCS 5/11-605.1	http://www.ilga.gov/legislation/ilcs/iles4.asp?DocName=062500050HCh%2E+11&ActID=1815&ChapAct=625%26nbsp%3BILCS%26nbsp%3B5%2F&Cha	Speeding	No	Yes	\$375 for a first offense; \$1,000 for subsequent offenses	N/A

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

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						Fixed (\$)	Multiple of Original Fine
		pterID=49&ChapterName=VEHICLES&SectionID=28620&SeqStart=102800000&SeqEnd=125900000&ActName=Illinois+Vehicle+Code%2E					
Indiana	IC 9-21-5-11	http://www.in.gov/legislative/ic/code/title9/ar21/ch5.html	Speeding	No	Yes	\$300 for a first offense; \$500 for a second offense; and \$1,000 for a third offense within three years	N/A
Iowa	Iowa Code § 805.8A	http://coolice.legis.state.ia.us/Cool-ICE/default.asp?category=billinfo&service=IowaCode&input=805.8A	All moving vehicle violations	No	Yes	N/A	2X up to \$1,000
Kansas	K.S.A. § 8-2004	http://www.ksrevisor.org/2010/C08/8-2004.pdf	All moving vehicle violations	No	Yes	N/A	2X
Kentucky	KRS § 189.394	http://www.lrc.ky.gov/KRS/189-00/CHAPTER.HTM	Speeding	No	No	N/A	2X
Louisiana	La. R.S. 32:57	http://www.legis.state.la.us/lss/lss.asp?doc=88472	Speeding	Yes	No	N/A	2X
Maine	29-A M.R.S. § 2075	http://www.mainelegislature.org/legis/statutes/29-A/title29-Asec2075.html	Speeding	No	Yes	N/A	2X
Maryland	Md. Transportation Code Ann. § 27-101	http://www.michie.com/maryland/lpext.dll/mdcode/2390e/25939/2593b?f=templates&fn=document-	Speeding	No	Yes	Up to \$1,000	N/A

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

Appendix A: Enhanced Fines Applicable to Work Zones

State	Citation	Link to Full Text	Violations Affected	Workers Must be Present	Signs Must be Present	Type of Enhanced Fine	
						Fixed (\$)	Multiple of Original Fine
		frame.htm&2.0#JD_tr27-101 (this link is not currently operational)					
Massachusetts	ALM GL ch. 90, § 17	http://www.mass.gov/legis/laws/mgl/90-17.htm	Speeding	No	Yes	N/A	2X
Michigan	MCLS § 257.601b and MCL § 257.320a	http://www.legislature.mi.gov/(S(s1oqkge1yu4cg4fej00lpqjw))/mileg.aspx?page=getObject&objectName=mcl-257-601b&highlight=construction%20zone and http://www.legislature.mi.gov/(S(i3k1ej55ykhofrbs0ackzp))/mileg.aspx?page=GetObject&objectname=mcl-257-320a	All moving vehicle violations	No	Yes	N/A	2X + at least 3 points
Minnesota	Minn. Stat. § 169.14	https://www.revisor.mn.gov/statutes/?id=169.14	Speeding	Yes	Yes	N/A	2X or X + \$25 (whichever larger)
Mississippi	Miss. Code Ann. § 63-3-516	http://www.michie.com/mississippi/lpExt.dll?f=templates&eMail=Y&fn=main-h.htm&cp=mscode/1314f/132f4/1342c/1345a (this link is not currently operational)	Speeding	Yes	Yes	N/A	Up to \$250 for a first offense; 2X for subsequent offenses
Missouri	§ 304.582 R.S.Mo.	http://www.moga.mo.gov/statutes/C300-399/3040000582.HTM	Speeding or passing	Yes	Yes	N/A	\$250 + X for a first offense; \$300 + X for subsequent offenses
Montana	Mont. Code Anno.,	http://data.opi.mt.gov/bills/mca/	All traffic violations	Yes	Yes	N/A	At least 2X

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

Appendix A: Enhanced Fines Applicable to Work Zones

State	Citation	Link to Full Text	Violations Affected	Workers Must be Present	Signs Must be Present	Type of Enhanced Fine	
						Fixed (\$)	Multiple of Original Fine
	§ 61-8-314(5)(a)	61/8/61-8-314.htm					
Nebraska	R.R.S. Neb. § 60-682.01	http://uniweb.legislature.ne.gov/laws/statutes.php?statute=s6006082001	Speeding	Yes	Yes	N/A	2X
Nevada	NRS 484B.130	http://www.leg.state.nv.us/nrs/NRS-484B.html#NRS484BSec130	Numerous violations specified	Yes	Yes	N/A	2X up to \$1,000, 6 months jail or 120 hrs. community service
New Hampshire	RSA 265:6-a	http://www.gencourt.state.nh.us/rsa/html/XXI/265/265-6-a.htm	Speeding	Yes	Yes	\$250 to \$500	N/A
New Jersey	N.J. Stat. § 39:4-203.5	http://lis.njleg.state.nj.us/cgi-bin/om_isapi.dll?clientID=125072674&Depth=4&TD=WRAP&advquery=%2239%3a4-203.5%22&headingswithhits=on&infobase=statutes.nfo&rank=&record=%7bEB11%7d&softpage=Doc_Frame_Pg42&wordsa-roundhits=2&x=42&y=9&zz=	All moving vehicle violations	No	Yes	N/A	2X
New Mexico	N.M. Stat. Ann. § 66-7-301	http://www.conwaygreene.com/nmsu/lpext.dll/nmsa1978/9b0/20268/20dd1/20e6f/20e70?f=templates&fn=document-frame.htm&2.0#JD_66-7-301	Speeding	No	Yes	N/A	2X
New York	NY CLS Veh & Tr § 1180	http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=\$%24VAT1180%24@TXVAT01180+&LIST=LAW+&BROWSER=	Speeding	No	Yes	\$90 to \$600, up to 30 days jail, or both	N/A

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

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						Fixed (\$)	Multiple of Original Fine
		EXPLORER+&TOKEN=30008090+&TARGET=VIEW					
North Carolina	N.C. Gen. Stat. § 20-141 (Amended by SB 649)	http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_20/GS_20-141.html (http://www.ncga.state.nc.us/Sessions/2009/Bills/Senate/PDF/S649v5.pdf)	Speeding	No	Yes	N/A	Additional \$250 plus court costs
North Dakota	N.D. Cent. Code. § 39-06.1-06	http://www.legis.nd.gov/cencode/t39c06-1.pdf	Speeding	Yes	Yes	Minimum \$80	N/A
Ohio	ORC § 4511.21(P)(3) and ORC 4511.98	http://codes.ohio.gov/orc/4511.21 and http://codes.ohio.gov/orc/4511.98	Speeding	Must be during hours of actual work	Yes	N/A	2X
Oklahoma	47 Okl. St. § 11-806	http://oklegal.onenet.net/oklegal/cgi/get_statute?97/Title.47/47-11-806.html	Speeding	Yes	Yes	N/A	2X
Oregon	ORS § 811.230	http://www.leg.state.or.us/ors/811.html	Numerous violations specified	No	Yes	N/A	Minimums: misdemeanor, 20% of max. penalty; felony, 2% of max. penalty
Pennsylvania	75 Pa.C.S. § 3326	http://www.legis.state.pa.us/WU01/LI/LI/CT/HTM/75/00.033.026.000..HTM	Numerous violations specified	Yes	Yes	N/A	2X
Rhode Island	R.I. Gen. Laws §	http://www.rilin.state.ri.us/Statutes/TITLE31/31-14/31-14-	Speeding	No	Yes	N/A	2X

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

Appendix A: Enhanced Fines Applicable to Work Zones

State	Citation	Link to Full Text	Violations Affected	Workers Must be Present	Signs Must be Present	Type of Enhanced Fine	
						Fixed (\$)	Multiple of Original Fine
	31-14-12.1	12.1.HTM					
South Carolina	S.C. Code Ann. § 56-5-1535	http://www.scstatehouse.gov/code/t56c005.htm	Speeding	No	Yes	\$75 to \$200, up to 30 days jail, or both	N/A
South Dakota	S.D. Codified Laws § 32-25-19.1 and § 22-6-2	http://legis.state.sd.us/statutes/DisplayStatute.aspx?Statute=32-25-19.1&Type=Statute and http://legis.state.sd.us/statutes/DisplayStatute.aspx?Statute=22-6-2&Type=Statute	Speeding	Yes	Yes	N/A	2X up to \$500, 30 days jail, or both
Tennessee	Tenn. Code § 55-8-152(f)(2) and § 55-8-153(e)	http://www.michie.com/tennessee/lpExt.dll?f=templates&eMail=Y&fn=main-h.htm&cp=tncode/1f951/20167/2016a/202cd and http://www.michie.com/tennessee/lpExt.dll?f=templates&eMail=Y&fn=main-h.htm&cp=tncode/1f951/20167/2016a/202d2 (these links are not currently operational)	Speeding	Yes	Yes	\$250 to \$500	N/A
Texas	Tex. Transp. Code § 542.404	http://www.statutes.legis.state.tx.us/Docs/TN/hm/TN.542.htm	All moving vehicle violations	Yes	Yes	N/A	2X
Utah	Utah Code Ann. § 41-6a-209	http://le.utah.gov/~code/TITLE41/hm/41_06a020900.htm	Speeding	Yes	Yes	N/A	At least 2X
Vermont	23 V.S.A. § 1010	http://www.leg.state.vt.us/statutes/fullsection.cfm?Title=23&Chapter=013&Section=01010	Speeding	No	Yes	N/A	2X

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.

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						Fixed (\$)	Multiple of Original Fine
Virginia	Va. Code Ann. § 46.2-878.1	http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+46.2-878.1	Speeding	Yes	Yes	Up to \$500	N/A
Washington	Rev. Code Wash. (ARCW) § 46.61.527	http://apps.leg.wa.gov/RCW/default.aspx?cite=46.61.527	Speeding	No	No	N/A	2X
West Virginia	W. Va. Code § 17C-3-4b	http://www.legis.state.wv.us/WVCODE/ChapterEntire.cfm?chap=17c&art=3&section=4B#03	Speeding	Yes	Yes	Up to \$200, 20 days in jail, or both	N/A
Wisconsin	Wis. Stat. § 346.17-346.65	http://www.legis.state.wi.us/statutes/Stat0346.pdf	Numerous violations specified	Yes	No	N/A	2X
Wyoming	None						

Source: **Work Zone Traffic Laws**, Governors Highway Safety Association, June 2011 (http://www.ghsa.org/html/stateinfo/laws/sanctions_laws.html) and **Enhanced Fine Legislation in Work Zones**, The National Work Zone Safety Information Clearinghouse, last modified February 18, 2011 (http://www.workzonesafety.org/laws/state_laws/fine_legislation). Where there are discrepancies, data from the **Work Zone Traffic Laws** table are reflected here.