Integrating Speed Management
within Roadway Departure, Intersections, and Pedestrian and Bicyclist Safety Focus Areas

U.S. Department of Transportation
Federal Highway Administration

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16. Abstract Speeding contributes to nearly one-third of all roadway fatalities, and this proportion has remained largely unchanged for the past decade. Since roadway departure, intersection, and pedestrian and bicycle crashes have been identified by the Federal Highway Administration (FHWA) as the three areas with great potential to reduce fatalities, States are being encouraged to integrate speed management into these three safety focus areas. To assist agencies with integrating speed management into their policies, practices, and safety plans, this report presents information on national speeding-related crash trends, promotes a speed-related crash data analysis approach, and recommends strategies and initiatives for integrating speed management into an agency's overall policies, as well as their roadway departure, intersection, and pedestrian/bicyclist safety programs.			
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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
BAC	Blood Alcohol Concentration
CMF	Crash Modification Factors
CRF	Crash Reduction Factors
CV	Connected Vehicle
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
GES	General Estimation System
HAWK	High Intensity Crosswalk
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
ICWS	Intersection Collision Warning System
IHSDM	Interactive Highway Safety Design Model
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program
NDS	Naturalistic Driving Study
NHS	National Highway System
NHTSA	National Highway Traffic Safety Administration
PEDSAFE	Pedestrian Safety Guide and Countermeasure Selection System
RCUT	Restricted Crossing U-turn Intersection
RRFB	Rectangular Rapid Flash Beacon
RSAP	Roadside Safety Analysis Program
SHRP	Strategic Highway Research Program
SHSP	State Highway Safety Plan
TZD	Towards Zero Deaths
USDOT	United States Department of Transportation
V2I	Vehicle to Infrastructure
V2P	Vehicle to Pedestrian

EXECUTIVE SUMMARY

Speeding, defined as traveling too fast for conditions or in excess of the posted speed limits, contributes to nearly one-third of all roadway fatalities, and this proportion has remained largely unchanged for the past decade. Practitioners and communities working to reduce speeding-related crashes need the latest information and tools to guide their efforts. Since roadway departure, intersection, and pedestrian and bicycle crashes have been identified by the Federal Highway Administration (FHWA) as the three areas with great potential to reduce fatalities, States are encouraged to integrate speed management into these three safety focus areas. In order to assist agencies with integrating speed management into their policies, practices, and safety plans, this report presents information on national speeding-related crash trends, promotes a speed-related crash data analysis approach, and recommends strategies and initiatives for integrating speed management into both an agency's overall policies as well as its roadway departure, intersection, and pedestrian and bicyclist safety programs.

This project's objectives were as follows:

- Investigate current practices of speed management at State and local levels within roadway departure, intersection, and pedestrian safety focus programs;
- Conduct an analysis of national crash data to identify speeding-related safety issues within the three safety focus programs;
- Identify gaps and needs for effectively managing speed to improve roadway departure, intersection, and pedestrian and bicyclist safety; and
- Develop strategies, approaches, and activities agencies can use to integrate speed management within roadway departure, intersection, and pedestrian and bicyclist safety activities.

There is a wide variety of policies, practices, and procedures regarding speed management across the United States. Some States have their own manual of uniform traffic control devices, traffic studies manuals, guidelines, or other policies and procedures regarding speed management. Others do not have jurisdiction-specific speed management policies or guidance available to their practitioners. Many State and local agencies lack documentation regarding the methods or procedures to identify speeding-related crash problems within the roadway departure, intersection, and pedestrian safety focus areas. With regard to Strategic Highway Safety Plans (SHSP), all States reference speeding in their plans, although mostly in the context of enforcement and aggressive driving. Several States list roadway departure, intersections, and pedestrian safety as emphasis areas, but most of those States do not include a specific mention of speeding as a factor contributing to crashes, nor do they identify speeding-related countermeasures. Therefore, there are opportunities for agencies to enhance their speed management programs, whether by improving their policies on setting speed limits, defining their speeding-related data analysis process, or incorporating more speed management techniques or countermeasures within their safety action plans.

Agencies are encouraged to take a broad look at their policies and programs related to speed to identify opportunities on how speed management can be more fully integrated by considering the following program-level strategies:

- Establish or enhance policies, safety plans, and performance measures,
- Educate and improve awareness,

- Collaborate with stakeholders, and
- Establish data analysis process for analyzing speeding-related data.

In addition to program-level strategies, roadway departure, intersections, and pedestrian and bicyclist focus areas are a vital link in managing speed and targeting speeding-related crashes. By reviewing the results of this research project's crash analysis report,[1] investigating the state of the practice, and conducting interviews with national experts, researchers have been able to identify key issues relating to speeding-related crashes in each focus area and present potential strategies to assist agencies in addressing speeding-related crashes within those focus areas.

Overall, speeding is a complex problem involving the interaction of many factors such as public attitudes, vehicle performance, roadway design, posted speed limits, and enforcement strategies, to name a few. For a State or local agency to manage speed successfully, it must integrate and coordinate engineering, enforcement, and education efforts. This requires numerous techniques and cooperation among multiple groups to effectively accomplish the goal of reducing speeding-related fatalities and injuries. State and local agencies must integrate speed management strategies within their organization, policies, and each of the three focus areas in order to meet their safety goals.

1 See Appendix A, Evaluation of the Role of Speeding in Crashes and Safety-critical Events.

Chapter 1. Introduction

"NHTSA considers a crash to be speeding-related if the driver was charged with a speeding-related offense or if an officer indicated that racing, driving too fast for conditions, or exceeding the posted speed limit was a contributing factor in the crash."

National Highway Traffic Safety Administration

Over the past decade, the United States has made great strides in reducing roadway fatalities, which fell from more than 42,000 in 2003 to approximately 33,000 in 2013. While the reduction in fatalities is significant and to be commended, additional focus on speed management is needed to continue the trend. Reducing fatalities and severe injuries on the Nation's transportation system is directly impacted by the effort agencies put into managing roadway speed. Speeding is a key factor in many safety areas, including impaired driving, unbelted drivers, distracted drivers, motorcycles, pedestrian safety, roadway departure, intersection safety, and truck rollovers. Speeding contributes to nearly one-third of all roadway fatalities, and this proportion has remained largely unchanged for the past decade. Practitioners and communities working to reduce speeding-related crashes need the latest information and tools to guide their efforts.

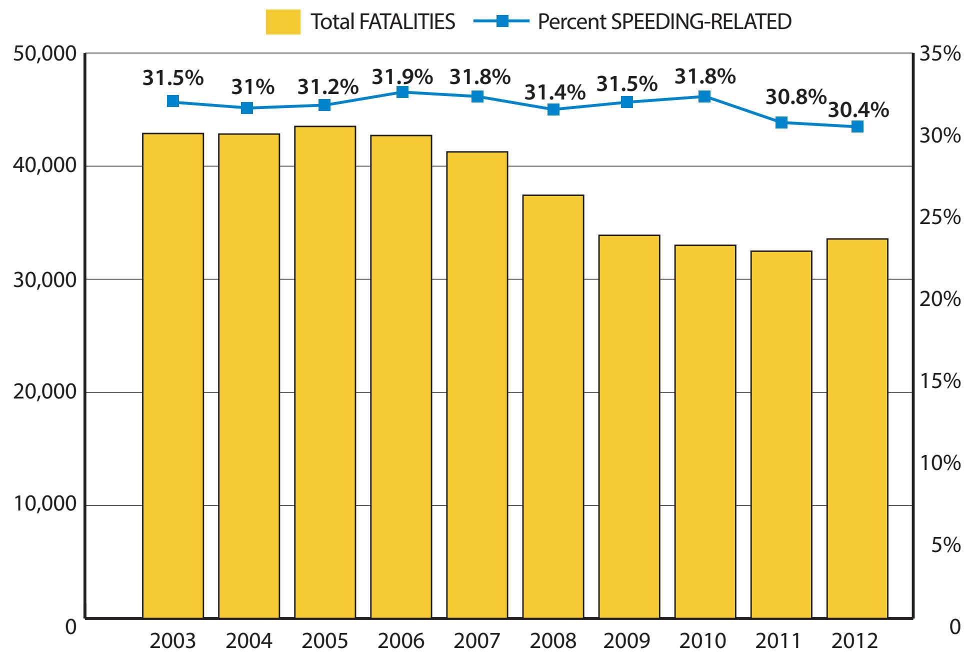

Figure 1 - Trend in Fatalities and Speeding-related Fatalities in the United States (Source: FARS, 2003 to 2012)

Excessive speeding is a key crash contributor that must be addressed in order to continue the advancement Toward Zero Deaths (TZD), the national vision for safety. Therefore, it is essential that agencies examine gaps and needs related to speed management and identify and explore new approaches to addressing speeding-related issues.

Roadway departure, intersection, and pedestrian and bicycle crashes have been identified by the Federal Highway Administration (FHWA) as the three focus areas with great potential to reduce fatalities. Many States have incorporated the three focus areas into their State Highway Safety Plans (SHSP) and, as the next step, FHWA is encouraging States to integrate speed management into these three safety focus areas.

To assist agencies with integrating speed management into their policies and practices, this report presents information on national speeding-related crash trends, promotes a speed-related crash data analysis approach, and recommends strategies and initiatives for integrating speed management into roadway departure, intersection, and pedestrian and bicyclist safety programs.

Figure 2 – Integrating Speed Management with the Three Focus Areas Can Help Transportation Agencies Move Towards Zero Deaths, the National Vision for Safety

1.1 Speed Management and the Three Focus Safety Areas

Speeding is a complex problem, involving the interaction of many factors including public attitudes, sentiments and culture; road user behavior; vehicle performance; roadway design; traffic characteristics; weather conditions; posted speed limits; enforcement strategies; and legislative and judicial decisions. For a State or local agency to successfully manage speed, it must integrate and coordinate engineering, enforcement, and education efforts. The effort requires numerous processes and cooperation among multiple groups to effectively accomplish the goal of reducing speeding-related fatalities and injuries.

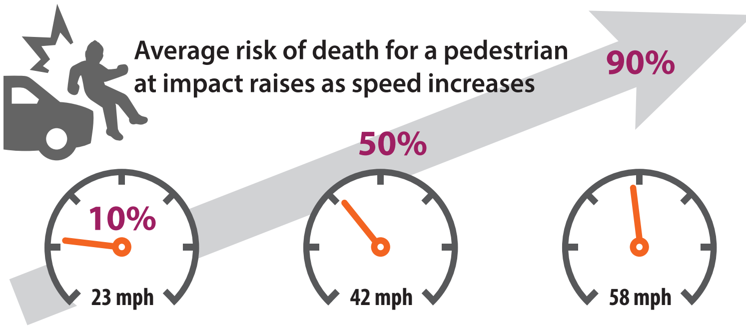

Figure 3 – Pedestrian's Risk of Death Relating to Impact Speed

Roadway departure, intersection, and pedestrian and bicycle crashes collectively contribute to an overwhelming 90 percent of the traffic fatalities in the United States.[2] Speeding contributes to nearly 30 percent of all traffic fatalities and reaches into all three of the focus areas.[3] Nearly 40 percent of fatal roadway departure crashes and 20 percent of fatal intersection crashes are speeding-related.[4] Although the percentage of speeding-related pedestrian and bicyclist fatalities is less than 10 percent,[5] travel speed at impact greatly influences the severity of pedestrian crashes, as illustrated in Figure 3.[6] Integrating a speed management component into each of the three focus areas is essential for State and local agencies to meet their safety goals.

Research Objectives

- *Investigate current practices of speed management at State and local levels within the three focus areas of roadway departure, intersection, and pedestrian safety focus programs.*
- *Conduct an analysis of national crash data to identify speeding-related safety issues within the three safety focus programs.*
- *Identify gaps and needs for effectively managing speed to improve roadway departure, intersection, and pedestrian and bicyclist safety.*
- *Develop strategies, approaches, and activities agencies can use to integrate speed management within roadway departure, intersection, and pedestrian and bicyclist safety activities.*

1.2 Research Methodology

This project supports the USDOT Speed Management Program Plan,[7] which was developed jointly by the National Highway Traffic Safety Administration, FHWA, and Federal Motor Carrier Safety Administration in order to improve public health and safety by reducing speeding-related fatalities and injuries.

The research for this project took place in multiple phases.[8] In Phase 1 researchers scanned and documented practices and processes used by State and local agencies, focusing on how speeding-related problems and issues are identified; what approaches are used for speeding-related data collection and analysis; and which engineering-, enforcement-, and education-related speed management counter-measures practitioners use to tackle speeding-related safety issues. The state of the practice is summarized in Chapter 2.

2 FHWA Office of Safety Web site, "Focused Approach to Safety– Purpose of the Focused Approach." Available at: http://safety.fhwa.dot.gov/fas/ (accessed December 8, 2015).

3 Fatality Analysis Reporting System (FARS) 2004-2012.

4 See Appendix A, Evaluation of the Role of Speeding in Crashes and Safety-critical Events.

5 See Appendix A, Evaluation of the Role of Speeding in Crashes and Safety-critical Events.

6 AAA Foundation, Impact Speed and a Pedestrian's Risk of Severe Injury or Death (Washington, DC: AAA, September 2011). Available at: https://www.aaafoundation.org/sites/default/files/2011PedestrianRiskVsSpeed.pdf

7 National Highway Traffic Safety Administration, Federal Highway Administration, and Federal Motor Carrier Safety Administration, Speed Management Program Plan, Report No. DOT HS 812 028 (Washington, DC: May 2014).

8 At the start of this research project, the focus areas identified by FHWA were roadway departure, intersections, and pedestrians. During the course of the project, the focus areas were updated in July 2015 to roadway departure, intersections, and pedestrians and bicyclists. Memorandum available at: http://safety.fhwa.dot.gov/fas/docs/signed_memo2015.pdf

Phase 2 of the research involved conducting detailed analyses of speeding-related fatal and serious injury crash data to evaluate the role of speeding in crashes or other safety-critical events. The first analysis included a summary of the characteristics of speeding-related crashes using crash data from the Fatality Analysis Reporting System (FARS) and the General Estimation System (GES). Researchers also explored the characteristics of speeding-related fatal crashes for the three focus areas (roadway departure, intersections, and pedestrians and bicyclists). The final analysis included existing summarized data from the Strategic Highway Research Program 2 (SHRP2) large-scale naturalistic driving study (NDS). The research team extracted baseline and safety-critical events from the InSight Data Access Website, comparing them to assess the role of speed. Additionally, the research team conducted a typology of characteristics for safety-critical events. The full report from the comprehensive data analysis is included in Appendix A.

In the final phase, the research team held individual interviews and safety focus group discussions with Federal, State, and local practitioners to investigate major speed management issues and to identify gaps for addressing roadway departure, intersection, and pedestrian and bicyclist safety problems. In addition, researchers identified new or enhanced initiatives for integrating speed management into each of the three focus areas. The list of members for each safety focus group, the one-on-one interview questions, and the group's discussion agenda are available in Appendix B.

By using the information gained through these steps of the research project, the team identified strategies, approaches, and activities agencies can use to integrate speed management in their overall program and within roadway departure, intersection, and pedestrian and bicyclist safety activities.

Some additional resources are provided in Appendix C that may be useful for transportation agencies to consider when preparing their speed management strategies. A list of gaps and needs relating to speed management, effectiveness of countermeasures, and speeding-related crash risks emerged during the comprehensive literature review, crash data analysis, and focus group interviews. These are presented in Appendix D.

1.3 Organization of Report

This chapter of the report, **Chapter 1 – Introduction,** provided an introduction and background information on the research effort that resulted in this document. It also introduces the relationship between speed management and the safety focus areas, including the methodology of the research.

Chapter 2 – Speed Management State of the Practice. This section gives readers an overall summary of the current state of the practice relating to agencies' speed management approaches and integration into the safety focus areas.

Chapter 3 – Program Level Strategies for Integrating Speed Management. Here, readers are introduced to program-level strategies on how speed management can be integrated throughout the planning, project development, construction, and maintenance stages, and how such strategies can be institutionalized through policy.

Chapter 4 – Integrating Speed Management within the Three Safety Focus Areas. This chapter provides an overview of national crash trends involving speeding-related fatal crashes and suggests potential strategies to assist agencies in addressing speeding-related crashes within each focus area.

Chapter 5 – Conclusion, reinforces the importance of integrating speed management into the roadway departure, intersection, pedestrian and bicyclist focus areas, while recognizing there are opportunities in research and other initiatives to further enhance existing speed management strategies.

Chapter 2. Speed Management State of the Practice

Understanding the current state of the practice can help practitioners both to identify gaps and needs within an agency's speed management policies and practices as well as to select successful strategies for addressing speed-related crashes.

2.1 Policies and Procedures

There is a wide variety of policies, practices, and procedures regarding speed management across the United States. Some States have their own manual of uniform traffic control devices, traffic studies manuals, guidelines, or other policies and procedures regarding speed management. Others do not have jurisdiction-specific speed management policies or guidance available to their practitioners.

When States develop their own manual on uniform traffic control devices or supplement the national version, they often include additional guidance on setting speed limits or placing signs and markings. For example, Arizona Department of Transportation (DOT) developed a supplement to the national Manual on Uniform Traffic Control Devices and added information on items such as photo enforcement, speed hump markings, and additional guidelines on school zones. Florida DOT created *Speed Zoning for Highways, Roads, and Streets in Florida*, a manual that provides guidelines and recommended procedures for establishing uniform speed zones on roadways throughout the State. Massachusetts DOT also has established procedures for speed zoning on State and municipal roadways. Iowa DOT has an online traffic and safety manual that includes information on the process for establishing speed limits and completing speed studies.

Some transportation agencies have gone further and created their own traffic calming manuals or handbooks, which provides detailed guidance regarding the appropriate use, design, and implementation of traffic calming measures. Delaware DOT's manual is intended to help encourage closer adherence to posted speeds, discourage cut-through traffic, and enhance user safety and community aesthetics. Pennsylvania's *Traffic Calming Handbook* provides guidance for the State DOT and municipalities for implementing traffic calming measures throughout the State.

Overall, while many States have developed general speed management policies and guidance on setting speed limits and completing speed studies, researchers identified many State and local agencies that lacked documentation regarding the methods or procedures to identify speeding-related crash problems within the roadway departure, intersection, and pedestrian safety focus areas.

2.2 Safety Plans and Focus Areas

With regard to State Strategic Highway Safety Plans (SHSP), all States reference speeding in their plans, although mostly in the context of enforcement and aggressive driving. Several States list roadway departure, intersections, and pedestrians as emphasis areas, but most of these do not include a specific mention of speeding as a contributing factor, nor do they identify speeding-related countermeasures.

The following summary is based on information available as of January 2015.

Fifteen States included speed management actions in their SHSP as part of a roadway departure emphasis area. These states apply strategies such as:

- Targeted corridor education and enforcement
- Advance warning signs
- Flashing beacons
- Curve markings on pavement
- Rumble strips
- Safety Edge $_{SM}$[9]
- Transverse lines with decreasing spacing
- Edge lines for lane narrowing.

Nine States included speed management actions as part of their intersection emphasis area. These states utilize strategies such as:

- Targeted speed enforcement
- Implementation of automated enforcement
- Education and outreach
- Pavement friction improvements at locations with wet pavement crash history
- Advanced warning flashers to inform drivers of a need to stop at high speed signalized intersections
- Rural intersection warning and decision support systems
- Roundabouts
- Installation of medians within the influence of intersection approaches.

Seven States included speed management actions as part of their strategic plans for pedestrians. These states employ strategies such as:

- Installation of medians near intersections
- Clearly marked crosswalks
- High intensity activated crosswalk beacons
- Rectangular rapid flash beacons
- Traffic calming techniques (e.g., speed humps, bulb-outs, street trees, on-street parking)
- Road Diets
- Education and outreach.

The attention to speeding issues varies widely across the State SHSPs, with some States providing minimum mention of speeding as part of a broader aggressive driving focus, and others providing greater details and targets related to speeding-related crashes.

In recent years, more than 20 State DOTs and a number of local agencies have developed focused safety action or implementation plans. FHWA continues to support development of State-level Roadway Departure Action Plans and Intersection Action Plans – efforts that began in 2008. Each plan includes analysis of speeding-related crashes and recommends engineering, enforcement, and education countermeasures to reduce speeding-related roadway departure or intersection-related crashes. The

9 Safety Edge$_{SM}$ provides a transition for vehicles to return to the pavement more smoothly and easily by shaping the edge of pavement to 30 degrees and eliminating vertical drop-off. More information on Safety Edge$_{SM}$ is available at http://www.fhwa.dot.gov/everydaycounts/technology/safetyedge/intro.cfm.

plans estimate the cost of these strategies and the benefits of each in terms of reduced annual traffic crashes, severe injuries, and fatalities. To date, FHWA has led development of more than 35 of these plans.

Many State DOTs and local communities recognize the need to address pedestrian crashes and have developed pedestrian action plans which include a range of countermeasures to reduce pedestrian-motor vehicle crashes. Although speed reduction is a significant focus of these pedestrian action plans, some plans are more robust than others.

2.3 Research Publications and Guidance

Many research publications and guidance documents address speed management, speeding-related crashes, and speeding countermeasures in general, but the relevance to the three focus areas varies. The FHWA Office of Safety - Speed Management website contains links to resources and a wide range of engineering measures for managing speed in addition to each's effect on speed and safety.[10] Other available literature, such as *NCHRP Report 500 – Volume 23: A Guide for Reducing Speeding-related Crashes*, provides solid guidance regarding engineering and law enforcement strategies and countermeasures to reduce the risk of speeding-related crashes.[11] For a more comprehensive list of speed management-related resources, see Appendix C.

2.4 Future Opportunities

In summary, there are many opportunities for agencies to enhance their speed management programs, whether by improving policies on setting speed limits, defining speeding-related data analysis process, or incorporating more speed management techniques or countermeasures within safety action plans. Additional information on how to identify and deploy strategies that will support the goal of enhancing speed management programs is discussed in Chapter 3.

10 FHWA Office of Safety, "Speed Management Safety" Web page. Available at: http://safety.fhwa.dot.gov/speedmgt/. Accessed December 8, 2015.

11 T.R. Neuman, K.L. Slack, K.K. Hardy, V.L. Bond, et al. NCHRP 500 – Volume 23: A Guide for Reducing Speed-Related Crashes, Transportation Research Board of the National Academies, (Washington, DC: TRB, 2009). Available at: http://www.trb.org/Main/Blurbs/160862.aspx.

Chapter 3. Program Level Strategies for Integrating Speed Management

Prior to exploring the detailed, specific strategies for managing speed within the three safety focus areas, FHWA encourages agencies to take a broad look at their speeding-related policies and programs to identify opportunities for integrating speed management throughout the planning, project development, construction, and maintenance stages and for institutionalizing speed management through agency policy.

There are a number of program-level strategies agencies may pursue. These are identified and discussed below.

What is USLIMITS2?

USLIMITS2 is a web-based tool designed to help give advice to practitioners about setting reasonable, safe, and consistent speed limits for specific segments of roadway. It is applicable to all types of roads, from rural local roads and residential streets to urban freeways. For additional information, visit http://safety.fhwa.dot.gov/uslimits.

3.1 Establish or Enhance Policies, Safety Plans, and Performance Measures

There is potential for agencies to more fully integrate speed management into their practices by establishing or enhancing their policies, safety plans, and performance measures. Elevating speed management as a primary strategy to support a broad vision for safety will create positive safety outcomes.

- Establish speed management policies that create a clear direction for practitioners within the organization. Policies may include disseminating technical information on the importance of establishing appropriate speeds for all types of roads in the network, conducting assessments, and monitoring existing speed limits, the role of speed in crash severity, and the effect of speeding on the environment (e.g., fuel consumption, emissions, and noise). Agencies may also choose to enact more detailed policies such as jurisdiction-wide guidance on the applications of specific speed management countermeasures.
- Establish procedures for setting speed limits by conducting engineering speed studies using an established, uniform protocol across the agency and employing the USLIMITS2 web-based tool to support and confirm speed limit setting decisions.
- Set performance goals and metrics related to speed management (e.g., reducing the number of speeding-related fatalities and severe injuries, reducing top-end speeders).
- Develop a jurisdiction-wide speed management action plan.
- Review all current agency safety plans (e.g., SHSP; roadway departure, intersection, and pedestrian safety implementation plans; etc.) to identify opportunities to integrate speed management.
- Integrate speed management programs with related highway safety activities, such as programs to combat impaired driving and safety initiatives targeted at youths, motorcyclists, and commercial vehicle operators.

3.2 Educate and Improve Awareness

Many people do not fully understand speed concepts, the basis of speed limits, reasons for speed management countermeasures, or the effect of speed on safety and crash risk. Agencies need to employ diverse training and outreach strategies to educate a variety of groups.

- Educate staff on speed management (include planners, designers, construction inspectors, traffic engineers, and maintenance personnel):[12]
  - Explain speed definitions and concepts; how to set speed limits, choose design speed, and select appropriate speed management countermeasures
  - Incorporate speed management learning modules within other established training programs
  - Educate staff throughout the entire lifecycle of the project development process on the importance of context sensitivity awareness (e.g., types of users, surroundings, functional classification, etc.); design features (e.g., curves, intersections); and countermeasures affecting speed.
- Make speed management/awareness a priority throughout all phases of a project by developing speed management checklists.
- Review and evaluate current communication/outreach strategies to ensure speed management is represented and look for ways to integrate speed management messages within other focus areas.
- Determine whether a particular group needs a larger focus or more education on speeding-related issues by analyzing the speeding-related crashes by:
  - Driver characteristics
  - Location within the jurisdiction
  - Contributing circumstances
  - Crash type (e.g., roadway departure, intersection-related)
  - Driver behaviors.
- Develop specific education campaigns focused on partners, such as:
  - Judges and prosecutors
  - Elected officials
  - Law enforcement
  - Corporations
  - Education community (e.g., teachers, administrators, volunteer groups)
  - Other special interest groups.
- Develop and target public information and education programs to specific aspects of the speeding problem based on data analysis. Some common aspects may include the following:
  - Young drivers
  - Males
  - Nighttime crashes
  - Adverse weather and traffic conditions

12 NHTSA sponsors a Speed Program Management course that is conducted by the Transportation Safety Institute.

- Impaired driving
- School zones
- Work zones
- Roads and streets with major potential conflicts in traffic and with pedestrians.

3.3 Collaborate with Stakeholders

Stakeholder involvement and collaborative arrangements are vital for improving transportation safety by building trust, understanding, and comprehensive solutions.

- Gather input from groups outside the transportation agency (e.g., pedestrian and bicyclist groups, special community groups, law enforcement, public officials, schools, etc.) when making decisions on speed limits.
- Collaborate internally and with partner agencies to improve speeding-related data, such as:
  - Improve data collection and analysis by combining speeding-related data across other organizations and databases,
  - Examine the types of data relating to speed currently being captured and identify areas for improvement (e.g., inventories for speed limits, curves, etc.),
  - Join together with law enforcement to determine the definition of speeding-related crashes and ensure the crash type is consistently reported. Review the law or statute that defines speeding-related crash to determine whether it can be revised for clarity.
- Assist law enforcement in their patrol efforts by identifying high-crash locations where speeding was a contributing factor.
- Collaborate with law enforcement and the judicial system to ensure speed limit violations or citations are consistent; gather input on their perspectives regarding specific speed limits.
- Proactively work with elected officials to promote speeding-related legislation.
- Work together with local agencies and/or neighboring States to share best practices, success stories, and lessons learned regarding speed management by holding peer exchanges or conferences.

3.4 Establish Data Analysis Process for Analyzing Speeding-related Crash Data

Many agencies do not have an established process for analyzing their speeding-related crash data. Using the national crash analysis report as the base model, States can replicate the process using their own crash data to begin identifying State-specific trends and can compare the results to national data.[13] Analyzing speeding-related crash data within the focus areas allows agencies to effectively enhance their existing focus area safety plans with appropriate speed management countermeasures and strategies.

Speeding-related Roadway Departure Crashes

- Roadway characteristics - analyze the percentage or distribution of vehicles involved in speeding-related roadway departure crashes by:
  - Roadway type

13 For more information, the crash analysis report, Evaluation of the Role of Speeding in Crashes and Safety Critical Events, is included in Appendix A.

- Speed limit
- Speed limit (only non-vehicle collisions)
- Horizontal Alignment.

- Driver characteristics - analyze the percentage or distribution of vehicles involved in speeding-related roadway departure crashes by:
  - Age and gender
  - Blood alcohol concentration (BAC).
- Environmental characteristics - analyze the percentage or distribution of vehicles involved in speeding-related roadway departure crashes by:
  - Time of day
  - Hour of day
  - Surface conditions.
- Vehicle type
- Crash type (e.g., non-vehicle collision, front-to-front, front-to-rear, angle, sideswipe)
- First harmful event (e.g., tree, rollover, culvert/ditch/embankment, etc.)
- Characteristics of a specific type of crash, for example:
  - Rollover crashes (by speed limit, BAC, surface condition, or vehicle type)
  - Opposing direction crashes (by speed limit, BAC, surface condition, or vehicle type).

Speeding-related Intersection Crashes

- Roadway characteristics - analyze the percentage or distribution of vehicles involved in speeding-related fatal intersection crashes by:
  - Traffic control
  - Intersection type
  - Roadway type
  - Speed limit.
- Driver characteristics - analyze the percentage or distribution of vehicles involved in speeding-related fatal intersection crashes by:
  - Age and gender
  - Blood alcohol concentration (BAC).
- Environmental characteristics - analyze the percentage or distribution of vehicles involved in speeding-related fatal intersection crashes by:
  - Time of day
  - Hour of day
  - Surface conditions.
- Vehicle type
- Crash type (e.g., non-vehicle collision, front-to-front, front-to-rear, angle, sideswipe)

- First harmful event (e.g., tree, rollover, culvert/ditch/embankment, etc.)
- Characteristics of a specific type of crash, for example:
  - Angle crashes (by speed limit, BAC, surface condition, or vehicle type)
  - Rear-end crashes (by speed limit, BAC, surface condition, or vehicle type)
  - Left-turn crashes (by speed limit, BAC, surface condition, or vehicle type).

Speeding-related Pedestrian and Bicycle Crashes

- Roadway characteristics - analyze the percentage or distribution of vehicles involved in speeding-related pedestrian and bicycle crashes by:
  - Location
  - Roadway type
  - Speed limit.
- Driver characteristics - analyze the percentage or distribution of vehicles involved in speeding-related pedestrian and bicycle crashes by:
  - Age and gender
  - Blood alcohol concentration (BAC).
- Environmental characteristics - analyze the percentage or distribution of vehicles involved in speeding-related pedestrian and bicycle crashes by:
  - Time of day
  - Hour of day.
- Vehicle type.

Chapter 4. Integrating Speed Management within the Three Safety Focus Areas

With roadway departure, intersections, and pedestrian and bicycle crashes accounting for approximately 90 percent of the traffic fatalities in the United States, these key focus areas are a vital link in managing speed and targeting speeding-related crashes.[14] Using the results of this research project's crash analysis report,[15] this chapter includes crash trends involving speeding-related fatal crashes and potential strategies to assist agencies in addressing speeding-related crashes within each focus area. While each focus area and its respective strategies are listed in separate sections within Chapter 4, FHWA encourages agencies to use a combination of strategies since speeding-related crash issues often overlap into multiple focus areas. Overall program-level strategies (non-focus area specific) are listed in Chapter 3.

4.1 Roadway Departure and Speed Management

A roadway departure crash is defined by FHWA as "a crash which occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way."[16]

Roadway departure crashes are frequently severe and account for the majority of highway fatalities. In 2013, there were 18,257 fatalities as a result of roadway departure crashes, which accounted for 56 percent of the traffic fatalities in the United States.[17] Approximately 40 percent of fatal roadway departure crashes are speeding-related.[18]

4.1.1 National Crash Data Analysis Trends

Crash analysis performed on national data relating to speeding-related and roadway departure crashes gives insight into the nature of these crash types, where these crashes occur, and driver characteristics or behavioral elements that may affect the number and severity of these crashes.

The FHWA Safety Roadway Departure Program analyzed Fatality Analysis Reporting System (FARS) and General Estimation System (GES) data (2010-2013) and determined there are three primary event types that are most harmful in 75 percent of all roadway departure crashes:

- Overturn/rollover crashes
- Opposing direction crashes
- Crashes involving trees.

14 FHWA Office of Safety, "Focused Approach to Safety – Purpose of the Focused Approach" Web page. Available at: http://safety.fhwa.dot.gov/fas/. Accessed December 8, 2015.

15 See Appendix A, Evaluation of the Role of Speeding in Crashes and Safety-critical Events.

16 FHWA Office of Safety, "Roadway Departure Safety" Web page. Available at: http://safety.fhwa.dot.gov/roadway_dept/. Accessed December 8, 2015.

17 Ibid.

18 See Appendix A, Evaluation of the Role of Speeding in Crashes and Safety-critical Events.

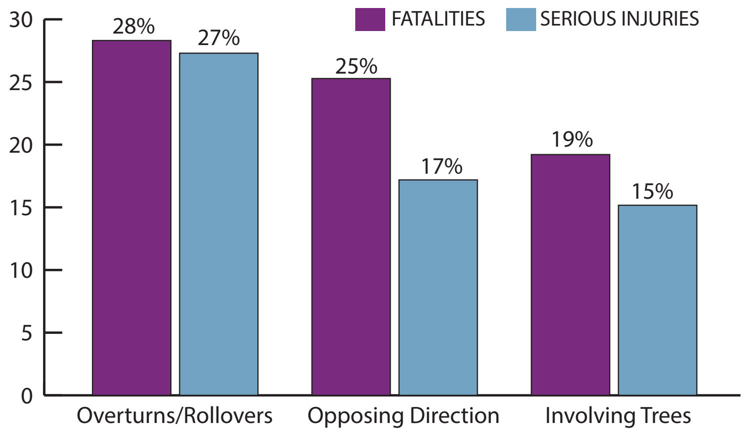

Figure 4 – Percent of Roadway Departure Fatalities and Serious Injuries by Crash Type (FARS and GES 2010-2013)

These top three crash types have been designated as primary emphasis areas and researchers determined speed is one of the contributing factors. Each crash category underwent further analysis to determine where these crashes occur and significant contributing factors. Figures 5 through 7 show the results.

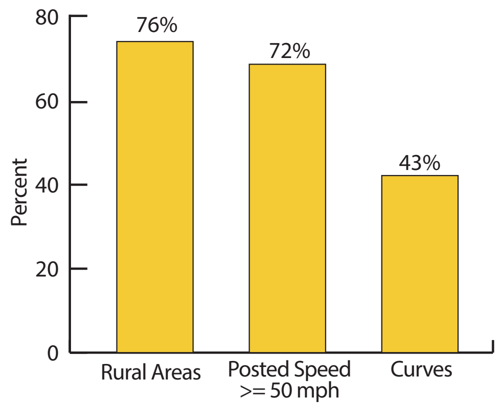

Figure 5– Critical Locations for Rollover/Overturn Roadway Departure Crashes (Source: FARS 2010-2013)

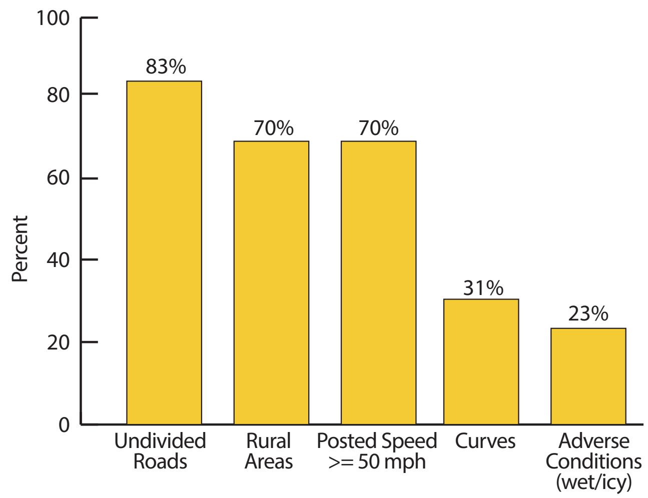

Figure 6– Critical Locations for Opposing Direction Roadway Departure Crashes (Source: FARS 2010-2013)

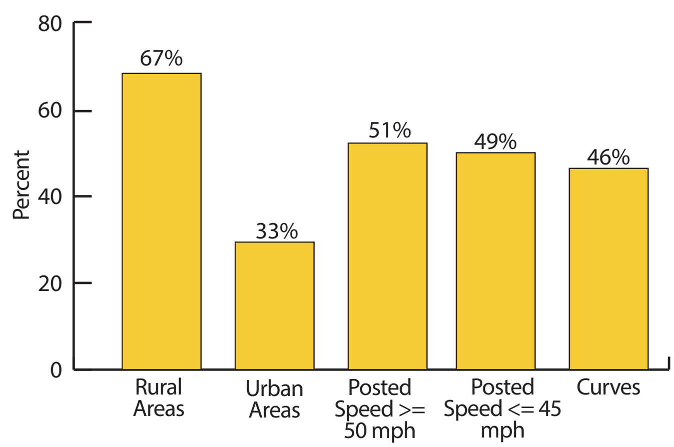

Figure 7– Critical Locations for Roadway Departure Crashes Involving Trees (Source: FARS 2010-2013)

While the data above focuses more broadly on roadway departure crashes (not necessarily speeding-related), the following sections present some crash trends for speeding-related roadway departure crashes.

ROADWAY FUNCTIONAL CLASS

Initially, some may be surprised to learn that the majority of fatal speeding-related roadway departure crashes do not happen on Interstates and freeways. In fact, 85 percent of vehicles involved in these fatal crash types were traveling on local, collector, minor arterial, or other principal arterial roadways, as shown in Figure 8.

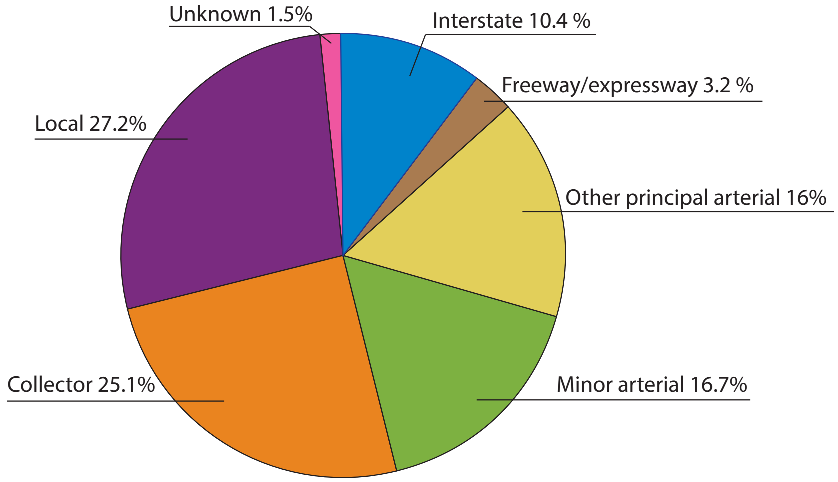

Figure 8 – Distribution of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Type of Roadway (Source: FARS 2010-2012)

The following figure shows the percentage of vehicles involved in these types of crashes that were speeding and non-speeding by roadway type during the 2010-2012 period. Nearly half of all vehicles involved in fatal roadway departure crashes on local roads are speeding-related. Other principal arterials and interstates ranked lowest at 32.4 percent and 33.8 percent, respectively.

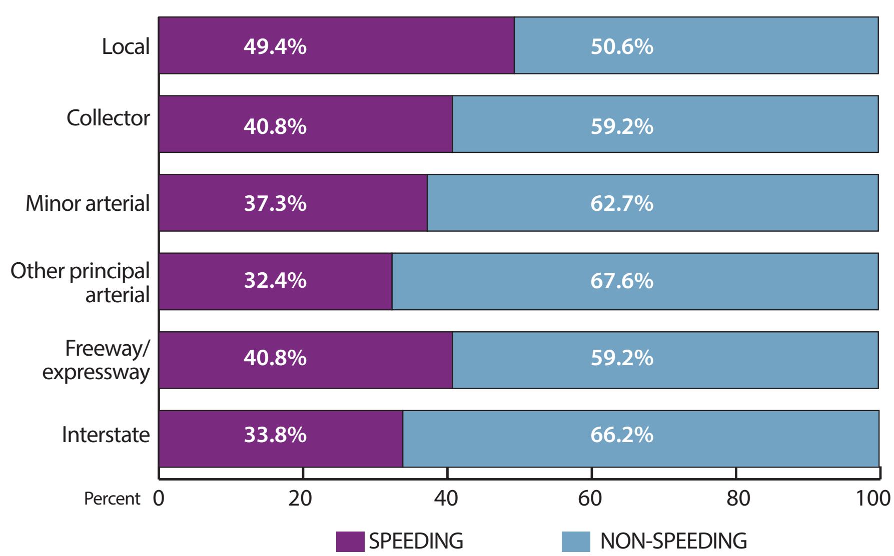

Figure 9 – Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Type of Roadway (Source: FARS 2010-2012)

POSTED SPEED LIMIT

The distribution of vehicles involved in speeding-related roadway departure fatal crashes by speed limit during the 2010-2012 period is shown in Figure 10. More than half of the vehicles involved in speeding-related roadway departure fatal crashes occur on roadways posted between 40 and 55 mph.

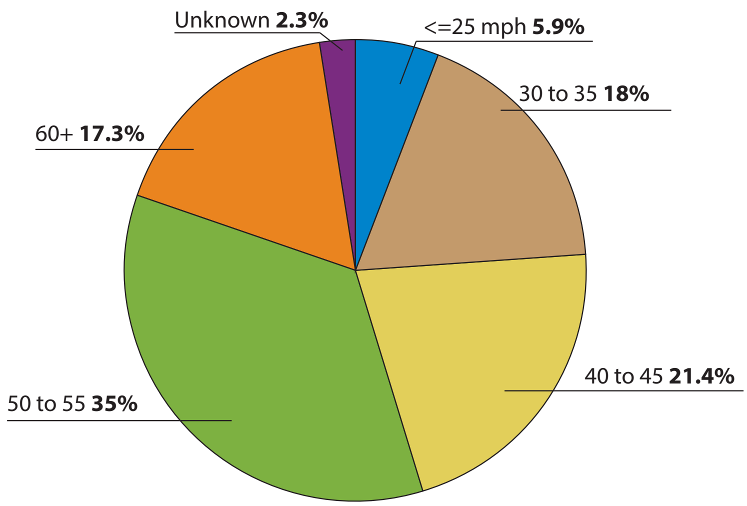

Figure 10 – Distribution of Vehicles Involved in Speeding-related Roadway Departure Fatal Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010-2012)

Figure 11 provides the percentage of vehicles involved in speeding and non-speeding roadway departure fatal crashes according to speed limit category. Note that the proportion of speeding-related crashes increases as the posted speed limit decreases.

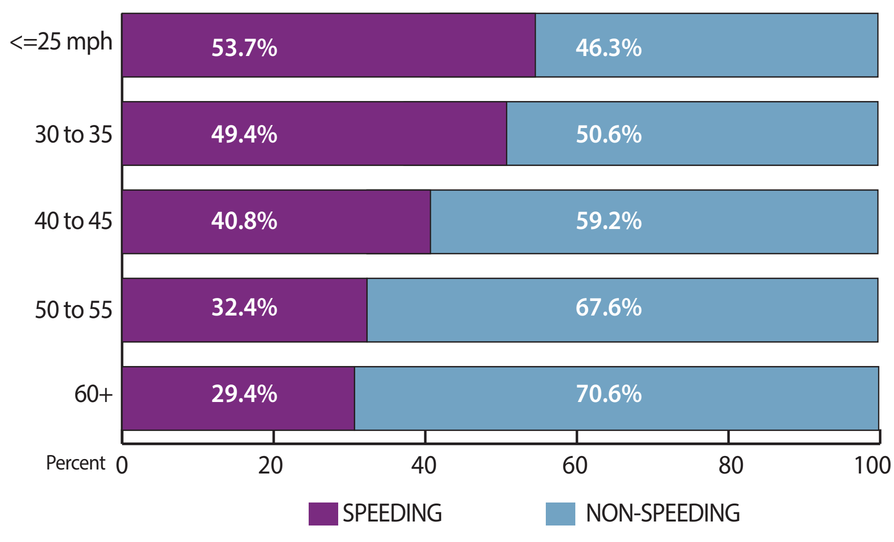

Figure 11 – Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010 – 2012)

ROADWAY GEOMETRY

A major aspect of preventing speeding-related roadway departure crashes is addressing curves. As Figure 12 shows, a large share of speeding-related fatal roadway departure crashes occur on tangent sections of roadways. More than 37 percent of vehicles involved in speeding-related fatal roadway departure crashes are on curves.

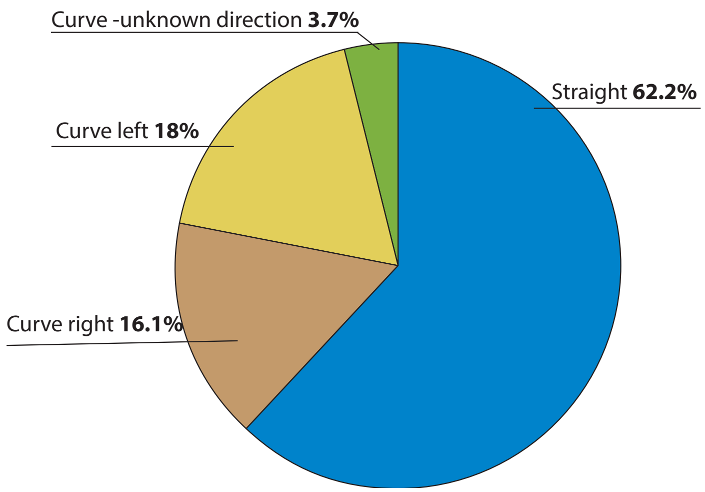

Figure 12 – Distribution of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Horizontal Alignment (Source: FARS 2010-2012)

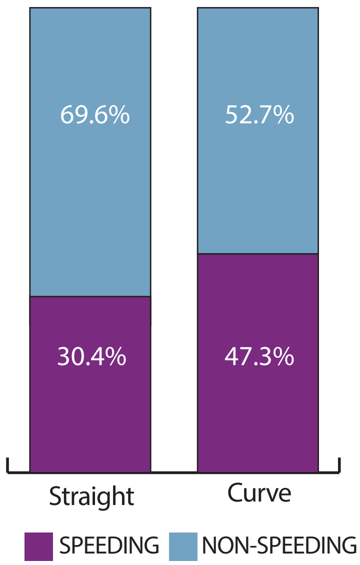

Figure 13 – Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Horizontal Alignment (Source: FARS 2010-2012)

When fatal roadway departure crashes are broken down separately by whether they occur on curves or straight sections of roadway, the likelihood of these types of crashes being speeding related is higher on curves. Close to half of vehicles involved in fatal roadway departure crashes on curves were coded as speeding related. By comparison, 30 percent of speeding-related fatal roadway departure crashes occurred on tangent sections of roadway.

DRIVER CHARACTERISTICS

The national data shows a very clear distinction: males are more likely to be involved in a roadway departure fatal crash and have even higher likelihood of being involved in a speeding-related roadway departure fatal crash. During the 2010-2012 period, males comprised approximately 75 percent of roadway departure fatalities and accounted for nearly 80 percent of speeding-related roadway departure fatalities.

When looking at the fatal roadway departure crashes within each age group, both males and females in the 15 to 20 age group were more likely to be involved in speeding-related roadway departure crashes. As shown in Figure 14, 42.7 percent of fatal roadway departure crashes for females in the 15 to 20 age group were speeding-related while 52.6 percent of fatal roadway departure crashes for males in that age group were speeding-related.

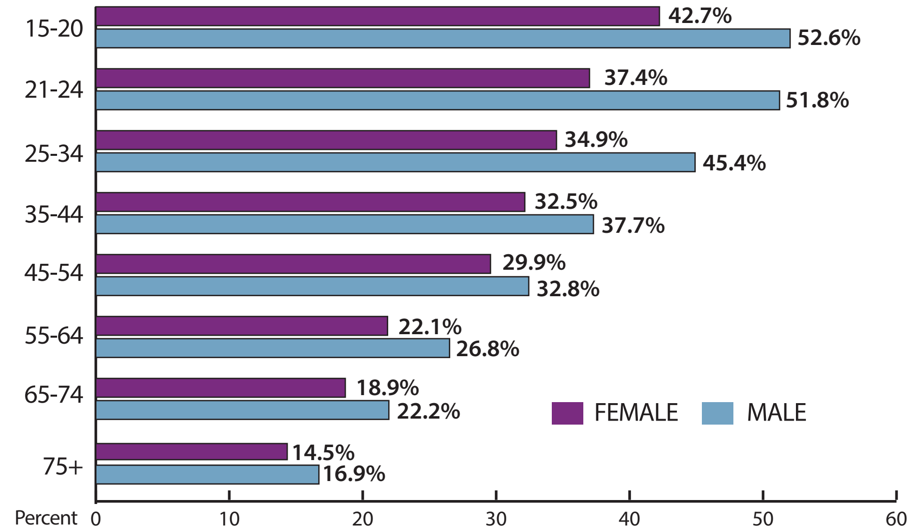

Figure 14 – Percentage of Drivers Involved in Speeding-related Roadway Departure Fatalities by Driver Age and Gender (Source: FARS 2010-2012)

TIME OF DAY

With respect to the time of day, Figure 15 shows 60 percent of the speeding-related fatal roadway departure crashes happen between 6 p.m. and 5 a.m. Further analysis reveals that between midnight and 5 a.m., nearly 50 percent of all fatal roadway departure crashes that occur are speeding-related.

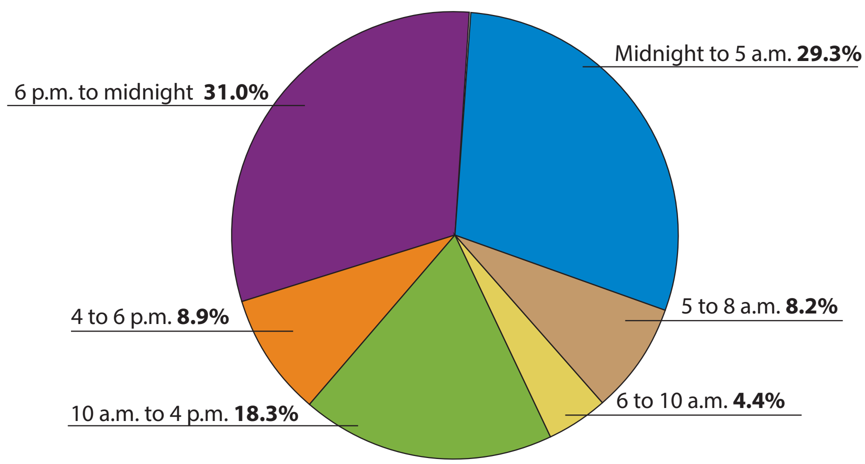

Figure 15 – Distribution of Speeding-related Roadway Departure Fatal Crashes by Hour of Day (Source: FARS 2010-2012)

4.1.2 Strategies

A number of potential strategies and countermeasures exist for agencies to consider when addressing speeding-related roadway departure crashes. By reviewing the national data, investigating the state of the practice, and conducting interviews with national experts, our researchers identified key issues relating to speeding-related roadway departure crashes. Some recommended strategies were identified through agency interviews and published resources.[19] Every situation or location is unique, and agencies should exercise engineering judgment for determining the appropriate solution for their specific crash concerns.

Issue: National data shows 85 percent of vehicles involved in speeding-related roadway departure fatal crash types were traveling on local, collector, or minor arterial, or other principal arterial roadways.

Potential strategies:

- **Appropriate speed limits**. Ensure speed limits are set appropriately by completing an engineering speed study and employing FHWA's USLIMITS2, a web-based tool to support and confirm speed limit setting decisions.[20]
- **Speed limit review.** Create a plan to review speed limits on these types of roadways systematically.
- **Data analysis.** Analyze crash data to determine corridors where a large amount of speeding-related roadway departure crashes are occurring and provide this information to law enforcement and engineers in the jurisdiction.
- **Countermeasure Selection.** Using the results of the data analysis and identifiable crash clusters, select appropriate speed management treatments using the speed management countermeasure reference materials available on FHWA's Speed Management website and other tools and resources listed in Appendix C.

Issue: Males are involved in nearly 80 percent of speeding-related roadway departure fatalities. Drivers ages 15 to 20 are more likely to be involved in speeding-related roadway departure fatal crashes.

Potential strategies:

- **Targeted educational campaigns**. Create educational campaigns that target high-risk groups, such as males or all drivers in the 15 to 20 age group. These could include media outlets or venues such as high schools and universities, sporting events, clubs or extracurricular activities, and popular local hangouts.
- **Collaboration with partners.** Collaborate with partners to improve driver education (e.g., schools, driver education programs, universities). Consider revisions for State driver education manuals.

Issue: Roadway departure fatalities within curves are more likely to be speeding-related.

Potential strategies:

- **Pavement markings.** Pavement markings to consider are edge line striping for delineation or markings which create the illusion of traveling faster or narrowing lanes (e.g., converging chevron marking pattern, transverse markings, optical speed bars).
- **Rumble strips.** Install centerline, edge line rumble strips, or both to provide audible and tactile notification to the driver if the vehicle departs the lane.
- **Standard curve signing**. Ensure the appropriate curve signing is applied to meet MUTCD standards.
- **Enhanced signing**. Apply enhanced signing and delineation (e.g., oversized signs, florescent sheeting, full post delineation, double-up signs).

19 Additional resources are listed in Appendix C.

20 FHWA developed USLIMITS2 to help practitioners set reasonable, safe, and consistent speed limits for specific roadway segments. It is applicable to all types of roads ranging from rural local roads and residential streets to urban freeways. For additional information, visit http://safety.fhwa.dot.gov/uslimits.

- **Dynamic or ITS signs.** Install dynamic chevrons, speed feedback signs, [21]and speed activated warning or speed limit reminder signs. Variable speed limit signs may be beneficial in areas where inclement weather is common.
- **High friction surface treatment.**[22] Effective in addressing locations with friction or wet crash issues, high-friction surface treatments secure a thin layer of specially engineered, durable, high-friction aggregate as a topping on resins or polymers – usually urethane, silicon, or epoxy – with a binder. While this countermeasure does not reduce speeding vehicles, it provides long lasting skid resistance while also making the overlay much more resistant to wear and polishing, improving safety within curves.
- **Safety Edge$_{SM}$[23] or widening pavement.** Installing Safety Edge$_{SM}$ along roadways or widening pavement within curves may increase the likelihood of drivers to regain control of their vehicle if they drift out of their lane.

Issue: Rollover/overturn crashes, opposing direction crashes, and crashes involving trees are the three primary event types that are most harmful in 75 percent of all roadway departure crashes, and speeding is identified as one of the contributing factors.

Potential Strategies:

- **Data analysis.** Analyze crash data to determine where these three types of crash types are occurring on the road system and either identify top corridors or use a systemic approach for choosing and implementing proven countermeasures.
- **Keep vehicles on the roadway and in their appropriate directional lane.** Choose countermeasures that help keep vehicles on the roadway and in their lane, such as rumble strips or stripes, high-friction surface treatments, and high-visibility center and edge line striping.
- **Reduce potential for crashes and crash severity when vehicles do leave the roadway or their lane.** Countermeasures that support this strategy include applying the Safety Edge$_{SM}$;widening the shoulder; removing, shielding, or delineating fixed objects; increasing the clear zone; and flattening slopes.

Speed management countermeasures references are available on FHWA's Speed Management website. FHWA has published two desktop references that summarize studies on the effectiveness of engineering countermeasures in reducing crashes and managing speed.[24] The CMF Clearinghouse provides a comprehensive database of CMFs along with supporting documentation to help agencies identify potential countermeasures and their proven levels of effectiveness.[25]

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21 FWHA, Evaluation of Dynamic Speed Feedback Signs on Curves: A National Demonstration Project, FHWA-HRT-14-020 (Washington, DC: FHWA, January 2015). Available at: https://www.fhwa.dot.gov/publications/research/safety/14020/index.cfm

22 FHWA, "High Friction Surface Treatments Frequently Asked Questions" FHWA-CAI-14-019. (Washington, DC: FHWA, 2014). Available at: http://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/pdfs/fhwa-cai-14-019_faqs_hfst_mar2014_508.pdf

23 Safety EdgeSM provides a transition for vehicles to return to the pavement more smoothly and easily by shaping the edge of pavement to 30 degrees and eliminating vertical drop-off. More information on Safety EdgeSM is available at http://www.fhwa.dot.gov/everydaycounts/technology/safetyedge/intro.cfm

24 FHWA, A Desktop Reference of Potential Effectiveness in Reducing Speed, 2014, available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm, and FHWA, A Desktop Reference of Potential Effectiveness in Reducing Crashes, 2014, available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_crashes.cfm, accessed September 4, 2015.

25 CMF Clearinghouse, available at: http://www.cmfclearinghouse.org/

4.2 Intersections and Speed Management

"An intersection, by design, is a planned location where vehicles traveling on different highways may come into conflict. The functional area of an intersection extends upstream and downstream from the physical area of the crossing streets. The different approach and crossing movements by motorists, bicyclists, and pedestrians make at-grade intersections one of the most complex traffic situations that people encounter."

Excerpt from FHWA Issue Brief 2, "The National Intersection Safety Problem," 2009

4.2.1 National Crash Data Analysis Trends

Intersections account for almost 20 percent of speeding-related fatal crashes and more than one-third of all speeding-related crashes. A summary of the national crash analysis results for speeding-related fatal crashes at intersections is shown below. The full analysis is included in Appendix A.

ROADWAY FUNCTIONAL CLASS

Figure 16 shows the distribution of vehicles involved in speeding-related fatal intersection crashes by roadway type during the 2010–2012 period. Nearly 53 percent took place on arterial roadways. Local roads contained more than 25 percent of the vehicles involved in speeding-related fatal intersection crashes.

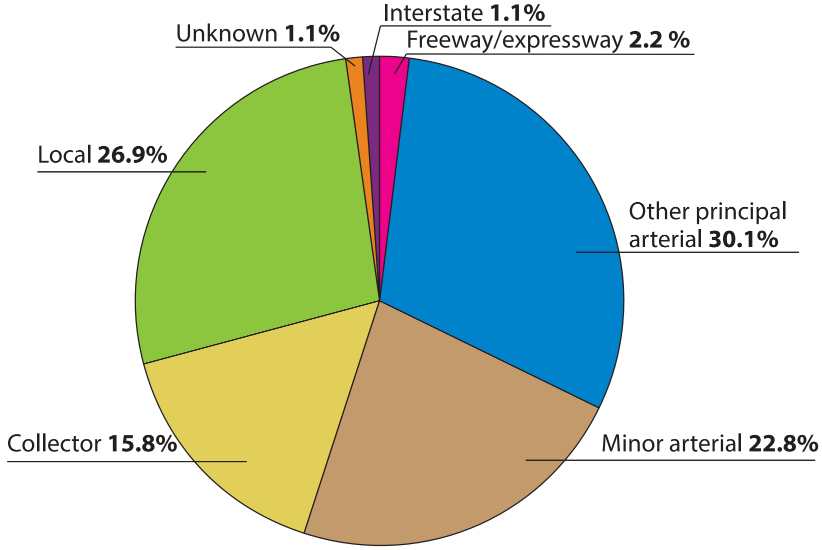

Figure 16 – Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Type of Roadway (Source: FARS 2010-2012)

POSTED SPEED LIMIT

The analysis by speed limit in Figure 17 shows that almost 60 percent of vehicles involved in speeding-related fatal intersection crashes from 2010 to 2012 happened on roadways with speed limits between 30 and 45 mph.

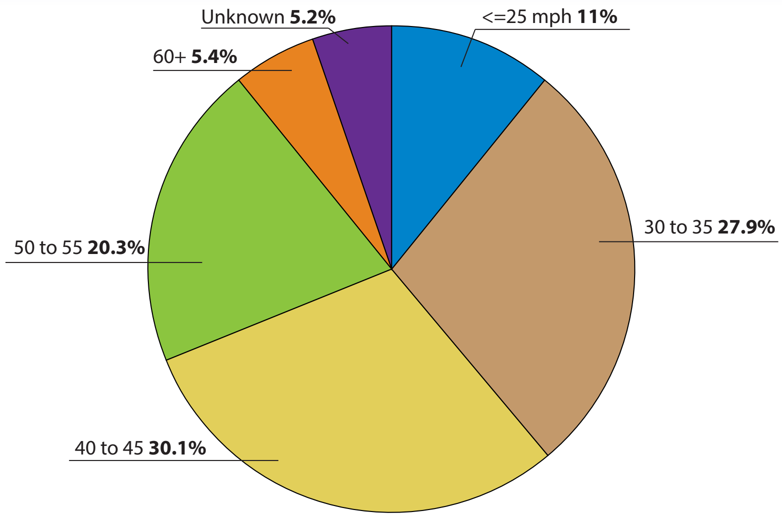

Figure 17 – Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010-2012)

DRIVER CHARACTERISTICS

Following the same trend as speeding-related fatal roadway departure crashes, male drivers account for more than 75 percent of speeding-related fatal crashes at intersections. When looking at the fatal intersection crashes within each age group, both males and females in the 21 to 24 age group were more likely to be involved in speeding-related intersection crashes. As shown in the figure below, 24.3 percent of female drivers and 35.6 percent of male drivers in that age group who were involved in fatal intersection crashes during the 2010-2012 period were speeding.

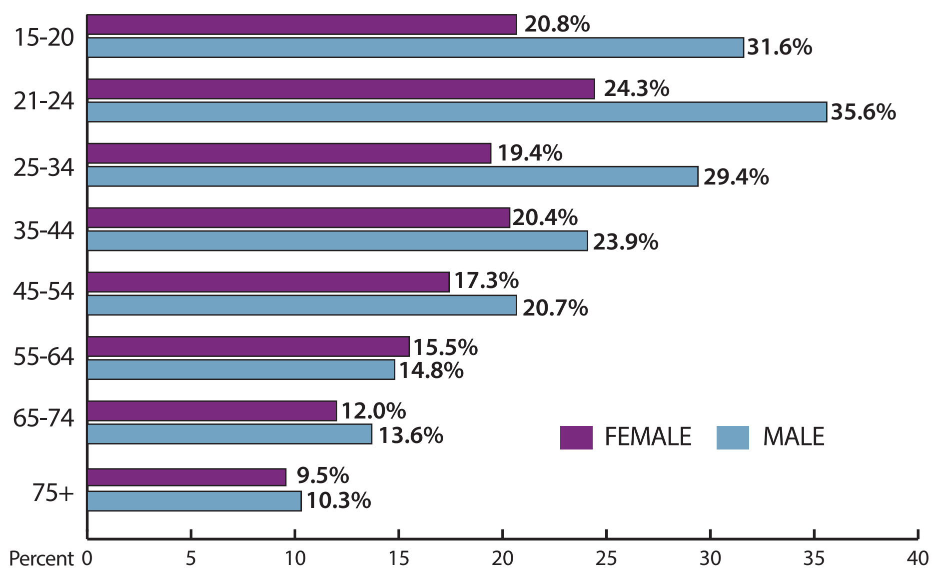

Figure 18 – Percentage of Drivers by Age and Gender Involved in Speeding-related Fatal Intersection Crashes (Source: FARS 2010-2012)

VEHICLE TYPE

The fact that passenger cars and light trucks account for approximately 75 percent of the vehicles involved in fatal intersection crashes is not surprising since they are the predominant transportation modes. With motorcycles making up just 3 percent of all registered vehicles in the United States and accounting for only 0.7 percent of all vehicle miles travelled,[26] the results in Figure 19, which shows that motorcycles account for over 17 percent of the vehicles that were involved in speeding-related fatal intersection crashes between 2010 and 2012, is significant.

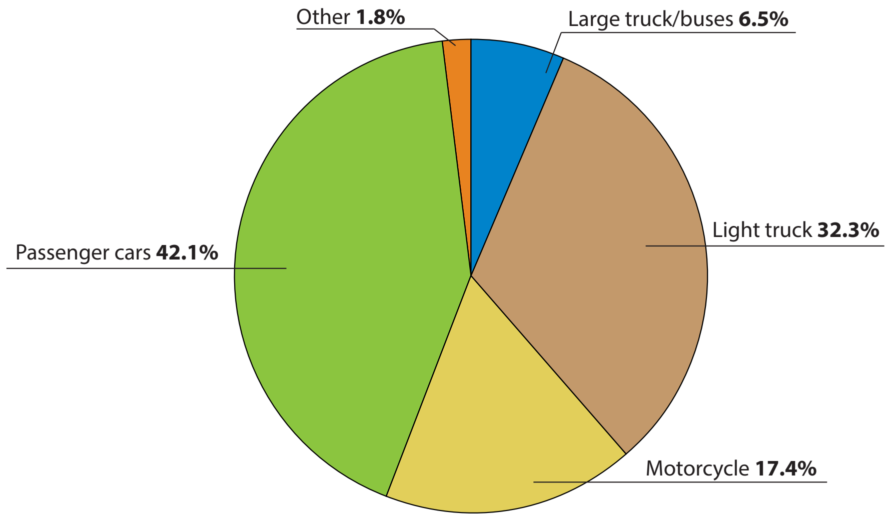

Figure 19 – Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Type of Vehicle (Source: FARS 2010-2012)

When analyzing each vehicle type separately to determine the percentage involved in speeding-related fatal intersection crashes, approximately 30 percent of motorcycle-involved intersection crashes—the highest percentage of all vehicle types—were considered speeding-related.

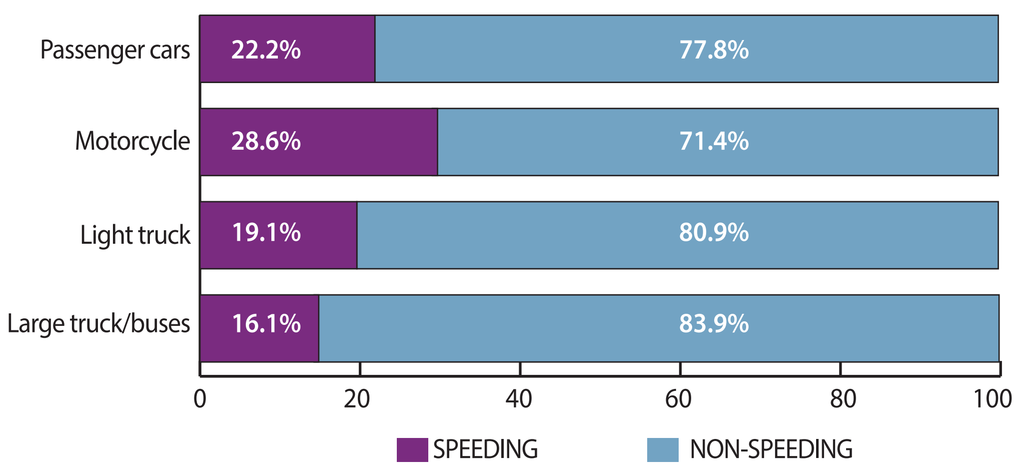

Figure 20 – Percentage of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Type of Vehicle (Source: FARS 2010-2012)

26 FHWA Office of Safety, "Motorcycle Safety" Web page. Available at: http://safety.fhwa.dot.gov/motorcycles/ . Accessed December 8, 2015.

CRASH TYPE

Figure 21 shows that, at more than 41 percent, angle crashes make up the highest percentage of speeding-related fatal intersection crashes for the 2010-2012 period, and collisions with non-vehicle objects (e.g., pedestrians, bicycles, roadside features, etc.) follows closely behind, accounting for almost 40 percent. Notably, although rear-end crashes make up just over 6 percent of all fatal intersection crashes, they more than doubled that percentage (13.3 percent) for speeding-related fatal intersection crashes. Around 44 percent of rear-end fatal intersection crashes took place in rural areas.

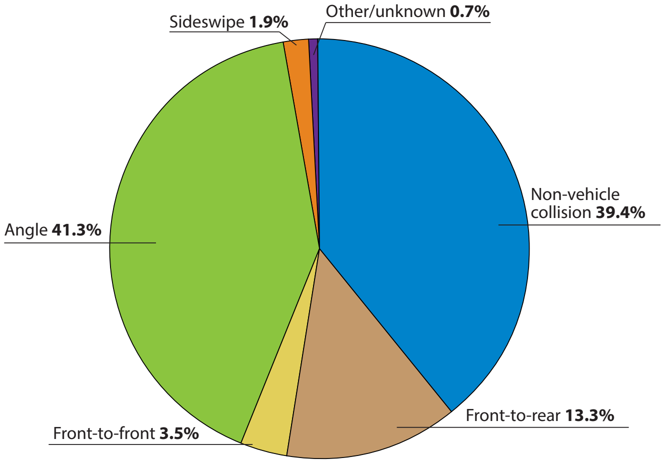

Figure 21 – Distribution of Speeding-related Fatal Intersection Crashes by Crash Type (Source: FARS 2010-2012)

When looking at the crash types independently, additional insight can be gained on the nature of fatal intersection crashes. Figure 22 shows the distribution of vehicles involved in speeding-related fatal angle crashes at intersections by vehicle type during the study period. Once again, motorcycles are the predominant vehicle type in these crashes. Almost 40 percent of the vehicles involved in speeding-related fatal angle crashes were motorcycles.

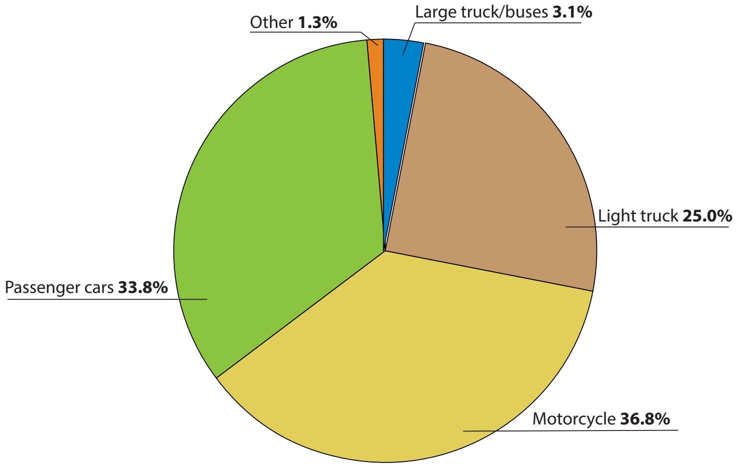

Figure 22 – Distribution of Vehicles Involved in Speeding-related Fatal Angle Crashes at Intersections by Vehicle Type (Source: FARS 2010-2012)

4.2.2 Strategies

FHWA, the National Highway Transportation Safety Administration (NHTSA), the American Association of State Highway and Transportation Officials (AASHTO), Institute of Transportation Engineers (ITE), and other organizations have developed a number of potential resources for agencies to use in identifying successful strategies for improving intersection safety. Many of these strategies and countermeasures are just as applicable for addressing speeding-related intersection crashes. By reviewing the national data, investigating the state of the practice, and conducting interviews with national experts, some key issues or focus areas relating to speeding-related intersection fatal crashes were identified. These strategies were discovered through agency interviews and published resources.[27] Every situation or location is unique, and agencies should exercise engineering judgment when determining the appropriate solution for their specific crash concerns.

27 Additional resources are listed in Appendix C.

Issue: National data shows nearly 53 percent of vehicles involved in speeding-related intersection fatal crash types were traveling on arterial roadways.

Potential strategies:

- **Appropriate speed limits.** Ensure speed limits are set appropriately by completing an engineering speed study and employing FHWA's USLIMITS2.
- **Improve visibility or conspicuity of intersection.** Ensure sight distance is adequate, clear sight distance triangles, install advance signing, or enhance striping. For signalized intersections, install backplates or reflectorized backplates; use mast arms instead of span-wire. For unsignalized intersections, install larger and/or more reflective signing.
- **Traffic calming.** Incorporate traffic calming measures at intersections along arterials, such as constructing roundabouts or mini roundabouts, applying lane narrowing techniques (using striping or a combination of striping and rumble strips), or creating median islands.
- **Signal timing.** Create a plan to systematically review signal timings at intersections on these types of roadways. Ensure the yellow and all-red clearance intervals are appropriate for the speed limit and the intersection geometry. Coordinate signals on appropriate roadways to promote progression and a uniform speed.
- **Dilemma zone protection measures.** Install advance detection sensor equipment that adjusts the start time of the yellow-signal phase either earlier or later based on observed vehicle locations and speeds; install advance warning signs that notify drivers of the need to stop at an upcoming signalized intersection.
- **Enforcement.** Determine specific arterial roadway corridors with a high speeding-related intersection crash history and conduct high-visibility enforcement and education efforts. Use red-signal enforcement lights[28] (i.e., "tattletale lights"), which assist law enforcement officers in more efficiently and safely issuing citations for drivers at an intersection. If the State or local jurisdiction allows, install red light running automated enforcement systems (see Fixing America's Surface Transportation Act [FAST Act], Section 1401, for federal funding rules on these systems).

Issue: Motorcyclists have a high risk of being involved in speeding-related intersection fatal crashes.

Potential strategies:

- **Targeted education campaigns.** Create educational campaigns that target motorcyclists or motorcycle clubs to promote safe riding. Campaigns can also target "other drivers" to promote increased awareness of motorcyclists.
- **Conspicuity of motorcyclists.** Encourage high visibility apparel and equipment for riders.
- **Helmet laws.** Support laws that require approved helmet use. NHTSA estimates that more than 700 lives could be saved if all motorcyclists had worn helmets.[29]
- **Rider training.** Work with appropriate organizations to coordinate and/or require training before a rider can be licensed.
- **Emergency responder training.** Engage and ensure emergency response personnel are properly trained to understand, identify, and treat the specific types of injuries common to motorcycle crashes (e.g., pelvic injuries).

28 FHWA, "Red-Signal Enforcement Lights," FHWA-SA-09-005 (Washington, DC: FHWA 2009). Available at: http://safety.fhwa.dot.gov/intersection/resources/techsum/fhwasa09005/

29 NHTSA, "Traffic Safety Facts, 2013 Data: Motorcycles," DOT HS 812 148 (Washington, DC: NHTSA, 2015). Available at: http://www-nrd.nhtsa.dot.gov/Pubs/812148.pdf

Issue: Angle crashes make up the highest percentage of speeding-related fatal intersection crashes at over 41 percent.

Potential strategies:

- **Roundabouts and mini roundabouts.** Roundabouts and mini roundabouts eliminate crossing conflicts that are present at conventional intersections, reducing both the total number of potential conflict points as well as the most severe of those conflict points.
- **U-turn-based intersection designs.** Both the restricted crossing U-turn intersection (RCUT) and median U-turn designs reduce overall conflict points significantly compared to conventional intersections. More importantly, certain RCUT designs have the potential to eliminate all "crossing" conflict points, which contribute to the most severe angle crashes (see Fixing America's Surface Transportation Act [FAST Act], Section 1401, for federal funding rules on these systems).
- **Automated red-light enforcement.** If the State or local jurisdiction allows installation of this enforcement method, photo enforcement can reduce red-light running and associated angle crashes (see Fixing America's Surface Transportation Act [FAST Act], Section 1401, for federal funding rules on these systems).

Issue: Speeding-related fatal intersection crashes are more likely to happen in rural areas.

Potential strategies:

- **Improve visibility or conspicuity of intersections.** Ensure sight distance is adequate, clear sight distance triangles, install advance signing, enhance signing and striping. Install lighting if there are high occurrences of speeding-related intersection crashes at night.
- **Transverse rumble strips.** Transverse rumble strips (i.e., in-lane rumble strips) are raised or grooves placed across the travel lane to supplement signing and alert drivers of the need to reduce speed as they approach an intersection.
- **High friction surface treatment.**[30] Effective in addressing locations with friction or wet crash issues, high friction surface treatments secure a thin layer of specially engineered, durable, high-friction aggregates as a topping on resins or polymers – usually urethane, silicon, or epoxy – with a binder. While this countermeasure does not reduce speeding vehicles, it provides long lasting skid resistance.
- **Detection control systems.** Install advance detection sensors, which adjusts the start time of the yellow-signal phase either earlier or later based on observed vehicle locations and speed; install advance warning signs that notify drivers of the need to stop at an upcoming signalized intersection
- **Rural ITS solutions.** Install ITS solutions such as intersection collision warning systems (ICWS), speed feedback signs, speed activated warning or speed limit reminder signs, or other signs or beacons that notify the side street or major street vehicle of an approaching vehicle. Variable speed limit signs may be beneficial in areas where inclement weather is common.
- **Transverse or optical speed bars.** These pavement markings are generally spaced at gradually decreasing distances and are used to increase the drivers' perception of speed and cause them to reduce speed.
- **U-turn-based intersection designs.** U-turn-based intersection designs, such as the RCUT or median U-turn can be beneficial on higher-speed rural divided highways by reducing conflict points and the probability of severe types of crashes. Certain RCUT designs have the potential to eliminate all "crossing" conflict points, which contribute to the most severe angle crashes.

30 FHWA, High Friction Surface Treatments Frequently Asked Questions, available at: https://www.fhwa.dot.gov/everydaycounts/edctwo/2012/pdfs/fhwa-cai-14-019_faqs_hfst_mar2014_508.pdf

- **Left and right turn lanes.** While adding left and right turn lanes may not reduce speeds, these auxiliary lanes allow the turning vehicles to move out of the main travel lanes, reducing the likelihood of rear-end speeding-related crashes or sudden lane-changing avoidance maneuvers. Consider offset left and right turn designs in order to provide better sight distance at the intersection.

Issue: While roundabouts and mini roundabouts are two of the most effective measures for managing speed through intersections and reducing severe crashes, initial cost or public sentiment often precludes widespread implementation in favor of conventional intersection designs and low-cost improvements.

Potential strategies

- **Education and outreach.** Educate the public and government officials on the benefits and safety of roundabouts.
- **Life cycle cost.** Calculate the life cycle cost, including the safety cost, in the planning and evaluation of intersection treatments.
- **Roundabout-first policy.** Implement an agency policy that requires consideration and evaluation of a roundabout as an alternative during a reconstruction or new intersection project. Typically, these types of policies indicate that, if the analysis shows a roundabout is a feasible alternative, the roundabout should then be considered a preferred option due to its great safety and operational benefits.

References and resources for speed management countermeasures are available on FHWA's Speed Management website. FHWA has published desktop references that summarize studies on the effectiveness of engineering countermeasures in reducing crashes and managing speed. [31] As an additional resource, the CMF Clearinghouse provides a comprehensive database of CMFs along with supporting documentation to help agencies identify potential countermeasures and effectiveness.[32]

4.3 Pedestrians/Bicyclists and Speed Management

Transportation safety is not only about motor vehicle safety, it also encompasses protecting vulnerable users. Pedestrian safety is a primary concern in communities across the United States, with pedestrians accounting for approximately 14 percent of traffic fatalities.[33] In 2013, bicyclist deaths accounted for over 2 percent of all motor vehicle traffic fatalities. [34,35]

4.3.1 National Crash Data Analysis Trends

The speeding-related crash analysis completed on the national data included information on both pedestrians and bicyclists involved in fatal crashes. Approximately 8 percent of fatal crashes involving a pedestrian or bicyclist were speeding related, and 73 percent occurred predominantly in an urban setting. When looking at all fatal pedestrian and bicycle crashes, the speeding-related crashes were almost twice as likely to be hit and run. While the complete report is included in Appendix A, some of the more significant results are listed below.

31 FHWA, A Desktop Reference of Potential Effectiveness in Reducing Speed, 2014, available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm, and FHWA, A Desktop Reference of Potential Effectiveness in Reducing Crashes, 2014, available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_crashes.cfm, accessed September 4, 2015.

32 CMF Clearinghouse, available at: http://www.cmfclearinghouse.org/

33 FHWA, A Desktop Reference of Potential Effectiveness in Reducing Speed, 2014, available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm, and FHWA, A Desktop Reference of Potential Effectiveness in Reducing Crashes, 2014, available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_crashes.cfm, accessed September 4, 2015.

34 The term bicyclist includes bicyclists and other cyclists including riders of two-wheel, non-motorized vehicles, tricycles, and unicycles powered solely by pedals.

35 NHTSA, "Traffic Safety Facts, 2013 Data: Bicyclists and Other Cyclists," DOT HS 812 151 (Washington, DC: NHTSA, 2015). Available at: http://www-nrd.nhtsa.dot.gov/Pubs/812151.pdf

LOCATION

Locations for speeding-related fatal pedestrian and bicycle crashes are summarized in Figure 23. The majority of these fatal crashes did not take place at an intersection. These locations, making up nearly 55 percent of fatal speeding-related pedestrian and bicycle crashes, may indicate mid-block crossings. Shoulders, roadsides, or parking lanes accounted for approximately 15 percent.

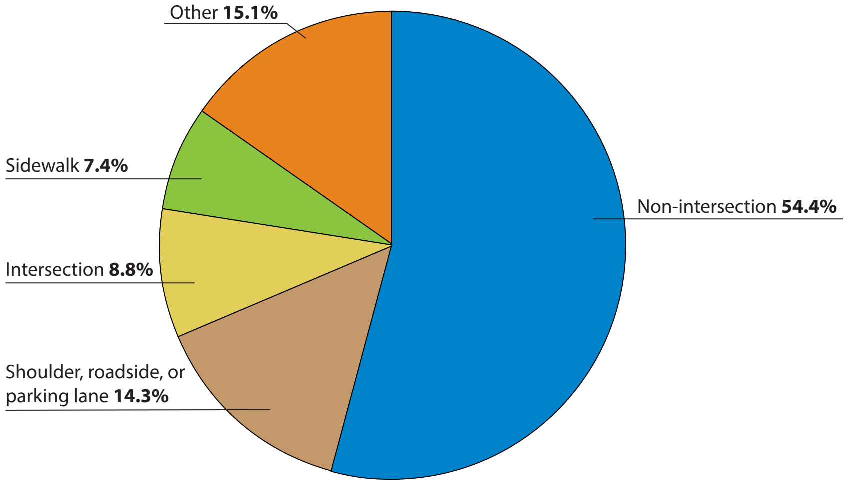

Figure 23 – Distribution of Speeding-related Fatal Pedestrian and Bicycle Crashes by Location (Source: FARS 2010-2012)

SPEED LIMIT

The distribution of vehicles involved in speeding-related pedestrian and bicycle fatal crashes by posted speed limit is shown in the figure below. More than 50 percent occurred on roads with speed limits between 30 mph and 45 mph, although roadways with these types of speed limits are more likely to have higher pedestrian and bicyclist volumes. Conversely, roads with speed limits of 60 mph or more, which account for almost 20 percent of the vehicles involved in these types of fatal crashes, typically have fewer pedestrians and bicyclists.

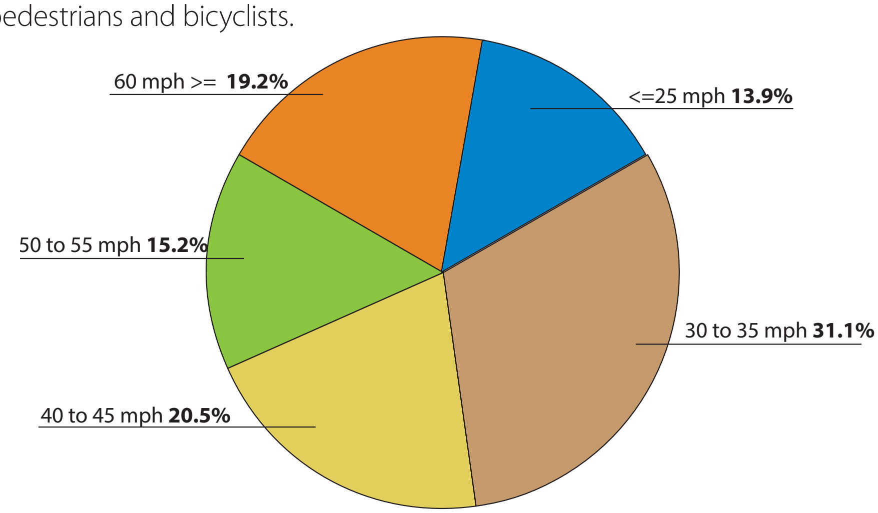

Figure 24 – Distribution of Vehicles Involved in Speeding-related Fatal Pedestrian and Bicycle Crashes by Posted Speed Limit (Source: FARS 2010-2012)

DRIVER CHARACTERISTICS

As with the other focus areas, males also make up more than 70 percent of drivers in speeding-related pedestrian and bicycle fatal crashes. The age group that is more likely to be involved in speeding-related fatal pedestrian and bicycle crashes is quite different than those involved in speeding-related roadway departure and intersection crashes. The distribution of drivers by age and gender category is shown in Figure 25 (the sum of all bars equals 100 percent). Males aged 45 to 64 make up nearly 30 percent of all speeding-related fatal pedestrian and bicycle crashes. Because of hit and run crashes, driver characteristics in all crashes may not be identified.

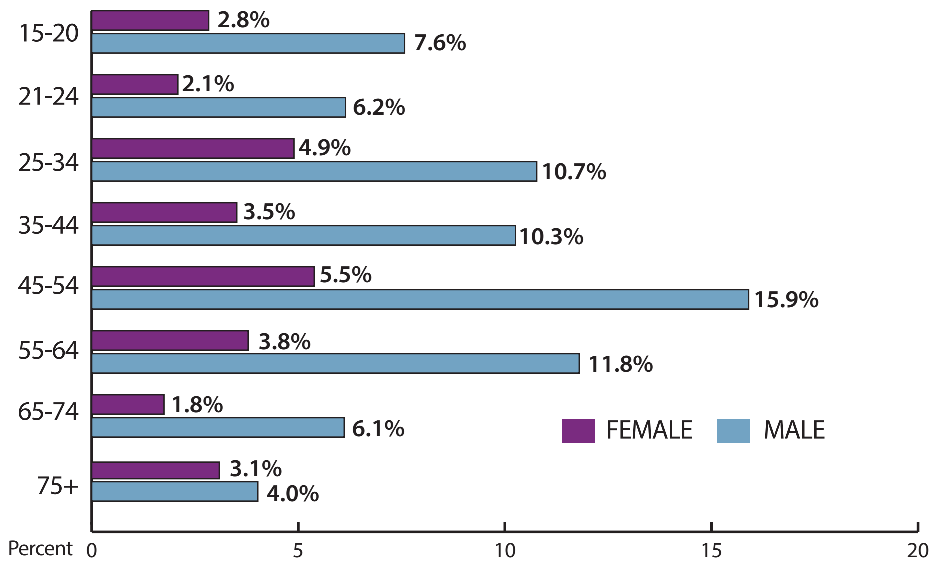

Figure 25 – Distribution of Drivers Involved in Speeding-related Fatal Pedestrian and Bicycle Crashes by Age and Gender (Source: FARS 2010-2012)

TIME OF DAY

As shown in Figure 26, the most problematic time period was 6 p.m. to midnight, during which period nearly 40 percent of speeding-related fatal pedestrian and bicycle crashes occurred. The period with the second highest rate of crashes was from midnight to 5 a.m., during which time almost 20 percent of fatal pedestrian and bicycle crashes occurred.

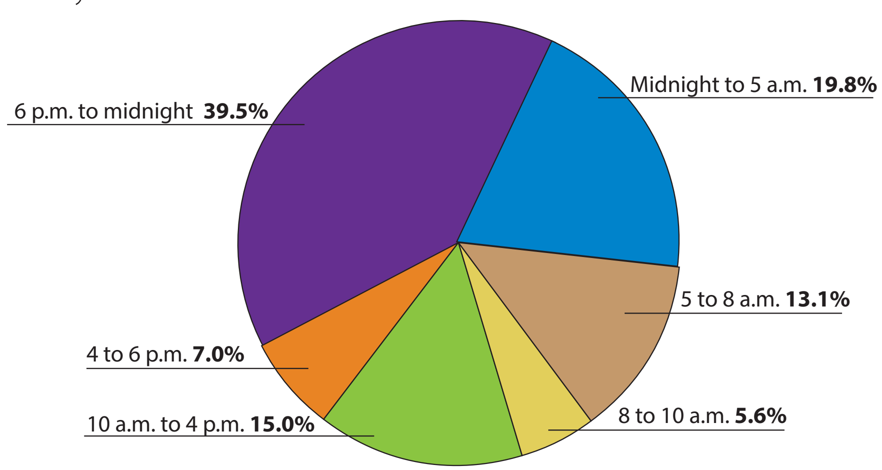

Figure 26 – Distribution of Speeding-related Fatal Pedestrian and Bicycle Crashes by Hour of Day (Source: FARS 2010-2012)

4.3.2 Strategies

Addressing speeding-related, fatal pedestrian and bicycle crashes may be more challenging or overwhelming to agencies compared to the other focus areas. The lack of robust data and convincing leaders to prioritize pedestrian and bicyclist safety are just some of the hurdles that agencies must overcome. Below are some of the common issues regarding speeding-related pedestrian and bicycle crashes that were identified both by agencies and by national data analysis results. The recommended strategies were identified through agency interviews and published resources.[36] Every situation or location is unique, and agencies should exercise engineering judgment for determining the appropriate solution for their specific crash concerns. Although many of these strategies focus on pedestrian safety, many are also applicable to bicycle safety improvements.

> *"Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems."*
>
> *– U.S. DOT Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations, March 2010*

Issue: It is challenging for agencies to identify clusters or problem locations for improving pedestrian safety because of data quality and quantity.

Potential strategies:

- **Data improvement plan.** Work together with law enforcement, emergency responders, community leaders, and special interest groups to improve and identify ways to capture information on the amount of pedestrians in a particular area, pedestrian injuries, and excessive speeding violations
- **Pedestrian facilities review.** Create an overall plan for assessing existing pedestrian facilities and identify gaps and needs relating to pedestrian safety. Activities might include: accurately inventorying existing facilities, identifying sidewalk gaps, verifying pedestrian facilities are constructed to meet ADA requirements, checking for properly marked crosswalks, and reviewing pedestrian cycle lengths at signalized intersections. These activities can help identify potential problem areas where pedestrians may be more vulnerable to speeding-related crash risks.
- **Maintain inventories**. Develop a process to keep crash and facility inventory data up to date.

Issue: National data analysis revealed nearly 40 percent of speeding-related fatal pedestrian and bicycle crashes took place between 6 p.m. and midnight. The period with the second greatest number of crashes, almost 20 percent, was from midnight to 5 a.m.

Potential Strategies:

- **Lighting.** In areas where there is a high amount of pedestrian activity, install lighting to illuminate intersections and crosswalks. Ensure existing lighting at intersections and crosswalks is designed properly for maximum safety and illuminance of pedestrians.
- **Rectangular rapid flash beacons.** Rectangular rapid flash beacons (RRFB) are user-activated (or detection activated) amber LEDs that supplement warning signs at unsignalized intersection or mid-block crossings. RRFBs are shown to significantly increase driver yielding behavior at crosswalks when supplementing standard pedestrian crossing warning signs and markings. [37]

36 Additional resources are listed in Appendix C.

37 FHWA, Rectangular Rapid Flash Beacons (RRFB), FHWA-SA-09-009, May 2009. Available at: http://safety.fhwa.dot.gov/intersection/resources/techsum/fhwasa09009/

- **In-roadway warning lights.** Each side of a crosswalk is lined with a series of actuated, amber lights embedded in the roadway that light up to warn approaching drivers when a pedestrian is in or near the marked crosswalk. The MUTCD contains information on the use and installation of in-roadway warning lights.
- **Public outreach and education.** Educate pedestrians and bicyclists on the importance of wearing reflective clothing or installing reflectors on bicycles for visibility at nighttime.

Issue: The majority of pedestrian speeding-related fatal crashes do not take place at an intersection.

Potential Strategies:

- **Raised median or refuge islands.** Raised medians or islands provide for a safe area for pedestrians, so they do not have to cross the entire street at once and only need to negotiate one direction of traffic at a time.
- **Pedestrian hybrid beacon (i.e., High intensity Activated crossWalK or "HAWK").** The pedestrian-activated warning device is located on the roadside or on mast arms over midblock pedestrian crossings. In general, they should be used if gaps in traffic are not adequate to permit pedestrians to cross, if vehicle speeds on the major street are too high to permit pedestrians to cross, or if pedestrian delay is excessive.[38]
- **Rectangular rapid flash beacons.** Rectangular rapid flash beacons (RRFB) are user-activated (or detection activated) amber LEDs that can supplement warning signs at mid-block crossings. RRFBs are shown to significantly increase driver yielding behavior at crosswalks when supplementing standard pedestrian crossing warning signs and markings.[39]
- **Barriers to prevent unwanted crossings.** Identify areas where pedestrians are making decisions to cross at unsafe locations and install barriers that prevent crossing.
- **Enforcement, education, and outreach.** Plan targeted enforcement and education campaigns for pedestrians on safe crossing habits, the risks of walking alongside higher-speed roadways, promote walking against traffic, etc., along with educating drivers to slow down and yield to pedestrians.

Issue: Many roadways have historically been designed with vehicles as the primary user; little consideration has traditionally been given to non-motorized users.

Potential Strategies:

- **Context sensitive design.** Incorporate context sensitive design into agency policy by examining needs of communities and the users of the roadway. Incorporate pedestrian and other users in the purpose and need for projects where appropriate.
- **Road Diets.** With the four-lane to three-lane conversion being the most common lane reconfiguration, Road Diets have been proven to reduce top-end speeders as well as to allow a more pedestrian- and bicycle-friendly design by reallocating space for bicycle lanes, sidewalks, pedestrian refuge islands, etc.[40]

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38 FHWA, Pedestrian Hybrid Beacon, FHWA-SA-12-012, October 2014. Available at: http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_012.cfm

39 FHWA, Rectangular Rapid Flash Beacons (RRFB), FHWA-SA-09-009 (Washington, DC: FHWA, 2009). Available at: http://safety.fhwa.dot.gov/intersection/resources/techsum/fhwasa09009/

40 FHWA, Road Diet Informational Guide, FHWA-SA-14-028 (Washington, DC: FHWA, November 2014). Available at: http://safety.fhwa.dot.gov/road_diets/info_guide/

- **Accommodating pedestrians and bicyclists.** Designers can review FHWA's Accommodating Bicycle and Pedestrian Travel: A Recommended Approach. FHWA's Separated Bike Lane Planning and Design Guide also provides practical information and promotes design flexibility for implementing separated bicycle lanes.
- **Bicycle-friendly rumble strips**. While rumble strips provide tremendous safety benefits for motorists, they may cause concern for bicyclists. Design opportunities exist whereby the impacts of rumble strips on other road users can be reduced by adjusting the strips' dimensions and location.[41]

Speed management countermeasures references are available on FHWA's Speed Management website. FHWA has published desktop references that summarize studies about the effectiveness of engineering countermeasures in reducing crashes and managing speed.[42] The CMF Clearinghouse provides a comprehensive database of CMFs along with supporting documentation to help agencies identify potential countermeasures and effectiveness.[43]

41 FHWA, "Technical Advisory: Shoulder and Edge Line Rumble Strips," T 5040.39, Revision 1 (Washington, DC: FHWA, 2011). Available at: http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/t504039/

42 FHWA, A Desktop Reference of Potential Effectiveness in Reducing Speed, FHWA-SA-14-101 (Washington, DC: FHWA, 2015). Available at http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm

43 CMF Clearinghouse, available at: http://www.cmfclearinghouse.org/

Chapter 5. Conclusion

Over the past decade, the United States has made great strides in reducing roadway fatalities. While the reduction in fatalities is significant and to be commended, additional focus on speed management is needed to continue the trend. Since roadway departure, intersection, and pedestrian and bicycle crashes have been identified by the Federal Highway Administration (FHWA) as the three areas with great potential to reduce fatalities, States are encouraged to integrate speed management into these three safety focus areas. Agencies are also encouraged to take a broad look at their existing policies and programs to identify opportunities on how speed management can be more fully integrated throughout their organization.[44]

This document has provided information on national speeding-related crash trends, promotes a speed-related crash data analysis approach, and recommends strategies for integrating speed management within an agency's policies, as well as their roadway departure, intersection, and pedestrian and bicyclist safety focus areas.

5.1 Gaps and Opportunities for Future Safety Improvements

Speeding is a complex problem and achieving reductions in speeding-related crashes will require comprehensive efforts, involving strategies and inputs from the engineering, education and outreach, enforcement, and emergency medical responder stakeholder communities. Speed management is essential for State and local agencies to meet their safety goals.

While this report provides practical guidance on how State and local agencies can enhance their speed management programs, policies, and strategies, some critical gaps in our understanding of the problem exist, and additional initiatives are needed in order to more effectively manage speeds to improve roadway departure, intersection, and pedestrian and bicyclist safety. A list of identified gaps and needs are included in Appendix D.

44 In order to promote, disseminate, and expand on the guidance presented in this report, FHWA is developing a National Highway Institute (NHI) training course on integrating speed management within the three safety focus areas, expected to be available in 2018.

APPENDICES

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1. EXECUTIVE SUMMARY

This report summarizes several different analyses which the research team used to evaluate the role of speeding in crashes or safety-critical events.

The **first analysis (Section 2)** summarized characteristics of speeding-related crashes using crash data from the Fatality Analysis Reporting System (FARS) and the General Estimation System (GES). As noted in Section 2, around 31 percent of fatal crashes annually are speeding related, and this trend has been consistent from 2003 to 2012. Around 20.2 percent of injury crashes are speeding related and around 16.2 percent of property damage only crashes are speeding-related.

The research team also summarized characteristics of crashes by crash type, driver characteristics, vehicle characteristics, and roadway/environmental characteristics.

Section 3 further explores characteristics of speeding-related fatal crashes at intersections. Summaries were developed using FARS data from 2010 to 2012. The research team evaluated fatal intersection crashes by type of roadway characteristics, driver characteristics, environmental characteristics, and crash types.

Section 4 evaluates characteristics of speeding-related fatal roadway departure crashes. Summaries were developed using FARS data from 2010 to 2012. The research team evaluated roadway departure crashes by type of roadway, driver, and environmental characteristics as well as by crash types.

Section 5 compares the characteristics of speeding-related fatal pedestrian and bicycle crashes. Summaries were developed using FARS data from 2010 to 2012. The research team evaluated pedestrian and bicycle crashes by type of roadway, driver, and environmental characteristics as well as by crash types.

Section 6 utilized existing summarized data from the Strategic Highway Research Program 2 (SHRP 2) large-scale naturalistic driving study (NDS). The research team queried or extracted baseline and safety critical (crash, near-crash, crash relevant) events from the InSight Data Access Website. The evaluation compares safety-critical events (crash and near-crash) to baseline events to assess the role of speed. Additionally, the research team conducted a typology of characteristics for safety-critical events.

2. ANALYSIS OF THE ROLE OF SPEEDING IN CRASHES USING FARS AND GES DATA

The objective of this section of the report is to summarize characteristics of speeding-related crashes. The research team used crash data from the Fatality Analysis Reporting System (FARS) and General Estimation System (GES). FARS includes all fatal motor vehicle crashes since 1975. A fatal crash is defined as the death of an occupant or a non-occupant within 30 days of the crash (NHTSA, 2012a). More than 100 data elements were coded in FARS including accident, vehicle, driver, occupant, non-occupant, and pre-crash information.

The most recent crash data in FARS was from 2012. The coding structure has gone through many changes over time; in particular, a major change was made in 2009 to address the data consistency between FARS and GES. As a result, the research team primarily used the most recent 3 years of crash data since the changes were made in 2009 (2010 to 2012) for this report.

GES, on the other hand, includes all types of injury severities from minor to fatal and has data available as early as 1988. Non-injury crashes are also included. The research team collected GES data from a nationally representative sample of motor vehicle crashes as reported by police (NHTSA, 2012b).

GES randomly sampled 50,000 police accident reports each year from more than 400 police agencies in the United States. The crashes included in GES must involve at least one motor vehicle traveling on a roadway and must result in property damage, injury, or death. Each crash in the dataset is also assigned with a weight that can be used to estimate the total number of crashes in the United States.

This report included both FARS and GES datasets to estimate the scope of the speeding-related crash problem in the United States.

The raw datasets were downloaded from FARS and GES ftp website. The data manipulation was conducted using R software. The categories used in the charts and figures are based on FARS definitions.

2.1 DEFINITION OF SPEEDING-RELATED CRASHES

The following summarizes the various definitions used to summarize crash information.

Definition of speeding-related crashes: "NHTSA considers a crash to be speeding-related if the driver was charged with a speeding-related offense or if an officer indicated that racing, driving too fast for conditions, or exceeding the posted speed limit was a contributing factor in the crash (Traffic Safety Facts, NHTSA)."

The coding system in FARS and GES contains a set of auxiliary data files which indicate whether a crash was speeding related based on the codes as shown in Table 1.

Table 1. Variable Coding Used in FARS and GES Datasets

Variables	FARS/GES	
	Auxiliary File Name	Field Name
Speeding-related Crashes	ACC_AUX	A_SCRA

The research team used these variables to identify what are termed "speeding-related" crashes in this report.

Definition of Intersection Crashes: The definition was based on the most recent definition provided by FHWA and incorporates intersection and intersection related crashes. An internal memo was the source for this information. Intersection crashes in 2010 or later FARS data are selected to include the following within the "Relation to Junction" field: (2) intersection; (3) intersection-related; (4) driveway access; and (8) driveways access related.

Definition of Roadway Departure Crashes: The definition was based on the most recent provided by FHWA for roadway departure crashes: "A crash in which a vehicle crosses an edge line, a center line, or leaves the traveled way." The research team queried roadway departure crashes in 2010 or later FARS data within the first event for any vehicle to include: (63) Ran Off Road – Right; (64) Ran Off Road – Left); (65) Cross Median; and (68) Cross centerline or include the following within the fixed object codes: 17, 19-43, 46, 52, 53, 57, and 59. The following are also included: (67) Vehicle Went Airborne and (69) Re-entering Roadway.

Definition of Pedestrian and Bicycle Crashes: The definition was based on the most recent provided by FHWA for pedestrian and bicycle crashes. Using 2010 or later FARS data this includes persons who were coded as: (5) Pedestrian; (6) Bicyclist; (7) Other Cyclist; or (8) Person on Personal Conveyance.

2.2. SPEEDING-RELATED CRASHES AT THE NATIONAL LEVEL

This section focuses on the breakdown of speeding-related crashes by crash type, driver characteristics, vehicle characteristics, and roadway environments at the national level. Unless otherwise noted, the information utilizes the most recent three years of data (2010 to 2012).

In most cases data are shown aggregated the crash level. In some cases data are presented at the vehicle or driver level (i.e. age or vehicle type), and this is indicated as such.

2.2.1 General Crash Trends

The trend of speeding-related fatalities in the past 10 years is shown in Figure 1. The number of fatalities has declined over the past 10 years from around 42,000 from 2003 to 2007 to around 33,000 from 2010 to 2012. The percent of fatalities that are speeding related has remained relatively constant at around 31 percent over the past 10 years. NHTSA estimated the annual cost of speeding-related crashes was $40.4 billion (NHTSA, 2012c).

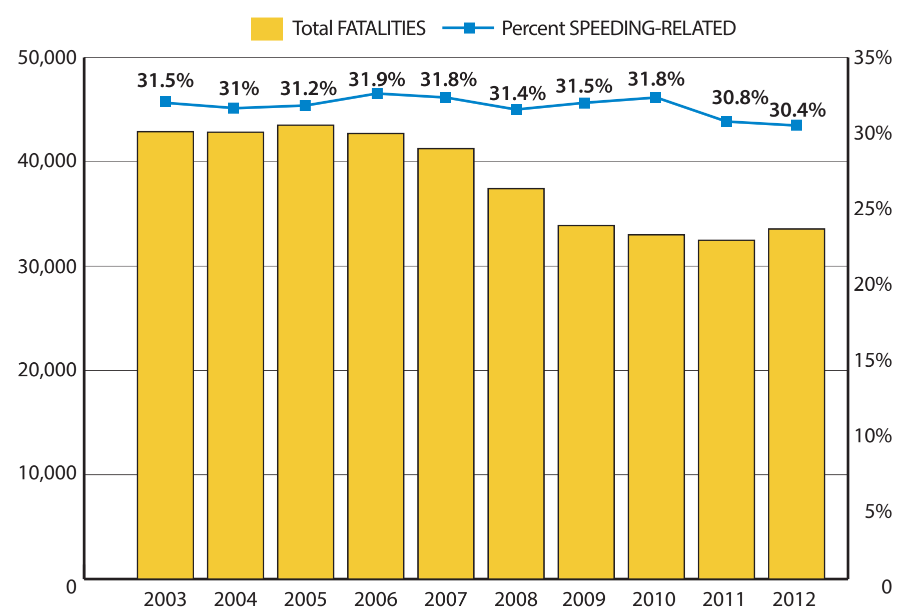

Figure 1: Trend in Fatalities and Speeding-related Fatalities in the United States (Source: FARS, 2003 to 2012)

The number of speeding-related crashes are summarized by injury type as shown in Figure 2. Around 20 percent of injury crashes were speeding related in comparison to around 31 percent of fatal crashes. Speeding-related crashes make up around 16 percent of property damage only crashes.

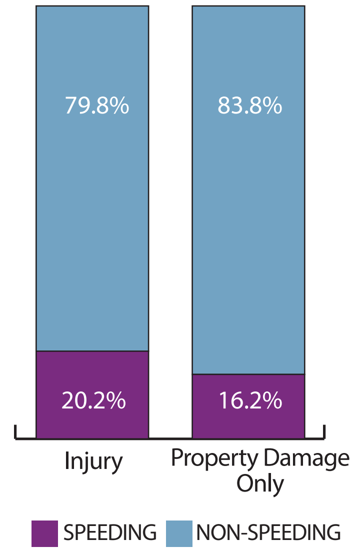

Figure 2: Percentage of Crashes by Injury Type that are Speeding-related (Source: GES, 2010 – 2012)

The percentage of different crash categories of interest are summarized in Figures 3 and 4. Figure 3 illustrates the percentage of roadway, intersection, work zone, and pedestrian and bicycle crashes overall. Roadway departures make up 55.8 percent of fatal crashes in general but only 21.8 percent of all crashes. As a result, roadway departure crashes are more disproportionately likely to be fatal. Work zone crashes make up 1.8 percent of fatal crashes in general and only 0.5 percent of all crashes. Intersection crashes account for 26.4 percent of fatal crashes in general and 50.7 percent of all crashes. Pedestrian and bicycle crashes account for 17.3 percent of fatal crashes in general but account for only 2.4 percent of all crashes. This suggests that intersection crashes are less likely to be fatal than roadway departures, work zones, or pedestrian and bicycle crashes. This also indicates that pedestrian and bicycle crashes are much more likely to result in a fatal crash.

Figure 4 provides similar information for crashes that were coded as speeding-related. As noted roadway departure crashes account for the majority of speeding-related fatal crashes (72.8 percent). In contrast they make up 36.8 percent of all speeding-related crashes. Work zones account for 2.0 percent of speeding-related fatal crashes and 0.5 percent of all speeding-related crashes. Intersections account for less than 20 percent of speeding-related fatal crashes while making up over one-third (37.6 percent) of all speeding-related crashes. Finally, pedestrian and bicycle crashes are 4.7 percent of speeding-related fatal crashes and less than one percent (0.4 percent) of all speeding-related.

It should be noted that the categories in Figures 3 and 4 are not mutually exclusive. A crash coded as a roadway departure could also be a work zone crash, an intersection crash could also be a pedestrian and bicycle crash, etc.

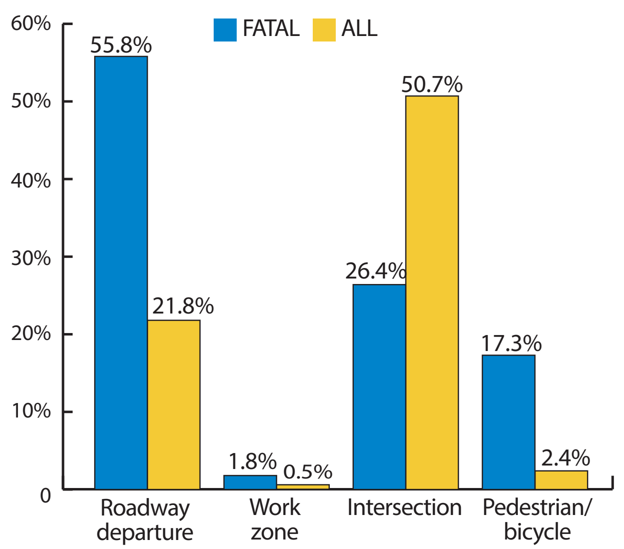

Figure 3: Percentage of Crashes by Crash Category (Source: FARS and GES, 2010 – 2012)

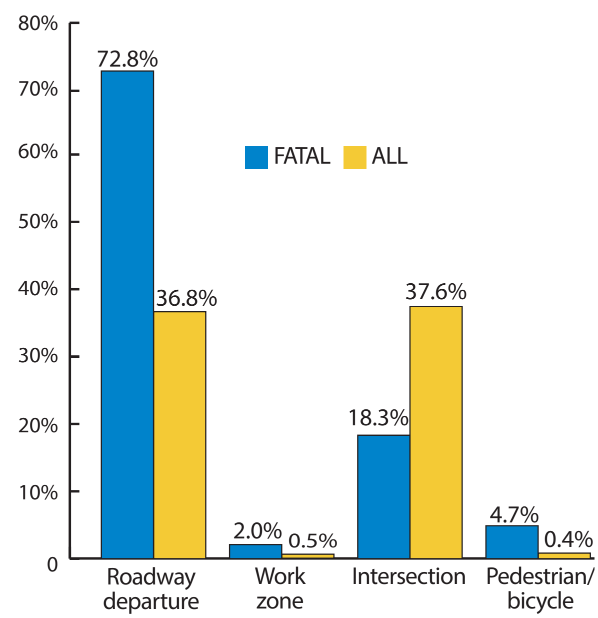

Figure 4: Percentage of Speeding-related Crashes by Crash Category (Source: FARS and GES, 2010 – 2012)

2.2.2 Manner of Collision

Figures 5 and 6 shows fatal crashes by manner of collision. The predominant crash type for both speeding- and non-speeding-related crashes is non-vehicle collisions, which include roadway departures (this is typically single vehicle roadway departure crashes). Manner of collision was similar for speeding versus non-speeding related crashes.

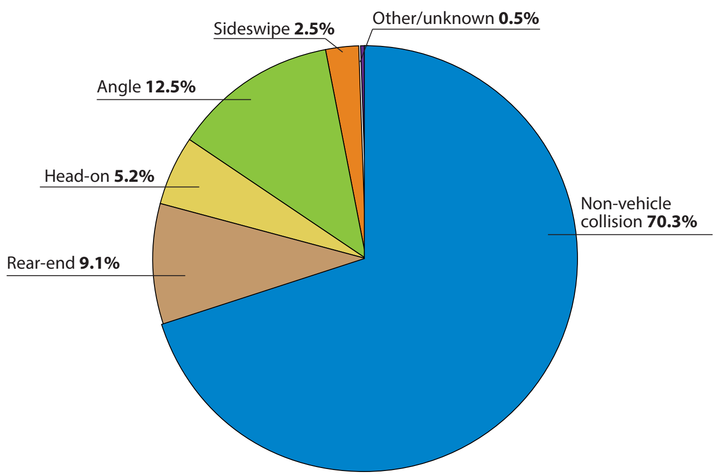

Figure 5: Distribution of Fatal Speeding-related Crashes by Manner of Collision (Source: FARS, 2003 to 2012)

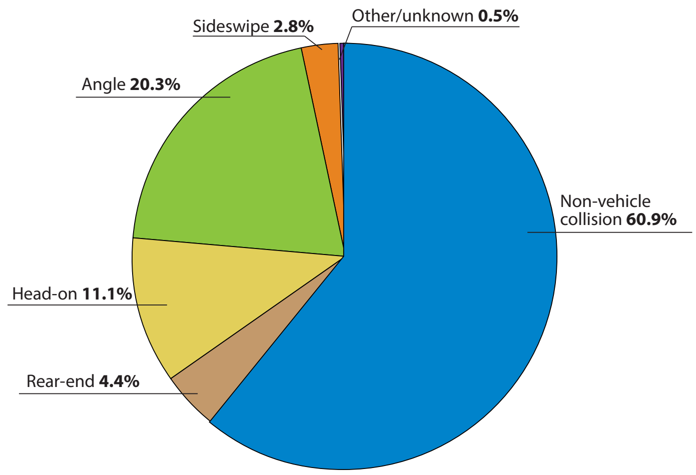

Figure 6: Distribution of Fatal Non-Speeding-related Crashes by Manner of Collision (Source: FARS, 2003 to 2012)

2.2.3 Driver Characteristics

Driver characteristics including driver age, gender, alcohol test results, and previous convictions are summarized in the following sections.

Age and Gender

Figure 7 shows the distribution of drivers involved in speeding-related fatal crashes as a function of age group. The sum of the columns equals 100 percent. For instance 13.5 percent of drivers involved in fatal speeding-related crashes were aged 15 to 20 years old. The largest percentage of drivers involved were aged 21 to 25. Drivers aged 71 to 75 accounted for the fewest number of speeding-related crashes.

Males accounted for 78.2 percent of drivers involved in speeding-related fatal crashes with females making up 22.8 percent. Males make up 73.7 percent of non-speeding-related fatal crashes and females make up 26.3 percent.

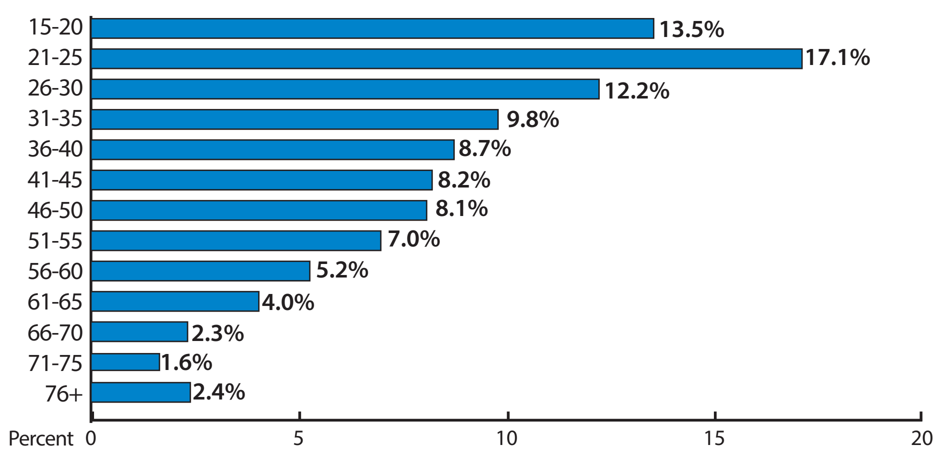

Figure 7: Distribution of Driver Age Involved in Speeding-related Fatal Crashes (Source: FARS, 2010 – 2012)

Blood Alcohol Concentration

Figure 8 shows the distribution of blood alcohol concentration (BAC) for drivers in fatal crashes. Only situations where BAC was reported were included. The left column show the distribution of drivers involved in speeding-related fatal crashes. Each column equals 100 percent. As noted, drivers with BAC of 0.08 or greater made up almost half of drivers involved in speeding-related fatal crashes while those with a BAC between 0.01 to 0.07 made up around 8 percent of all speeding-related crashes. In contrast, only 29 percent of drivers in non-speeding-related fatal crashes had a BAC of 0.08 and higher and 6 percent had a BAC between 0.01 and 0.07.

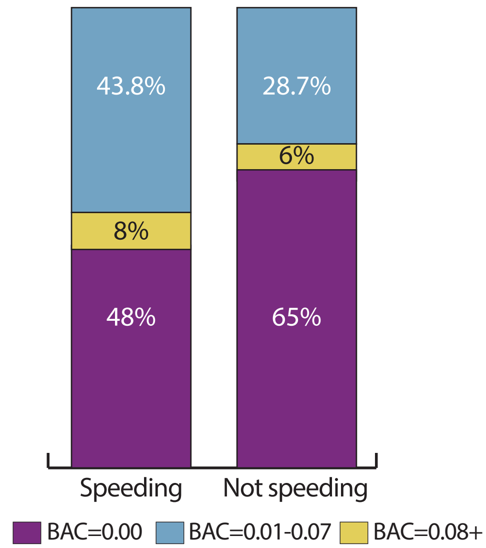

Figure 8: Distribution of Drivers Involved in Fatal Crashes by BAC (Source: FARS, 2010 – 2012)

Convictions

Figure 9 shows speed convictions. The bars show percentage of drivers involved in all fatal crashes by number of convictions. The sum of all columns equals 100 percent. The percentage of drivers for each conviction category which are speeding-related are shown using the trend line.

Drivers with no previous convictions make up almost 80 percent of fatal crashes, around 20 percent of crashes for those crashes were coded as speeding related. In contrast, drivers with one previous conviction make up 12.6 percent of fatal crashes but 26.0 percent of those crashes are speeding related. Drivers with five or more convictions account for 0.2 percent of fatal but 41.1 percent of those crashes are speeding related. Although drivers with more convictions made up only a small share of fatal crashes, when they were involved in a fatal crash, it was much more likely to be coded as being speeding related.

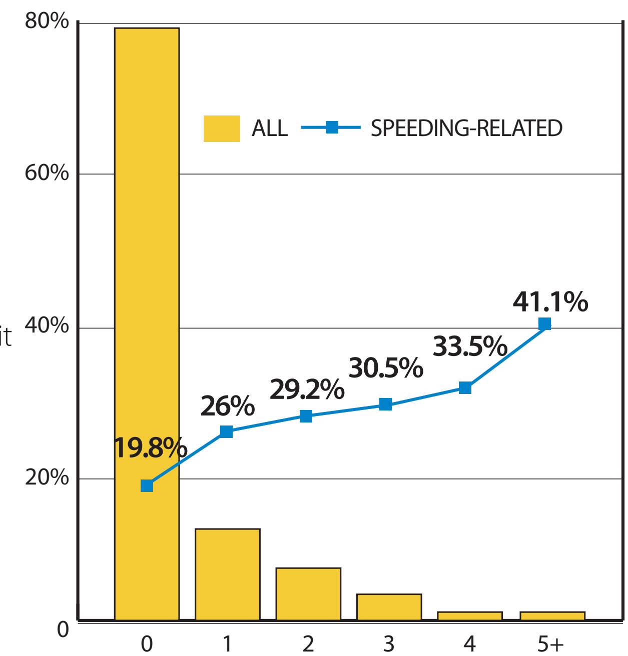

Figure 9. Percentage of Drivers Involved in Fatal Crashes by Previous Convictions (Source: FARS)

2.3 VEHICLE CHARACTERISTICS

Figures 10 and 11 show the type of vehicles involved in speeding-related and non-speeding-related fatal crashes. Passenger cars make up around 40 percent of both speeding- and non-speeding-related crashes. Slightly more light trucks are involved in non-speeding related (34.8 percent versus 32.3 percent). Similarly, large trucks and buses were more likely to be involved in non-speeding-related fatal crashes compared to those that are speeding-related (9.7 percent versus 6.5 percent). As shown, motorcycle fatalities were much more likely to be speeding-related. Motorcycles only account for 9.1 percent of non-speeding-related fatal crashes but they account for 17.4 percent of speeding-related fatal crashes.

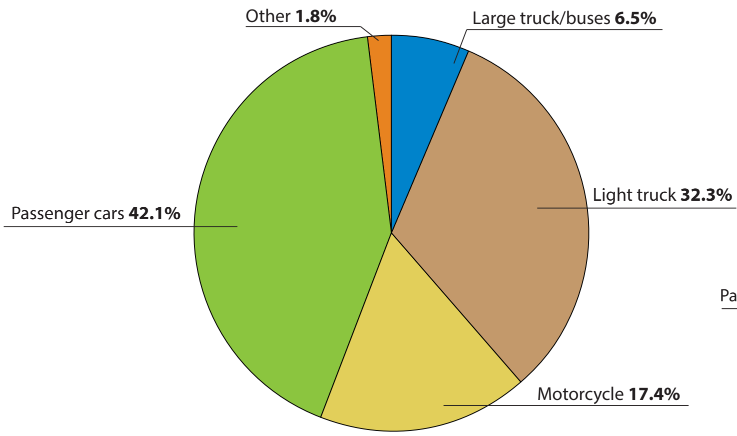

Figure 10: Distribution of Vehicles Involved in Speeding-related Fatal Crashes (Source: FARS, 2010 – 2012)

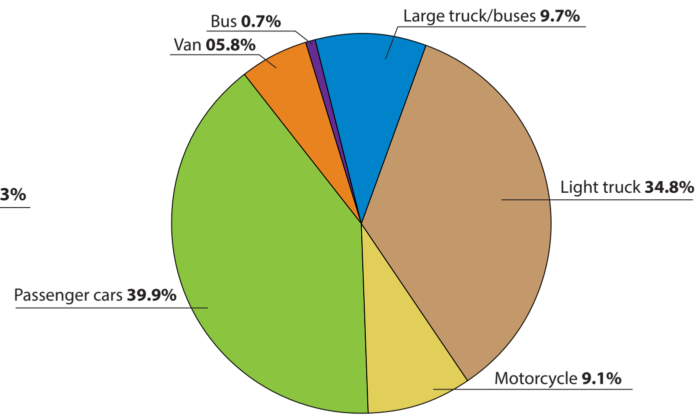

Figure 11: Distribution of Vehicles Involved in Non-Speeding-related Fatal Crashes (Source: FARS, 2010 – 2012)

2.4 ROADWAY AND ENVIRONMENTAL CHARACTERISTICS

This section summarizes the roadway and environmental characteristics of speeding-related crashes.

2.4.1 Roadway Type

Figures 12 and 13 illustrate fatal crashes by roadway type. As the charts indicate, more speeding-related fatal crashes occur on local streets and minor arterials, but more fatal non-speeding-related crashes occur on interstates and principal arterials.

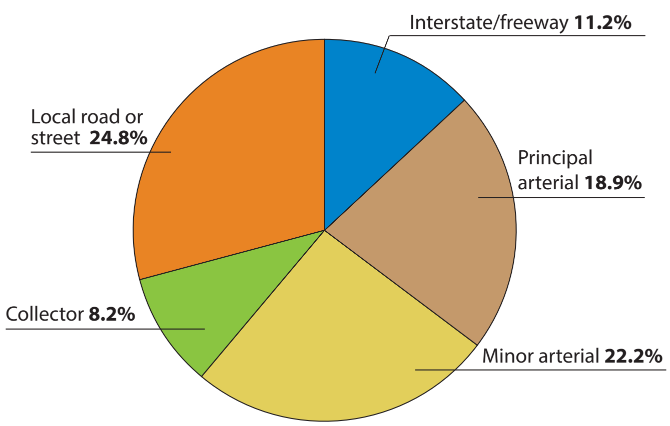

Figure 12. Distribution of Speeding-related Fatal Crashes by Roadway Function Class (Source: FARS, 2010 – 2012)

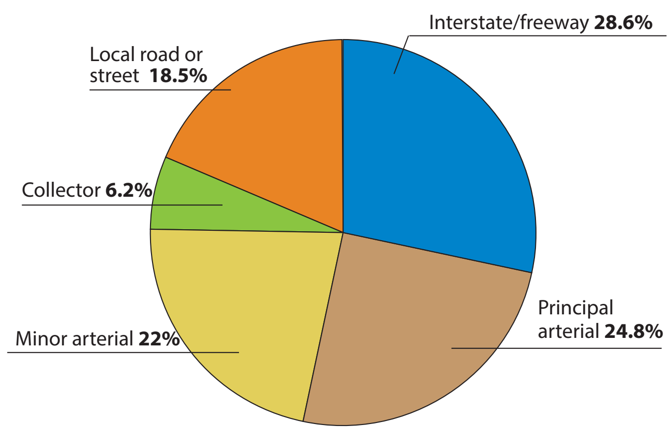

Figure 13. Distribution of Non-Speeding-related Fatal Crashes by Roadway Function Class (Source: FARS, 2010 – 2012)

2.4.2 Speed Limit

Figure 14 shows the percentage of vehicles involved in speeding-related crashes by speed limit of the corresponding roadway. Almost 37 percent of vehicles involved in fatal crashes on roadways posted at 25 mph and lower were coded as speeding-related. Correspondingly, 63.4 percent of crashes on roadways posted 25 mph or lower were non-speeding-related. Only 8.6 percent of vehicles involved in all crashes on roadways in the same speed limit range are speeding-related. As a result, fatal crashes were much more likely to be speeding-related for this roadway category.

In all cases, the percentage of vehicles involved in fatal speeding-related crashes for a particular speed limit range is higher than the number of all crashes that are speeding-related.

In addition, lower speed limit ranges have a higher percentage of vehicles involved in crashes that are coded as speeding-related. For instance, 27.9 percent of vehicles involved in fatal crashes on roadway posted at 60 or more mph were speeding-related while 34.1 percent were coded for roadways posted at 30 to 35 mph. This is likely due to the fact that it is easier to be coded as speeding for lower speed limits.

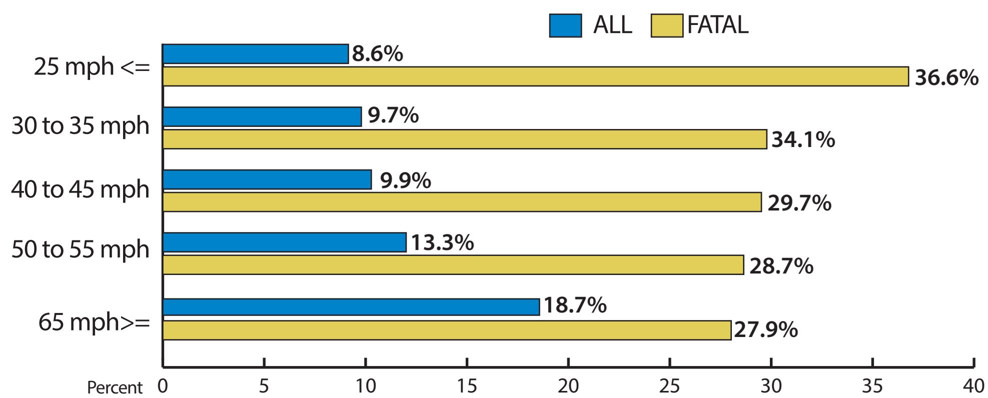

Figure 14: Percentage of Vehicles Involved in Crashes that are Speeding-related by Speed Limit Category (Source: FARS and GES, 2010 – 2012)

2.4.3 Work Zone

Figure 15 summarized the percentage of speeding-related crashes in work zones. Speeding-related crashes account for 35 to 42 percent of fatal work zone crashes, depending on the type of work zone. The percentage of all speeding-related crashes in work zones range from 15 to 27 percent. For instance, 42.4 percent of fatal crashes in utility type work zones were speeding-related while only 14.8 percent of all crashes in utility work zones were speeding-related.

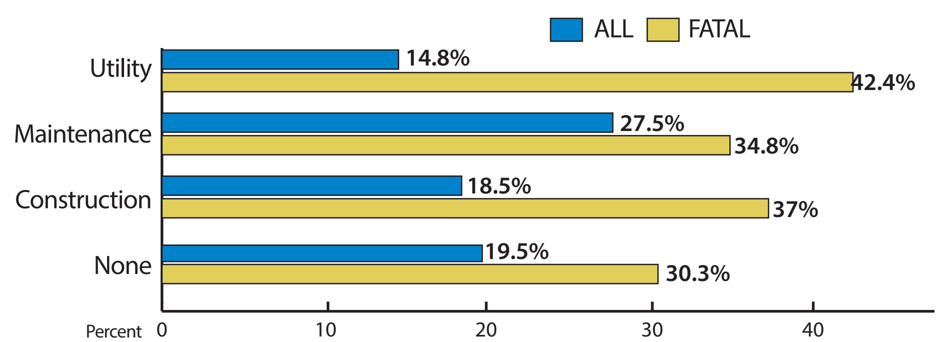

Figure 15: Percentage of Speeding-related Crashes by Work Zone Category (Source: FARS and GES, 2010 – 2012)

2.4.4 Surface Condition

Figure 16 show the percentage of vehicles involved in crashes that were speeding-related by surface condition. As noted, fatal crashes were more likely to be speeding-related for all roadway surface categories. Crashes on roadways where ice, frost, or slush was listed as the surface condition were the most likely to be speeding-related for both fatal and total crashes (41.6 percent and 32.7 percent), respectively.

Crashes on dry roads were the least likely to be coded as speeding-related, with 8.6 percent of all crashes and 20.0 percent of fatal crashes coded as having vehicles on dry roads.

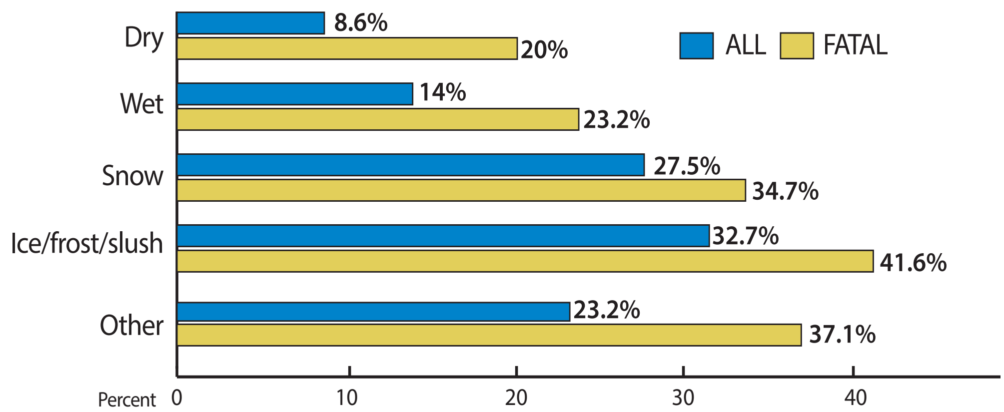

Figure 16: Percentage of Speeding Drivers in Fatal Crashes, by Roadway Surface Condition (2010 – 2012) (Source: FARS and GES)

2.4.5 Horizontal Alignment

Figure 17 showed the distribution of vehicles involved in speeding-related crashes by type of horizontal alignment. As noted, around 60 percent of vehicles involved in fatal speeding-related crashes were on a straight section of roadway while around 40 percent were on some type of horizontal curve. Figure 18 shows the distribution of vehicles involved in all crashes. As indicated, vehicles in all crashes were most likely to be on a straight section (78.7 percent) with around 21 percent occurring on some type of horizontal curves.

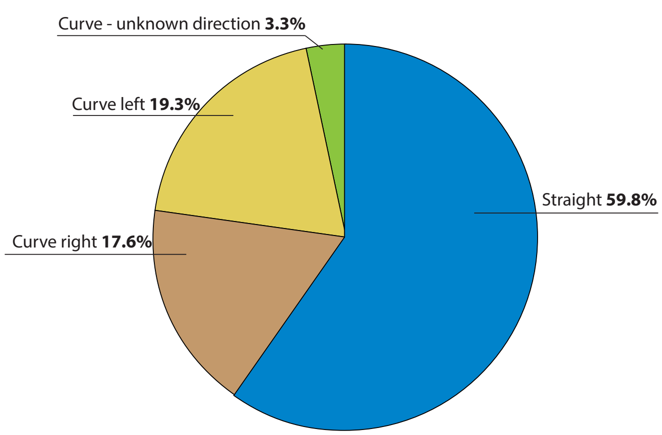

Figure 17: Distribution of Vehicles Involved in Fatal Speeding-related Crashes by Horizontal Alignment (Source: FARS, 2010 – 2012)

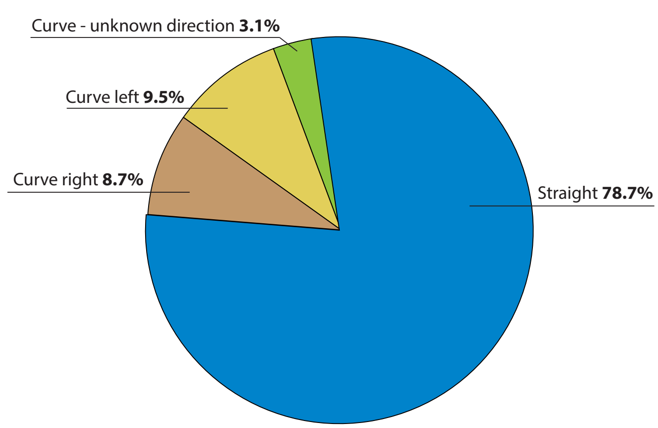

Figure 18: Distribution of Vehicles Involved in All Speeding-related Crashes by Horizontal Alignment (Source: GES, 2010 – 2012)

2.5 SUMMARY

- The percentage of fatalities that are speeding-related has remained relatively constant at around 31 percent over the past 10 years.
- Drivers with a BAC of 0.08 or higher make up almost 44 percent of all fatal speeding-related crashes.
- The percentage of fatal crashes that are speeding-related increases as the number of convictions increase.
- Motorcycle fatalities are more likely to be speeding-related than for other vehicle types. Motorcycle crashes make up 17.4 percent of speeding-related fatal crashes compared to 9.1 percent of non-speeding-related fatal crashes.
- More speeding-related fatal crashes occur on local streets and minor arterials than other roadway types.
- Snow or ice/frost/slush roadway conditions account for more speeding-related fatal crashes than other roadway conditions.
- The majority of speeding-related fatal crashes at intersections occurred in rural areas (67 percent).
- From 35 to 42 percent of work zone fatal crashes are speeding-related depending on the type of work zone.

3. ANALYSIS OF THE ROLE OF SPEEDING-RELATED FATAL CRASHES AT INTERSECTIONS USING FARS DATA

This chapter describes characteristics for fatal speeding-related intersection crashes. Crashes in the FARS databases were extracted based on the most recent definition utilized by FHWA as described in Chapter 2. Intersection crashes were extracted from the FARS data for 2010 to 2012.

The majority of fatal crashes at intersections occurred in rural areas (38 percent) while 35 percent of speeding-related fatal crashes occurred in rural areas.

3.1 ROADWAY CHARACTERISTICS

Many roadway characteristics within FARS are reported at the vehicle level. Since roadway characteristics were coded at the vehicle level and more than one vehicle may be involved in a crash, more than one roadway characteristic may be reported for each crash. For instance a crash between a vehicle at a major and minor approach for a two-way stop would be reported as "no control" and "stop sign."

3.1.1 Traffic Control

Figure 19 shows the distribution of all vehicles involved in speeding-related fatal crashes by type of intersection traffic control. Percentages for the pie chart add up to 100 percent. As indicated, 28 percent of all vehicles involved in fatal speeding-related intersection crashes were at an intersection with a traffic signal, 15 percent occurred at stop-controlled intersections, and 51 percent occurred at intersections with no stop control.

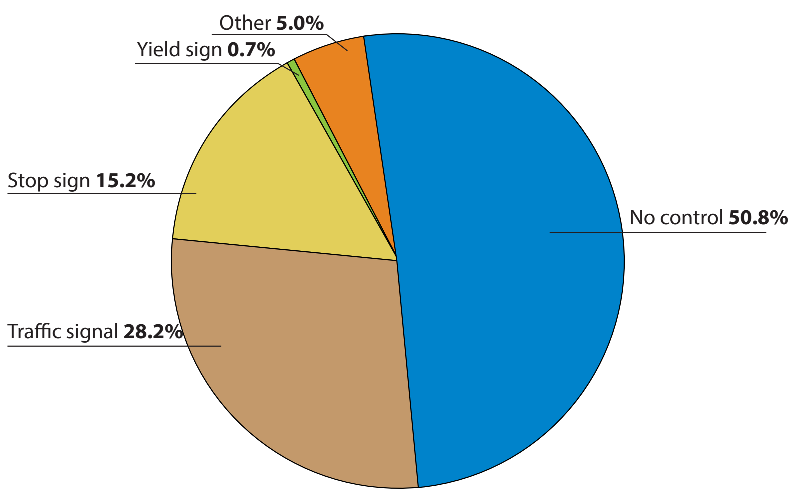

Figure 19: Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Intersection Traffic Control (Source: FARS 2010 – 2012)

Figure 20 shows the percentage of vehicles involved in fatal intersection crashes that were coded as speeding-related by type of intersection traffic control where the crash occurred. Each bar shows the total percentage of vehicles for that category (i.e. each bar equals 100 percent). As shown, 11.4 percent of vehicles involved in fatal crashes that occurred on an intersection approach with a traffic signal were coded as being speeding-related while 88.6 percent were not speeding-related. The type of intersection traffic control with the highest percentage of vehicles involved in speeding-related fatal crashes was yield signs, with 13.1 percent. The lowest percentage of vehicles involved in speeding-related fatal crashes was at stop signs, with 10.3 percent.

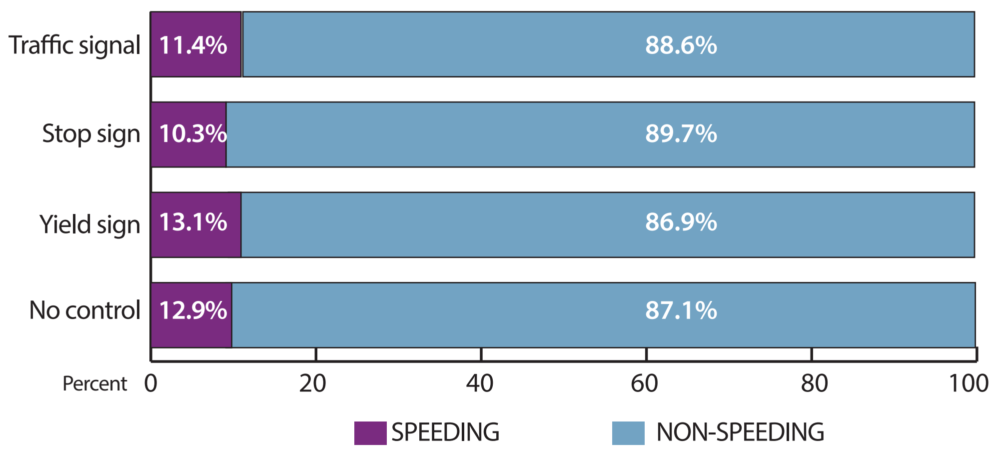

Figure 20: Percentage of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Intersection Traffic Control (Source: FARS 2010 – 2012)

3.1.2 Intersection Type

Figure 21 shows the distribution of all vehicles involved in speeding-related fatal crashes by type of intersection. The majority of vehicles involved in fatal speeding-related intersection crashes occurred at intersections with four approaches (45.1 percent). Roundabouts and traffic circles made up less than 1 percent and T-intersections accounted for 34.2 percent of vehicles involved in fatal speeding-related crashes at intersections.

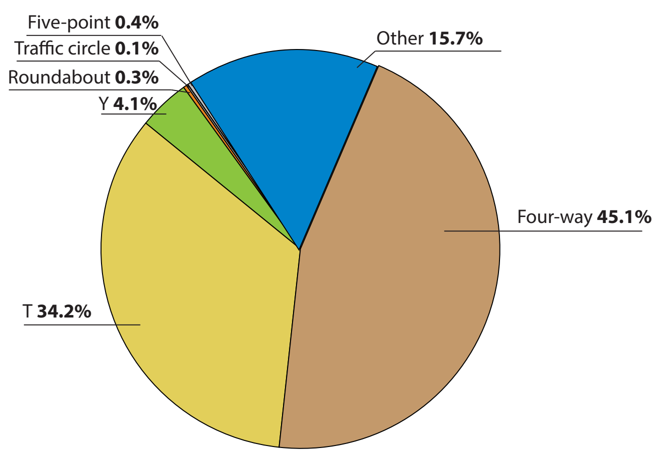

Figure 21: Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Intersection Type (Source: FARS 2010 – 2012)

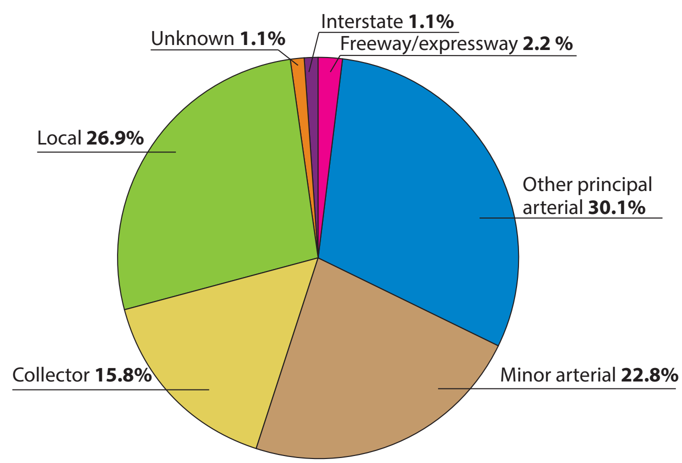

Figure 22: Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Type of Roadway (Source: FARS 2010 – 2012)

3.1.3 Roadway Type

Figure 22 shows the distribution of vehicles involved in speeding-related fatal intersection crashes by type of roadway. As the chart shows, the majority of vehicles involved in speeding-related intersection crashes were coded as being on principal arterials (30.1 percent), which excludes freeway, expressways, and interstates. A large percentage of vehicles were coded as being on minor arterials and local roads—22.8 percent and 26.9 percent, respectively.

Figure 23 shows the percentage of vehicles involved in speeding-related fatal intersection crashes by type of roadway. The percentages for each bar equal 100 percent.

As shown, the highest percentage of vehicles involved in speeding-related fatal intersection crashes was for interstates, at 28.9 percent. Other principal arterials had the lowest percentage of vehicles coded as speeding-related intersection crashes (17.8 percent). The remaining roadway types had similar fractions of vehicles involved in speeding-related fatal intersection crashes with 20.5 and 26.3 percent.

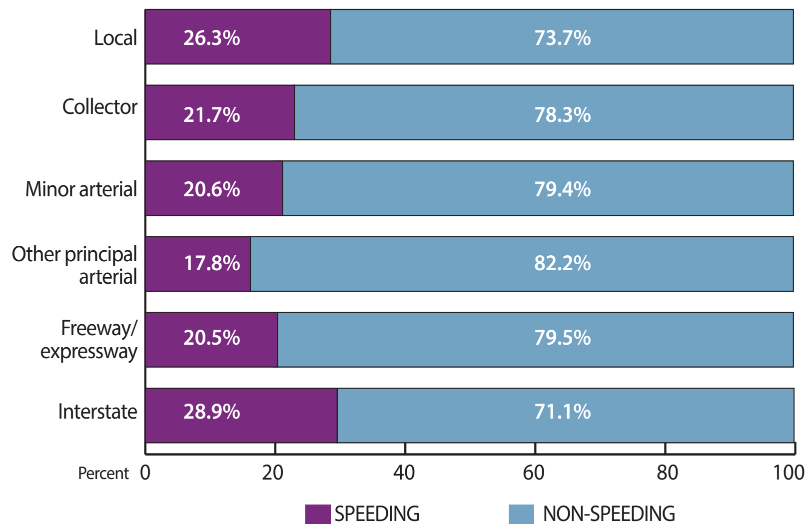

Figure 23: Percentage of Vehicles Involved Speeding-related Fatal Intersection Crashes by Type of Roadway (Source: FARS 2010 – 2012)

3.1.4 Speed Limit

Figure 24 shows the distribution of all vehicles involved in speeding-related fatal intersection crashes by speed limit. It should be noted that speed limit is correlated to roadway type. The largest share of vehicles involved in speeding-related intersection crashes, 30.1 percent, occur on roadways with speed limits of 40 or 45 miles per hour (mph). This is followed by roadways posted at 30 to 35 mph, with 27.9 percent.

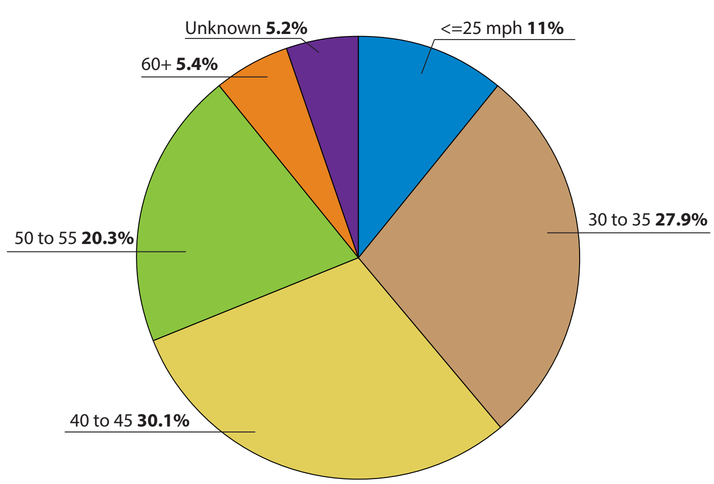

Figure 24: Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010 – 2012)

Figure 25 shows the percentages of vehicles involved in fatal intersection fatal intersection crashes for each speed limit category. Each bar shows the percentage of fatal crashes for that category (speeding and non-speeding related for each bar equals 100 percent).

As noted, almost 30 percent of vehicles involved in fatal intersection crashes at approaches which were signed at 25 mph or less were coded as speeding related. Only 17.3 percent of vehicles involved in fatal crashes at intersections/interchanges on approach roadways posted at 60 mph or higher were coded as speeding-related.

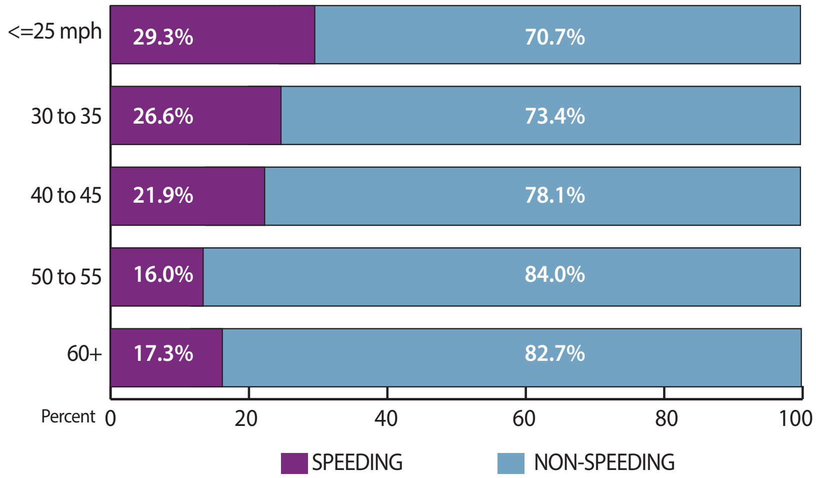

Figure 25: Percentage of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010 – 2012)

3.2 DRIVER CHARACTERISTICS

Males made up 71.2 percent of drivers involved in fatal crashes at intersections. They accounted for 76.6 percent of speeding-related fatalities at intersections.

3.2.1 Age and Gender

Figure 26 shows the percentage of drivers by age and gender who were involved in fatal intersection crashes which were coded as speeding-related. Each bar shows the percentage of speeding-related fatal crashes for that category. As the chart indicates, 20.8 percent of female drivers aged 15 to 20 who were involved in a fatal crash were coded as speeding-related. Conversely 79.2 percent of female drivers in that age group were not coded as speeding-related.

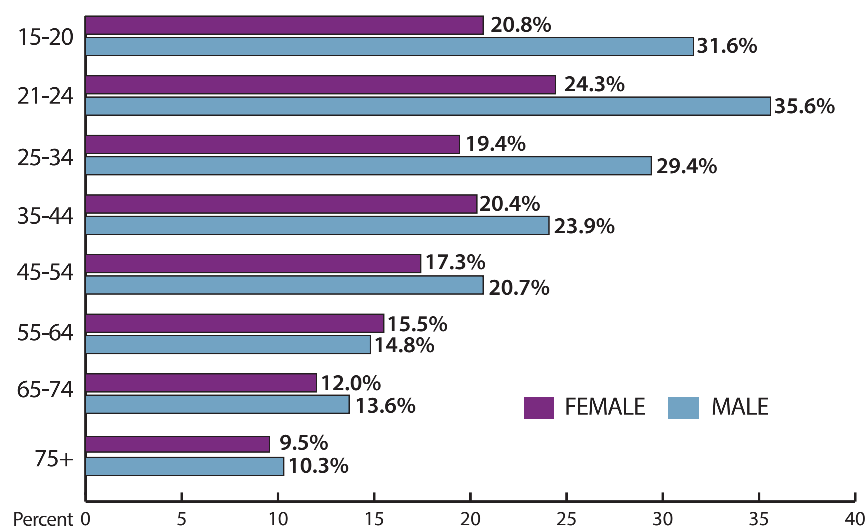

Figure 26: Percentage of Drivers by Age and Gender Involved in Speeding-related Fatal Intersection Crashes (Source: FARS 2010 – 2012

The age group 21 to 24 years had the highest fraction of speeding-related crashes for both male and females. As illustrated, almost 36 percent of male drivers aged 21 to 24 involved in intersection fatalities were coded as speeding-related while 24.3 percent of female drivers aged 21 to 24 were coded as speeding-related. Older drivers had the lowest fraction with around 10 percent for both female and males being coded as speeding-related.

3.2.2 Blood Alcohol Concentration

Figure 27 shows the distribution of drivers who were involved speeding-related intersection fatal crashes by blood alcohol concentration (BAC). As noted, BAC was not known for the majority of crashes (48.1 percent). Around one-third of drivers had a positive BAC while no BAC was noted in around 17.0 percent of fatal crashes.

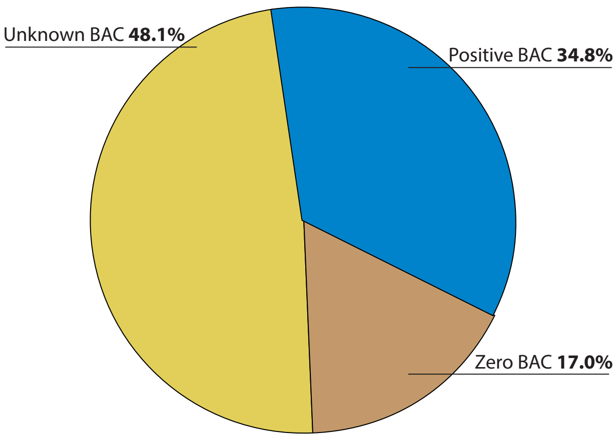

Figure 27: Distribution of Speeding-related Fatal Crashes by BAC (Source: FARS 2010 – 2012)

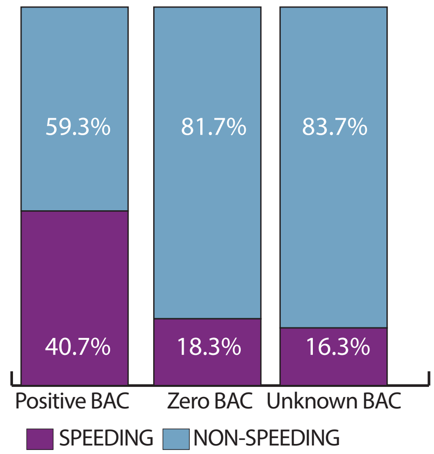

Figure 28: Percentage of Drivers Involved in Fatal Intersection Crashes by BAC (Source: FARS 2010 – 2012)

The percentage of drivers involved in fatal intersection crashes by BAC is provided in Figure 28. Each column shows the distribution for that particular category and the column totals to 100 percent.

The data show that drivers involved in fatal intersection crashes with positive BAC were more likely to be speeding-related than those with zero or unknown BAC. Around 41 percent of fatal intersection crashes where the driver had a positive BAC were speeding-related. Only 18 percent of fatal intersection crashes where the driver had zero BAC were speeding-related.

3.3 ENVIRONMENTAL CHARACTERISTICS

Fatal crashes by at intersections by time of day were summarized.

3.3.1 Time of Day

Figure 29 shows the distribution of speeding-related intersection fatal crashes by time of day. As noted, around half of crashes occurred during the daytime with the remaining occurring during nighttime or dawn/dusk. Thirty-two percent of fatal intersection crashes occurred during nighttime at intersections with lighting and 15 percent occurred at intersections with no lighting.

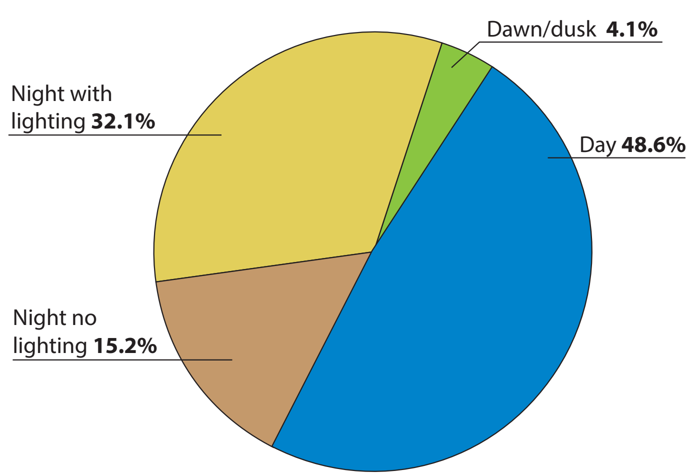

Figure 29: Distribution of Speeding-related Fatal Intersection Crashes by Time of Day (Source: FARS 2010 – 2012)

Figure 30 shows the percentage of speeding-related fatal crashes by time of day (each bar equal 100 percent). As shown, 21 percent of fatal intersection crashes that occurred during dawn/dusk were speeding-related. Around 24 percent of fatal intersection crashes that occurred during the nighttime with no lighting were speeding-related, and speeding-related crashes accounted for 28 percent of crashes that occurred during the night with lighting. Only 17 percent of fatal crashes that occurred during the daytime at intersections were speeding-related.

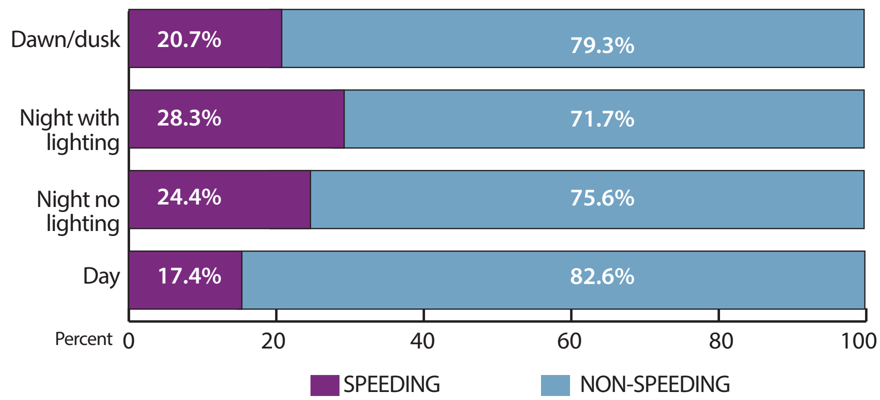

Figure 30: Percentage of Speeding-related Fatal Intersection Crashes by Time of Day (Source: FARS 2010 – 2012)

3.3.2 Hour of Day

Figure 31 shows the distribution of speeding-related fatal intersection crashes by hour of the day. As noted, the majority of speeding-related crashes occurred from 6 p.m. to midnight (31.3 percent) followed by mid-day (10 a.m. to 4 p.m.) at 23.2 percent.

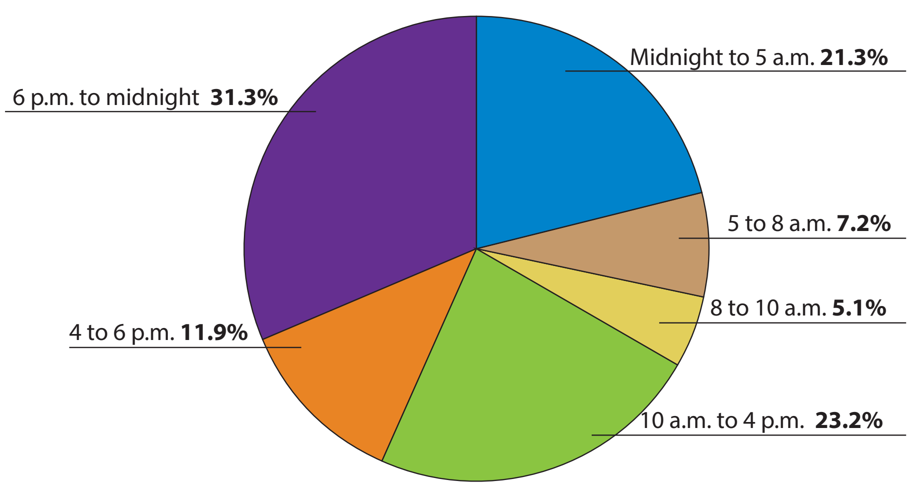

Figure 31: Distribution of Speeding-related Fatal Intersection Crashes by Hour of Day (Source: FARS 2010 – 2012)

Figure 32 illustrates the percentage of speeding-related fatal intersection crashes by hour of day (each bar equals 100 percent). More than 22 percent of fatal intersection crashes that occurred from 6 p.m. to midnight were speeding-related. The percentage of speeding-related crashes was highest during the early hours of the day (midnight to 5 a.m.) at 41.4 percent. The percentage of speeding-related intersection crashes were much lower during daytime periods with 15.4 to 19.2 percent between 5 a.m. to 6 p.m. A higher percentage (22.8 percent) of speeding-related crashes accounted for fatal crashes during the 6 p.m. to midnight period.

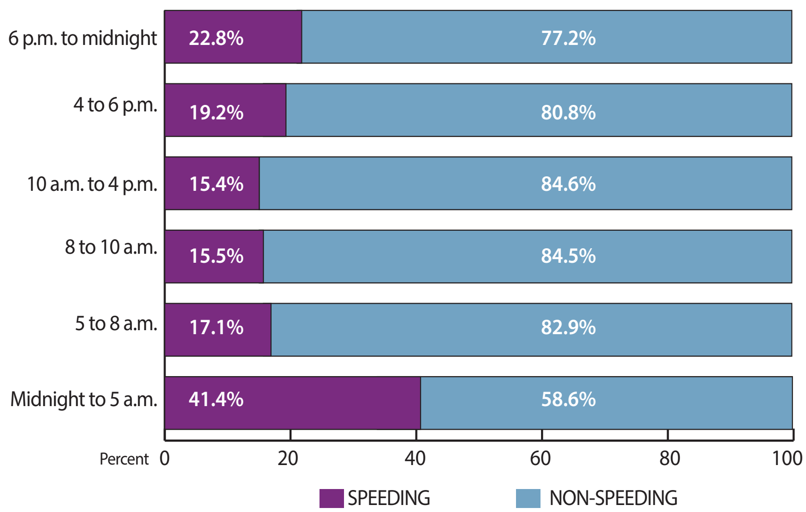

Figure 32: Percentage of Fatal Intersection Crashes that are Speeding-related by Hour of Day (Source: FARS 2010 – 2012)

3.3.3 Surface Condition

Figure 33 shows the distribution of surface conditions for speeding-related fatal intersection crashes. Surface conditions are reported by vehicle. The majority of vehicles involved in speeding-related fatal crashes at intersections were on dry roads (89 percent) with 8 percent being on a wet roadway surface.

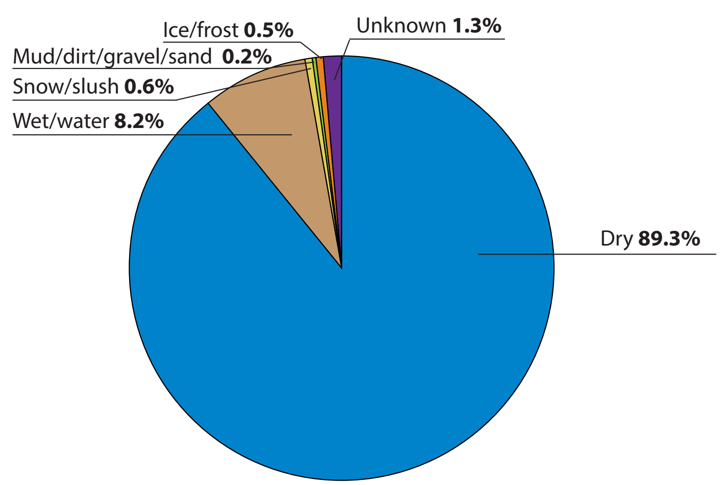

Figure 33: Distribution of Speeding-related Fatal Intersection Crashes by Roadway Surface Condition (Source: FARS 2010 – 2012)

3.4 VEHICLE TYPE

The distribution of vehicles involved in fatal intersection crashes by vehicle type is shown in Figure 34. Passenger vehicles were the most likely to be involved in speeding-related intersection crashes, making up 42.1 percent of all vehicles involved in these types of crashes. At 6.5 percent, large trucks represented the smallest share of vehicles involved in speeding-related intersection crashes.

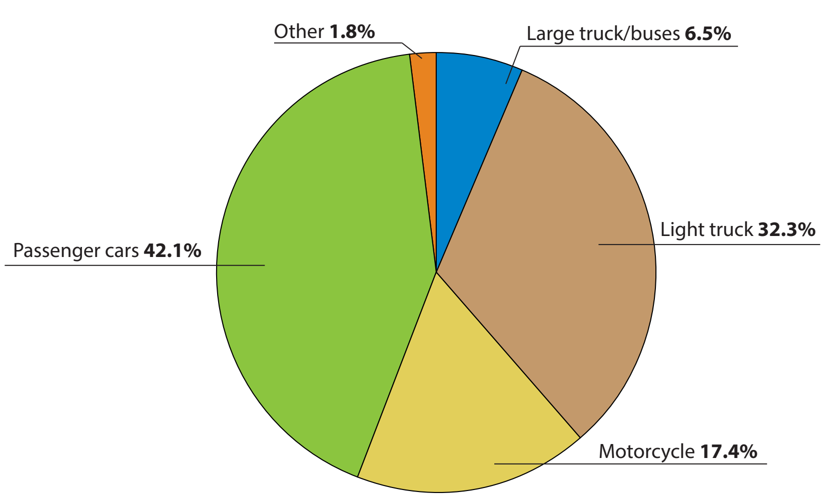

Figure 34: Distribution of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Type of Vehicle (Source: FARS 2010 – 2012)

The fraction of fatal intersection crashes by vehicle types that were speeding-related is shown in Figure 35. Each bar shows the distribution for that vehicle type.

Over 22 percent of passenger cars involved in fatal crashes at intersections were coded as being speeding-related (conversely 78 percent were not speeding-related). Motorcycles ranked highest, with 28.6 percent of motorcycles involved in fatal intersection crashes being coded as speeding-related. Large trucks were the least likely to be coded as speeding-related at 19.1 percent.

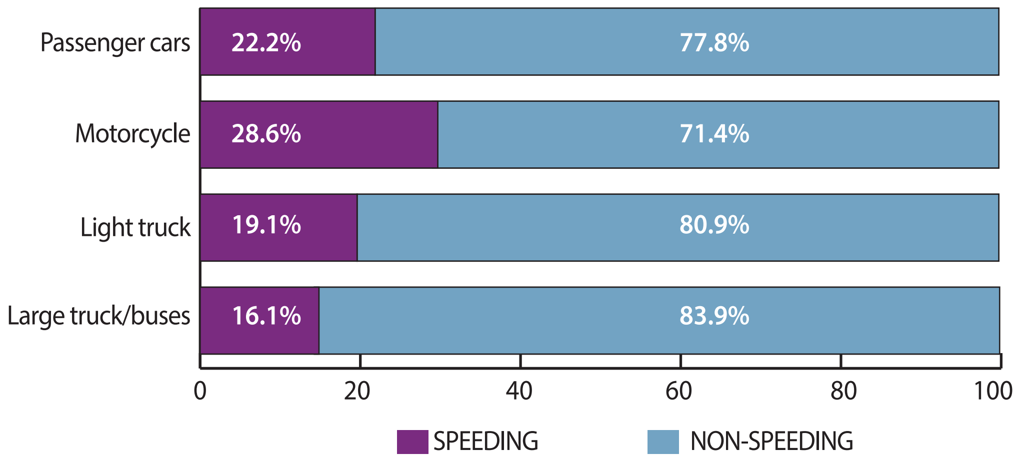

Figure 35: Percentage of Vehicles Involved in Speeding-related Fatal Intersection Crashes by Type of Vehicle (Source: FARS 2010 – 2012)

3.5 CRASH TYPE

Fatal intersection crashes were disaggregated by crash type as shown in Figure 36. As noted, angle crashes made up the highest percentage of speeding-related intersection fatal crashes (41.3 percent). Collisions with non-vehicle objects accounted for 39.4 percent of speeding-related fatal crashes at intersections.

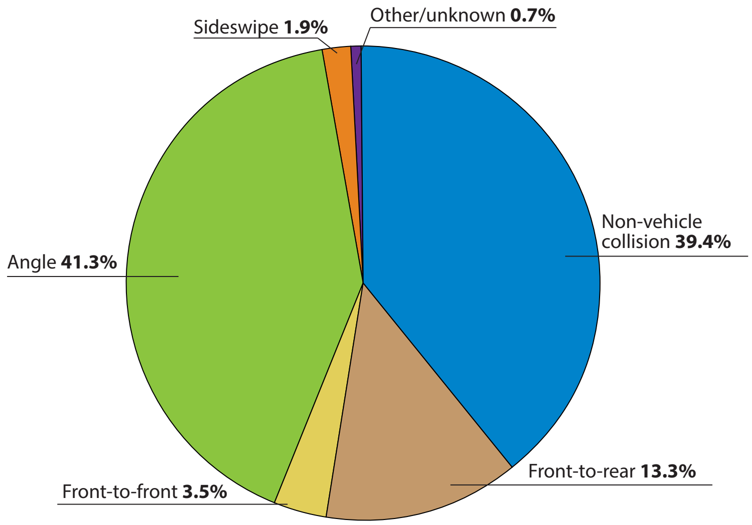

Figure 36: Distribution of Speeding-related Intersection Fatal Crashes by Crash Type (Source: FARS 2010 – 2012)

The distribution of first harmful event for speeding-related fatal intersection crashes is shown in Figure 37. As noted, the majority of crashes involve a collision with another vehicle (60.1 percent). Collision with a pedestrian or bicyclist make up 5.5 percent of speeding-related intersection fatal crashes. Collisions with traffic signals, signs, utility poles, light posts, and trees collectively account for 4.5 percent.

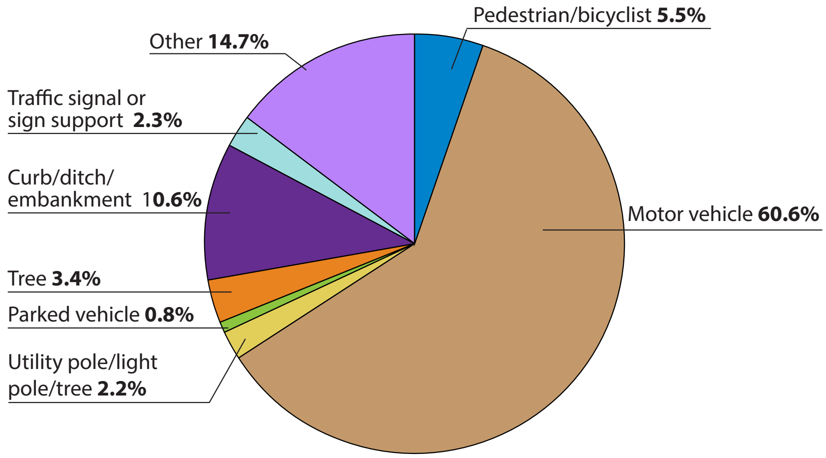

Figure 37: Distribution of Speeding-related Intersection Fatal Crashes by First Harmful Event (Source: FARS 2010 – 2012)

3.6 CHARACTERISTICS OF ANGLE CRASHES

This section summarizes characteristics of angle crashes. Type of crash was determined from manner of collision. Due to the manner in which this field is coded in FARS, right angle crashes could not be differentiated. As a result, this section summarizes characteristics of all angle crashes. Left-turn crashes were included in angle crashes. Since left-turn crashes could be inferred from a vehicle's pre-event movement, a separate summary for left turn crashes is also provided in Section 3.8.

Data for the analyses in this section were reduced at the vehicle level. Notably, 30 percent of fatal intersection angle crashes occurred in rural areas.

3.6.1 Speed Limit

Figure 38 shows the distribution of vehicles involved in fatal angle crashes by the posted speed limit of the corresponding roadway. Around 72 percent of vehicles involved in speeding-related fatal broadside intersection crashes were on roadways posted lower than 50 mph and around 23 percent were on facilities signed at 50 mph or higher.

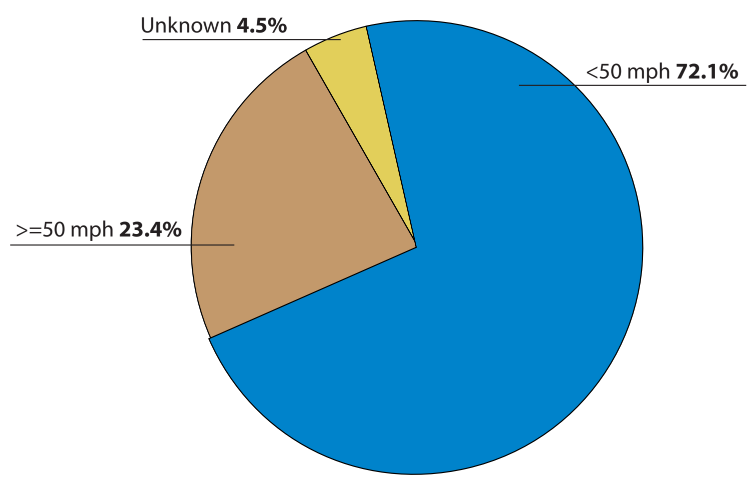

Figure 38: Distribution of Vehicles Involved Speeding-related Fatal Angle Crashes at Intersections by Speed Limit (Source: FARS 2010 – 2012)

3.6.2 BAC

Driver alcohol involvement in fatal angle crashes at intersections that are speeding-related are shown in Figure 39. Blood alcohol concentrations was not known in the majority of crashes (57.3 percent) while 28.1 percent had a positive BAC.

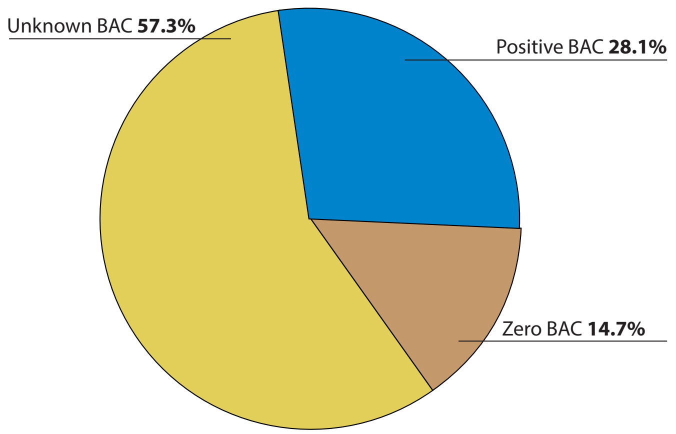

Figure 39: Distribution of Drivers Involved in Speeding-related Fatal Angle Crashes at Intersections by BAC (Source: FARS 2010 – 2012)

3.6.3 Surface Condition

Roadway surface for speeding-related fatal angle crashes at intersections is shown in Figure 40. As noted, the majority of vehicles involved were coded as being on dry roads (90.9 percent).

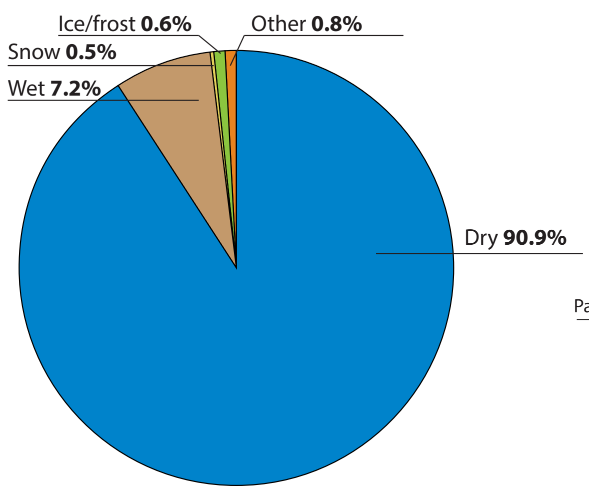

Figure 40: Distribution of Vehicles Involved in Speeding-related Fatal Angle Crashes at Intersections by Roadway Surface Condition (Source: FARS 2010 – 2012)

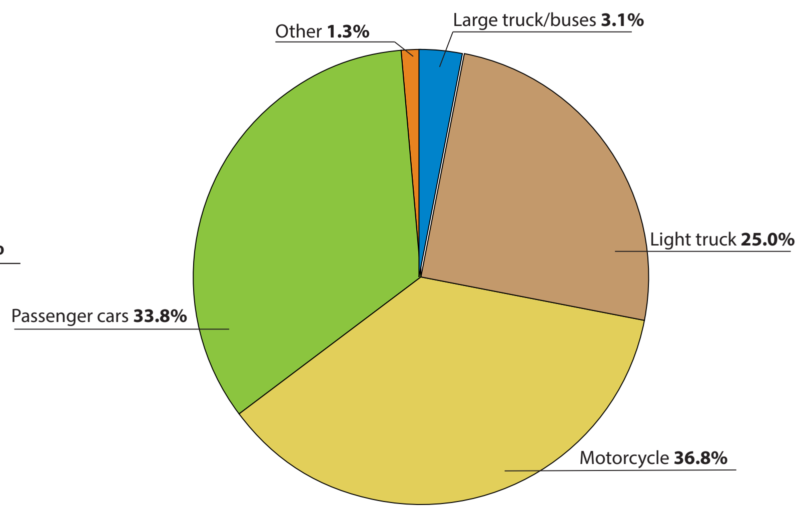

Figure 41: Distribution of Vehicles Involved in Speeding-related Fatal Angle Crashes at Intersections by Vehicle Type (Source: FARS 2010 – 2012)

3.6.4 Vehicle Type

Vehicle involvement in fatal angle crashes at intersections that are speeding-related is shown in Figure 41. As noted motorcycles make up the majority of fatal speeding-related broadside crashes (36.8 percent) followed by passenger vehicles (33.8 percent).

3.7 CHARACTERISTICS OF REAR-END CRASHES

Rear-end crashes make up 6.4 percent of all fatal crashes at intersections but make up 13.3 percent of speed-related fatal crashes at intersections. Around 44 percent of rear-end fatal intersection crashes were in rural areas. This section summarizes characteristics of fatal rear-end intersection crashes. Data were summarized at the vehicle level.

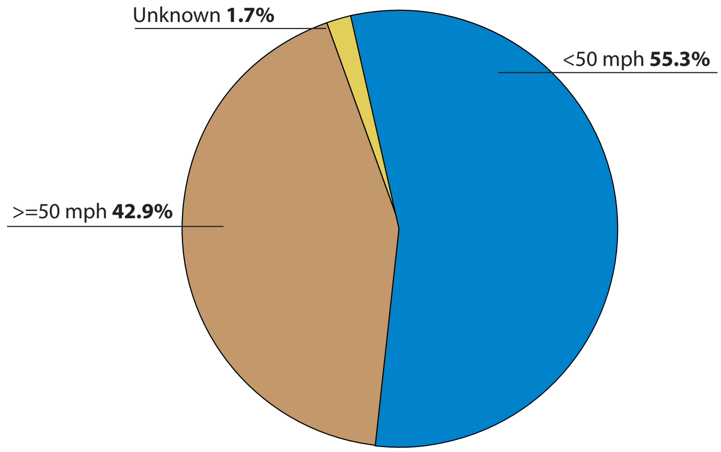

Figure 42: Distribution of Vehicles Involved in Speeding-related Fatal Rear-end Intersection Crashes by Speed Limit (Source: FARS 2010 – 2012)

3.7.1 Speed Limit

Figure 42 shows the distribution of vehicles involved in fatal rear-end crashes at intersections that were speeding-related. As shown, approximately 55 percent were on roadways posted lower than 50 mph and around 43 percent were on facilities signed at 50 mph or higher.

3.7.2 Blood Alcohol Concentration

The distribution of drivers involved in fatal rear-end intersection crashes that are speeding-related broken out by BAC are shown in Figure 43. Blood alcohol concentrations were not known in the majority of crashes (67.7 percent) while 23.2 percent had a positive BAC. Drivers with zero BAC accounted for less than 10 percent of drivers involved.

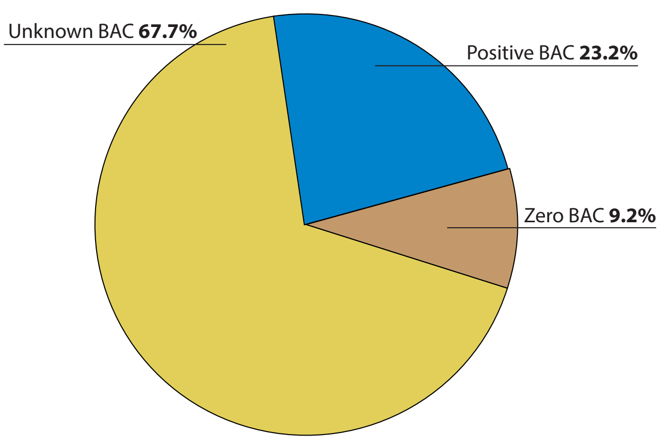

Figure 43: Distribution of Drivers Involved in Fatal Rear-End Intersection Crashes that are Speeding-related by BAC (Source: FARS 2010 – 2012)

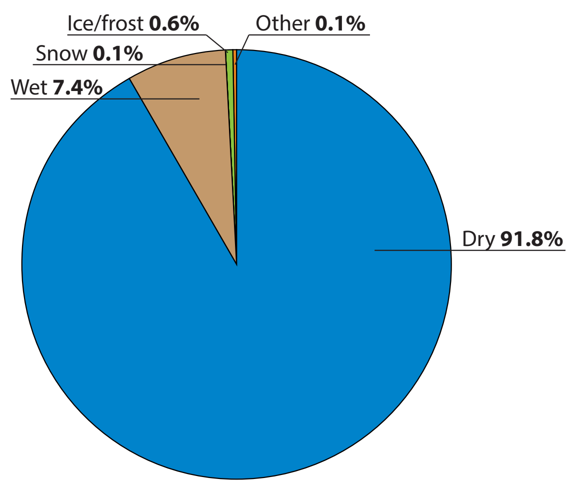

Figure 44: Distribution of Vehicles Involved in Speeding-related Fatal Rear-end Intersection Crashes by Roadway Surface (Source: FARS 2010 – 2012)

3.7.3 Surface Condition

Roadway surface for vehicles involved in speeding-related fatal rear-end intersection crashes is shown in Figure 44. As noted, the majority of vehicles involved in fatal rear-end crashes that were speeding-related occurred under dry road conditions (91.8 percent). Slightly more than 7 percent occurred on wet roads and less than 1 percent occurred on other surface conditions.

3.7.4 Vehicle Type

The distribution of vehicles involved in fatal rear-end crashes at intersections that are speeding-related is shown in Figure 45. As noted light trucks make up the majority of fatal involvement (38.0 percent) followed by passenger vehicles at 33.4 percent. Motorcycles accounted for 18.8 percent of speeding-related fatal rear-end crashes, and large truck/buses made up 9.1 percent.

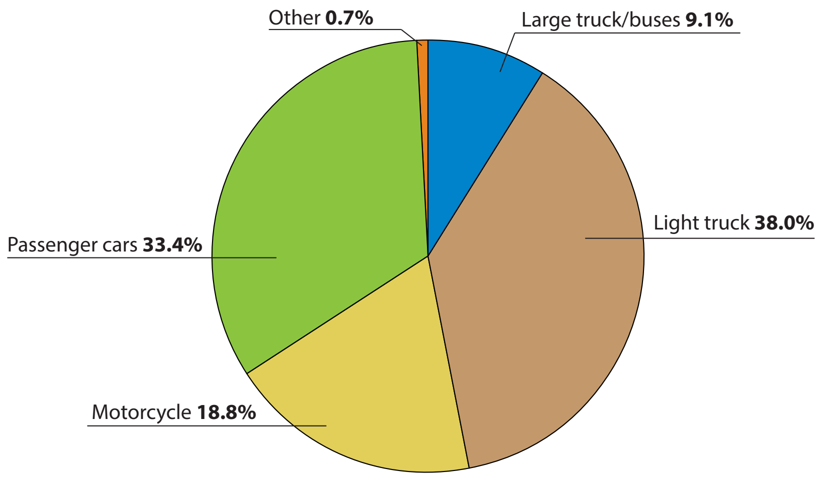

Figure 45: Distribution of Vehicles Types Involved in Speeding-related Fatal Rear-end Intersection Crashes (Source: FARS 2010 – 2012)

3.8 CHARACTERISTICS OF LEFT-TURN CRASHES

This section summarizes characteristics of left-turn crashes. Data for analysis in this section were reduced at the vehicle level. Left-turn crashes could be inferred from a vehicle's pre-event movement. Left-turn crashes were also included in angle crashes, which were summarized in Section 3.6. Notably, 31 percent of fatal intersection angle crashes occurred in rural areas.

3.8.1 Posted Speed Limit

Figure 46 shows the distribution of vehicles involved in left-turn crashes by the posted speed limit of the corresponding roadway. Around 67 percent of vehicles involved in speeding-related fatal left-turn intersection crashes were on roadways posted lower than 50 mph and around 25 percent were on facilities signed at 50 mph or higher.

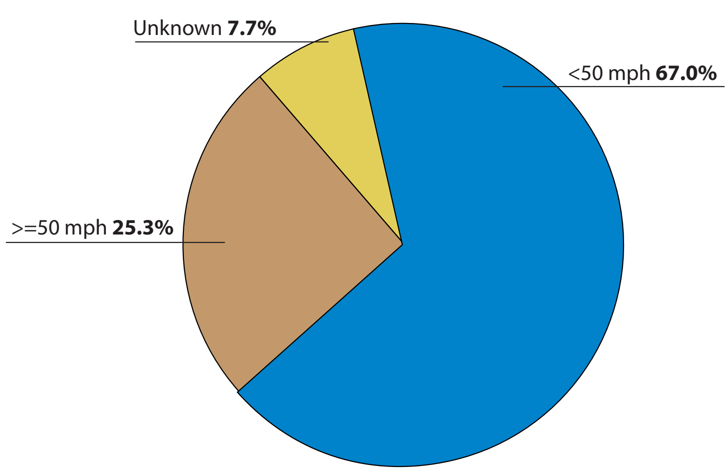

Figure 46: Distribution of Vehicles Involved in Speeding-related Fatal Left-turn Intersection Crashes by Speed Limit (Source: FARS 2010 – 2012)

3.8.2 Blood Alcohol Concentration

The distribution of drivers involved in fatal left-turn intersection crashes that are speeding-related by blood alcohol concentration is shown in Figure 47. Blood alcohol concentration was not known in the majority of crashes (56.9 percent), while 17.2 percent had a positive BAC.

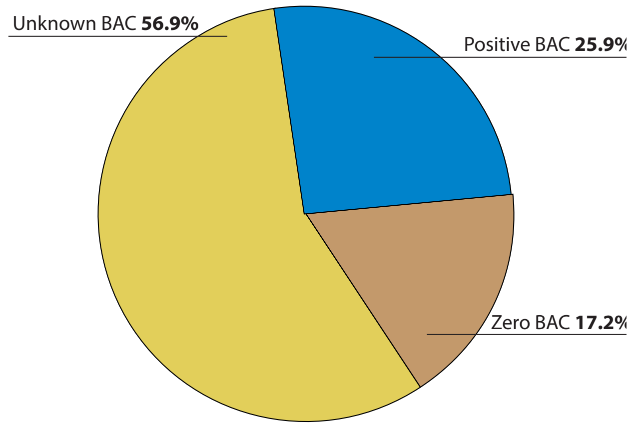

Figure 47: Distribution of Drivers Involved in Speeding-related Fatal Left-turn Intersection Crashes by BAC (Source: FARS 2010 – 2012)

3.8.3 Surface Condition

Roadway surface for speeding-related fatal left-turn intersection crashes is shown in Figure 48. As noted, the majority of vehicles involved were coded as being on dry roads (88.5 percent). Almost 9 percent of vehicles involved in fatal speeding-related left turn crashes were on wet roads, with less than 1 percent on roads coded as ice/frost or snow.

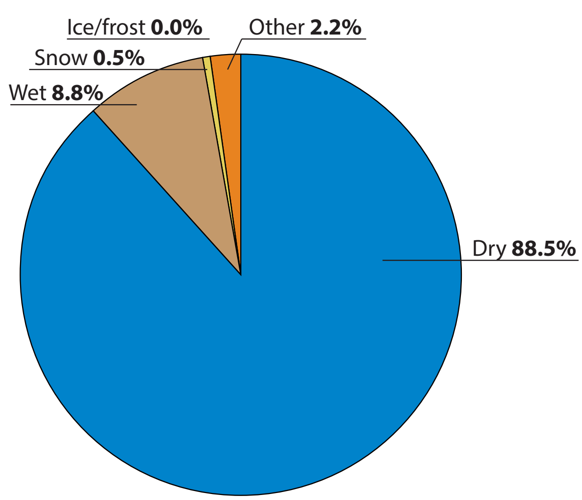

Figure 48: Distribution of Vehicles Involved in Speeding-related Intersection Left-turn Fatal Crashes by Roadway Surface Condition (Source: FARS 2010 – 2012)

3.8.4 Vehicle Type

The distribution of vehicles involved in fatal speeding-related left-turn crashes at intersections is shown in Figure 49. As noted, passenger vehicles make up the majority of fatal speeding-related left-turn crashes (46.7 percent) followed by light trucks (33.0 percent). Motorcycles make up 6.0 percent and large trucks/buses make up only 2.7 percent.

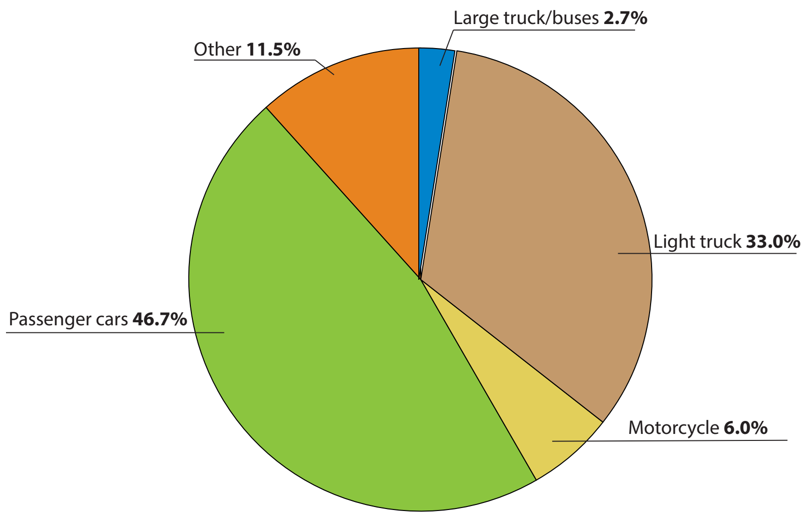

Figure 49: Distribution of Vehicles Involved in Speeding-related Left-turn Intersection Fatal Crashes by Vehicle Type (Source: FARS 2010 – 2012)

4. SPEEDING-RELATED FATAL ROADWAY DEPARTURE CRASHES

This chapter describes speeding-related crash characteristics for roadway departures. Roadway departure crashes were extracted from the FARS database using FHWA definition as described in Chapter 2. Roadway crashes were extracted from the FARS data for 2010 to 2012.

Around 40 percent of fatal roadway departure crashes are speeding-related. Sixty-five percent of fatal roadway departure crashes occur in rural areas.

4.1 ROADWAY CHARACTERISTICS

4.1.1 Roadway Type

Figure 50 shows the distribution of vehicles involved in fatal speeding-related roadway departure crashes by type of roadway. As noted, 27.2 percent of vehicles were on local roads followed by collectors, which account for 25.1 percent. Minor and other principal arterials accounted for 16.7 percent and 16.0 percent, respectively.

Figure 51 shows percentage of vehicles involved in roadway departure crashes by roadway type that were speeding-related. As can be seen, local roads had the highest percentage of vehicles involved in speeding-related crashes, and almost half of all vehicles involved in fatal roadway departure crashes on local roads are speeding-related. Other principal arterials ranked lowest at 32.4 percent.

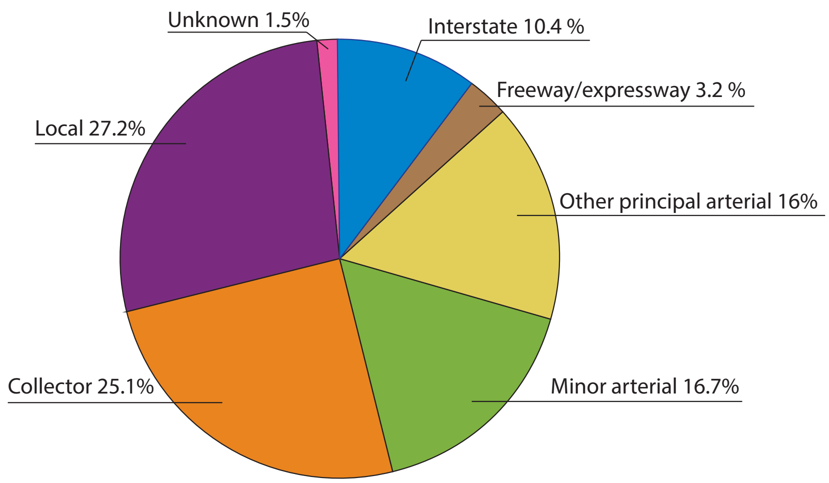

Figure 50: Distribution of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Type of Roadway (Source: FARS 2010 – 2012)

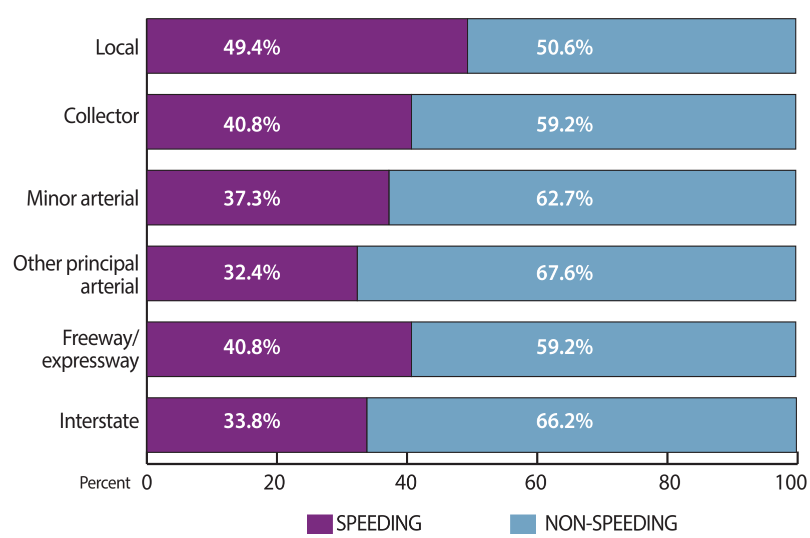

Figure 51: Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Type of Roadway (Source: FARS 2010 – 2012)

4.1.2 Speed Limit

The distribution of vehicles involved in speeding-related roadway departure fatal crashes by speed limit is shown in Figure 52. It should be noted that speed limit is correlated to roadway type. At 35.0 percent, the largest share of vehicles involved in speeding-related roadway departure fatal crashes were on roadways with speed limits of 50 or 55 mph. The second largest share was for vehicles on roadways with a posted speed limit of 40 to 45 mph (21.4 percent).

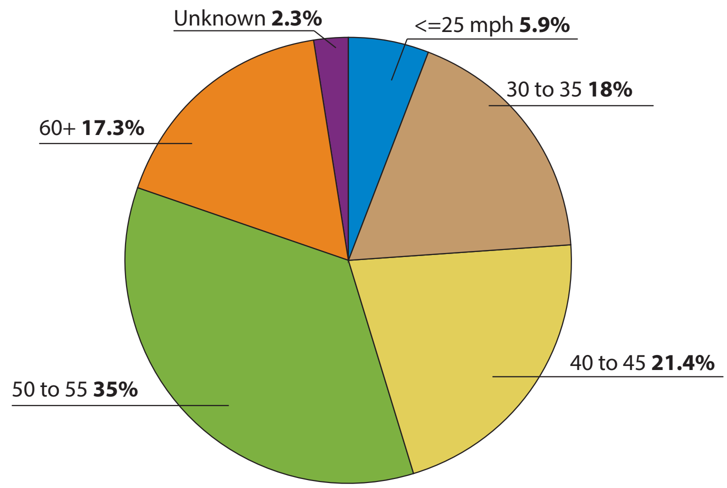

Figure 52: Distribution of Vehicles Involved in Speeding-related Roadway Departure Fatal Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010 – 2012)

Note that type of roadway (e.g., local, collector) does not necessarily correspond to a specific speed-limit range. As a result, information in Figure 51 does not necessarily correlate to that in Figure 53. For instance, local roads made up 27.2 percent of speeding-related fatal crashes as noted in Figure 51. The local roads category includes roadways other than residential and other low-speed roadways.

Figure 53 provides the speeding-related roadway departure fatal crashes for each speed limit category. Almost 54 percent of vehicles involved in fatal roadway departure crashes on roadways signed at 25 mph or less were speeding-related. Only 29.4 percent of vehicles involved in fatal roadway departure crashes on roadways signed at 60 mph or more were speeding-related.

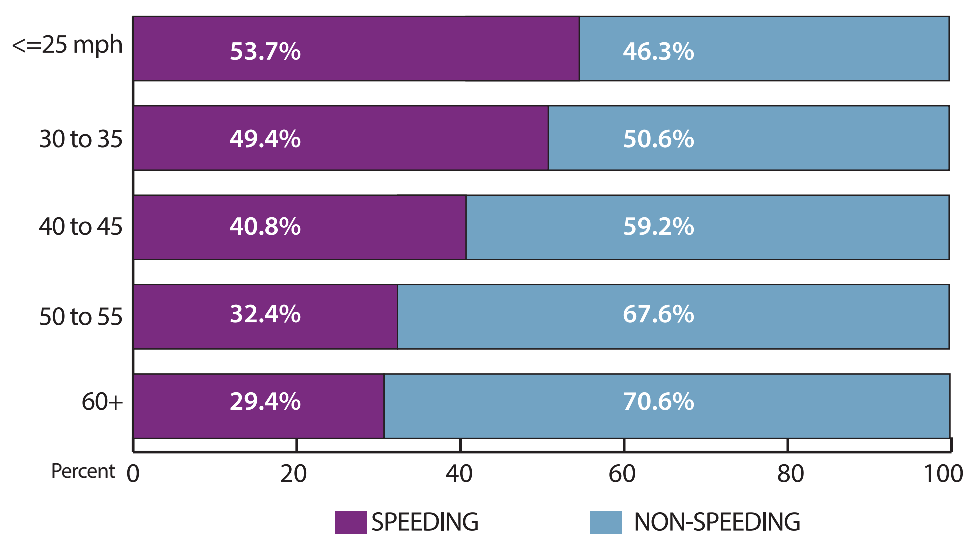

Figure 53: Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Speed Limit (MPH) of Corresponding Approach (Source: FARS 2010 – 2012)

4.1.3 Speed Limit for Single Vehicle Roadway Departure Crashes

Figure 54 shows the distribution of vehicles involved in speeding-related fatal crashes by speed limit for single vehicle roadway departure crashes. Single-vehicle roadway departures are non-vehicle collisions.

As can be seen, the majority of the vehicles involved in speeding-related single-vehicle roadway departure fatal crashes occur on roadways posted at 50 to 55 mph (35.0 percent), with 15.8 percent occurring on roadways posted 60 mph and higher. Around 20 percent were on roadways posted 30 to 35 mph. The distribution is similar to that presented for all speeding-related roadway departure crashes, as shown in Figure 53.

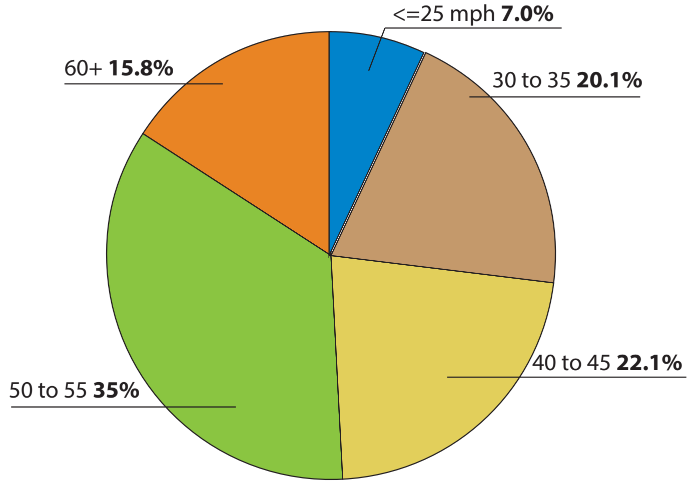

Figure 54: Distribution of Vehicles Involved in Speeding-related Single-vehicle Roadway Departure Fatal Crashes by Speed Limit (mph) of Corresponding Approach (Source: FARS 2010 – 2012)

4.1.4 Horizontal Alignment

Figure 55 illustrates the distribution of vehicles involved in fatal speeding-related roadway departure crashes by horizontal alignment. Almost 38 percent of vehicles involved in speeding-related fatal roadway departure crashes are on curves, with just over 62 percent being on straight sections, as shown.

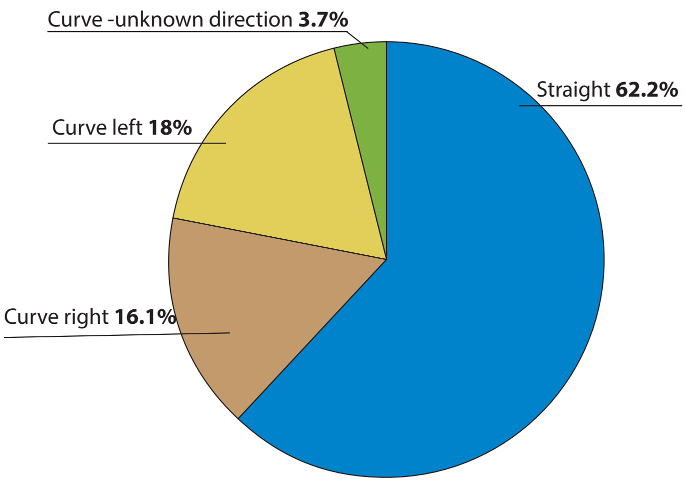

Figure 55: Distribution of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Curve Type (Source: FARS 2010 – 2012)

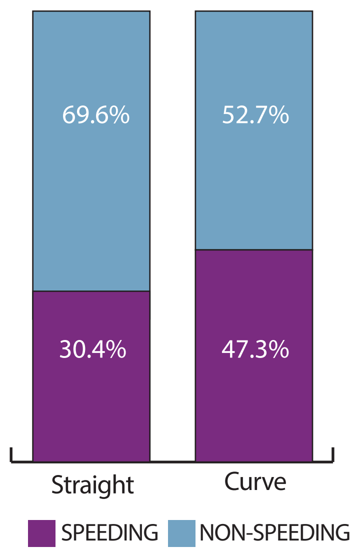

Figure 56: Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Horizontal Alignment (Source: FARS 2010-2012)

The percentage of vehicles involved in fatal roadway departure crashes for curve and tangent sections are provided in Figure 56. The left bar shows the fatal roadway departure on tangent sections. More than 30 percent of vehicles involved in fatal roadway departure crashes on straight sections were speeding-related,and around 70 percent coded as being not speeding-related. The right bar shows fatal roadway departure crashes on curves. As shown, 47.3 percent of vehicles involved in fatal roadway departure crashes on curves were coded as speeding-related.

4.2 DRIVER CHARACTERISTICS

Males made up 75.3 percent of roadway departure fatalities. They also accounted for 78.9 percent of speeding-related roadway departure fatalities.

4.2.1 Age and Gender

Figure 57 shows the distribution of drivers involved in speeding-related roadway departure crashes by age and gender. Each set of bars shows the percentage of drivers that were involved in speeding-related crashes for that age group by gender. As a result, 29.9 percent of female drivers aged 45 to 54 who were involved in fatal roadway departure crashes were coded as speeding related, while 70.1 percent were non-speeding related.

The 15 to 20 age group had the highest fraction of speeding-related fatal roadway departure crashes for both male and females. As shown, 42.7 percent of fatal roadway departure crashes for females in that age group were speeding-related while 52.6 percent of fatal roadway departure crashes for males in that same age group were speeding-related. Drivers aged 75 and older had the lowest fraction of speeding-related roadway departure crashes.

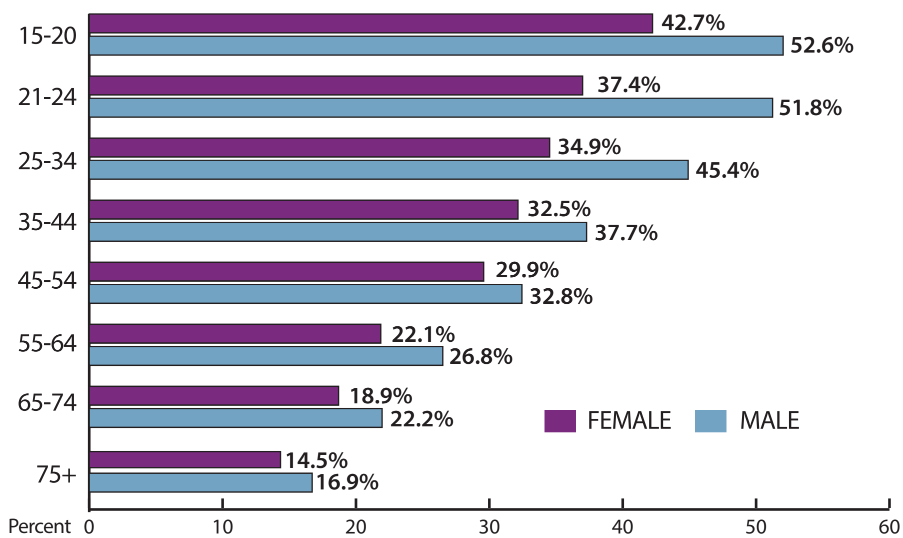

Figure 57: Percentage of Drivers Involved in Speeding-related Roadway Departure Fatalities by Driver Age and Gender (Source: FARS 2010 – 2012)

4.2.2 Blood Alcohol Concentration

Figure 58 shows the distribution of drivers involved in fatal speeding-related roadway departure crashes by blood alcohol concentration (BAC). As noted 45.4 percent of drivers involved in speeding-related fatal roadway departure crashes had a positive BAC, while no BAC was noted in nearly a quarter of drivers involved in speeding-related fatal roadway departure crashes.

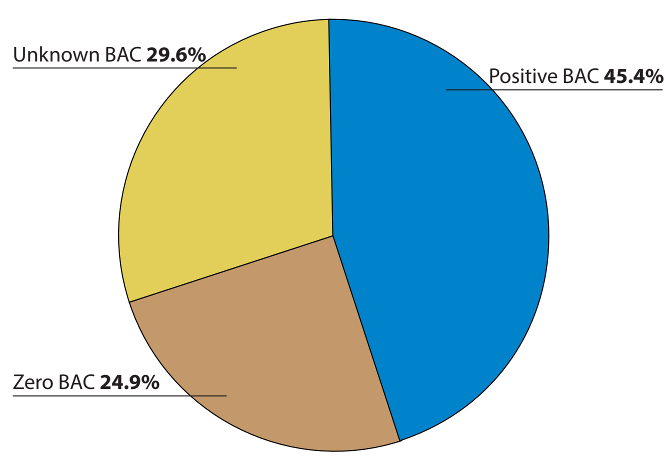

Figure 58: Distribution of Drivers Involved in Speeding-related Fatal Roadway Departure Crashes by BAC (Source: FARS 2010 – 2012)

4.3 ENVIRONMENTAL CHARACTERISTICS

4.3.1 Time of Day

Figure 59 illustrates the distribution of speeding-related fatal roadway departure crashes by time of day. As noted, 38.3 percent of roadway departure crashes occurred during the daytime, with 35.5 percent occurring during the night-time with no lights. Almost 19 percent of fatal road departure crashes occurred during nighttime with lighting and 7.3 percent occurred during dawn or dusk.

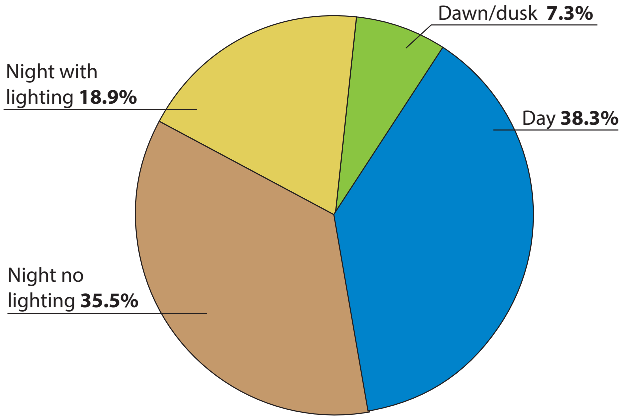

Figure 59: Distribution of Speeding-related Fatal Road Departure Crashes by Time of Day (Source: FARS 2010 – 2012)

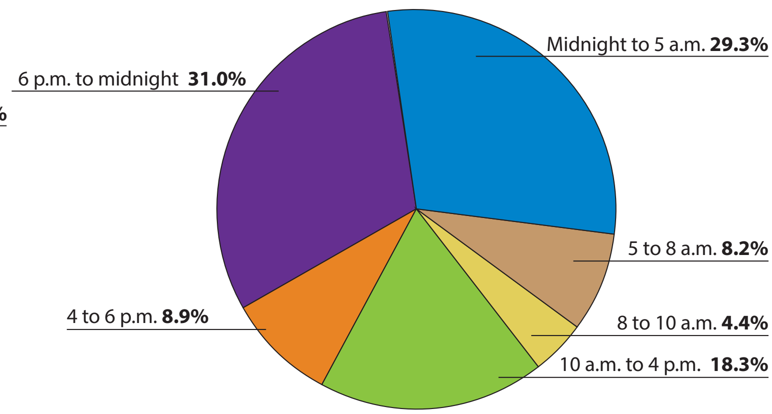

Figure 60: Distribution of Speeding-related Road Departure Fatal Crashes by Hour of Day (Source: FARS 2010 – 2012)

4.3.2 Hour of Day

Figure 60 shows the distribution of speeding-related roadway departure fatal crashes by hour of the day. As noted, the majority of speeding-related crashes occurred from 6 p.m. to midnight (31.0 percent) followed by midnight to 5 a.m. at 29.3 percent.

Figure 61 illustrates the percentage of speeding-related fatal roadway departure crashes by hour of the day. Each bar shows the percentage of speeding versus non-speeding related fatal roadway departure crashes for a specific time period. For instance, 27.1 percent of vehicles involved in fatal roadway departure crashes between 10 a.m. and 4 p.m. were speeding-related while 72.9 percent were not speeding-related.

The data show that the percentage of speeding-related fatal roadway departure crashes was highest during the early hours of the day (midnight to 5 a.m.) at 49.2 percent. During the time period from 10 a.m. to 4 p.m., only 27.1 percent of fatal roadway departure crashes were speeding-related.

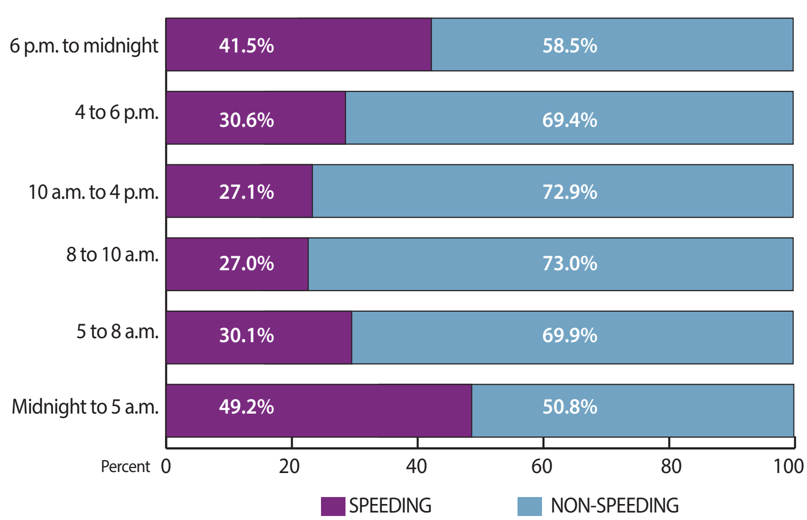

Figure 61: Percentage of Speeding-related Fatal Roadway Departure Crashes by Hour of Day (Source: FARS 2010 – 2012)

4.3.3 Surface Condition

The distribution of vehicles involved in speeding-related fatal roadway departure crashes by surface condition is shown in Figure 62. The majority of vehicles involved in speeding-related fatal roadway departure crashes were on dry roads (76.3 percent), with 15.0 percent occurring on a wet roadway surface, as illustrated.

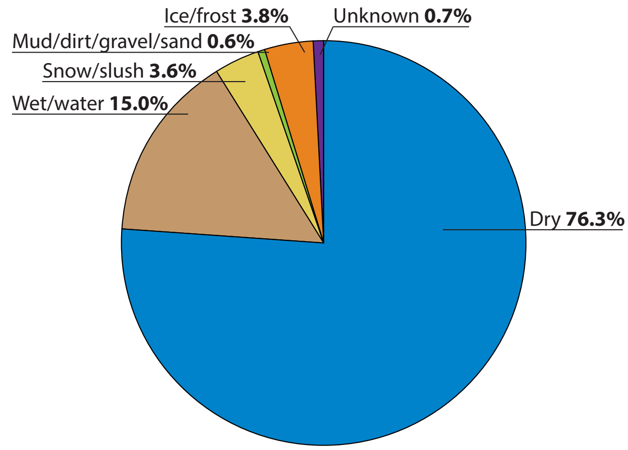

Figure 62: Distribution Vehicles Involved in Speeding-related Fatal Roadway Crashes by Roadway Surface Condition (Source: FARS 2010 – 2012)

4.4 VEHICLE TYPE

The distribution of vehicles involved in fatal speeding-related roadway departure crashes is provided in Figure 63. Passenger vehicles were the most likely to be involved in speeding-related roadway departure crashes making up 44.7 percent of vehicles involved in these types of crashes. Large trucks represented the smallest share (3.8 percent) of vehicles involved in speeding-related intersection crashes. Motorcycles made up 12.6 percent of speeding-related roadway departure crashes.

The fraction of speeding-related fatal roadway departure crashes by vehicle type is shown in Figure 64. As shown, for motorcycles that were involved in fatal roadway departure crashes, 45.4 percent were speeding-related, while only 21.0 percent of large trucks/buses involved in fatal roadway departure crashes were speeding-related. Of the passengers cars involved in fatal roadway departure crashes, around 40 percent were speeding-related.

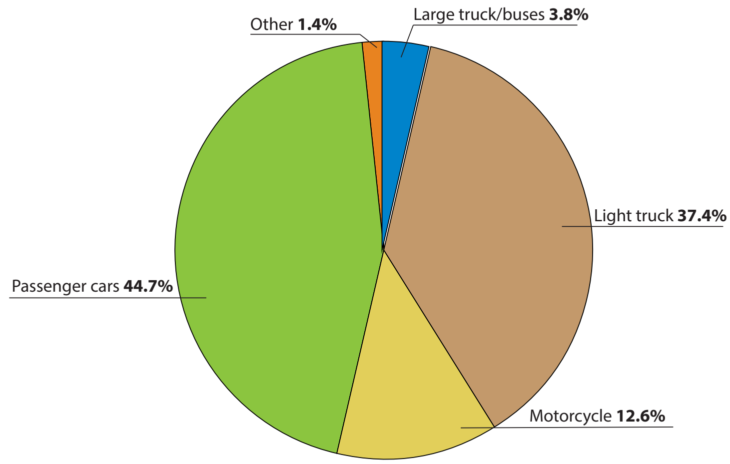

Figure 63: Distribution of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Type of Vehicle (Source: FARS 2010 – 2012)

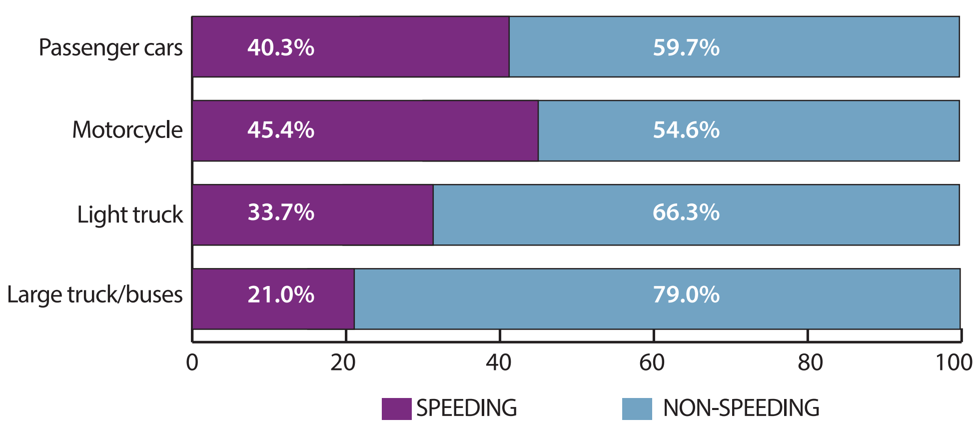

Figure 64: Percentage of Vehicles Involved in Speeding-related Fatal Roadway Departure Crashes by Type of Vehicle (Source: FARS 2010 – 2012)

4.5 CRASH TYPE

Roadway departure fatal crashes were disaggregated by crash type as shown in Figure 65. As can be seen, non-vehicle collisions made up the highest percentage of speeding-related roadway departure fatal crashes (92.9 percent). Head-on (front-to-front) crashes made up 3.0 percent, while sideswipe accounted for around 1 percent.

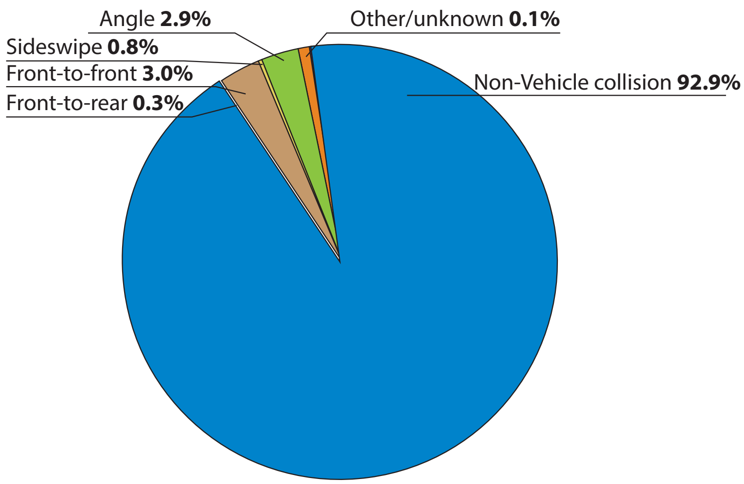

Figure 65: Distribution of Fatal Speeding-related Roadway Departure Crashes by Crash Type (Source: FARS 2010 – 2012)

A distribution of crashes by first harmful event for speeding-related roadway departure crashes is shown in Figure 66. Striking a tree accounted for the largest percentage of speeding-related roadway departure crashes (18.0 percent) followed by striking some type of embankment (17.6 percent). Roll-over/overturn crashes account for 15.8 percent.

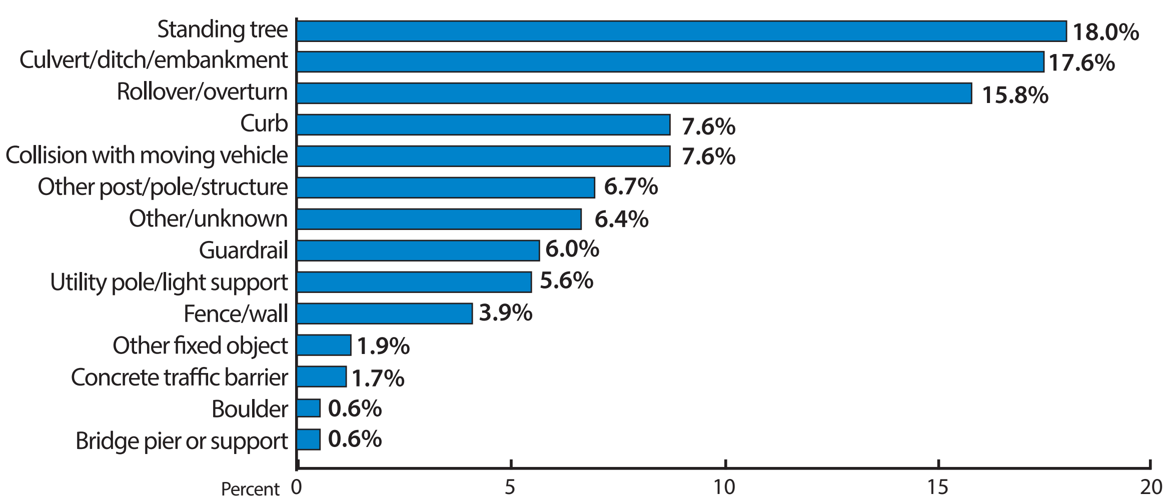

Figure 66: Distribution of Speeding-related Fatal Roadway Departure Crashes by First Harmful Event (Source: FARS 2010 – 2012)

Characteristics of crashes for several types of crashes are summarized in the following sections.

4.6 CHARACTERISTICS OF ROLLOVER CRASHES

Rollover/overturn crashes make up about 14 percent of all fatal roadway departure crashes and account for 16 percent of those that are speeding-related. Rollover/overturn crashes are predominantly rural crashes (72 percent). Information in the following sections was extracted at the vehicle level.

4.6.1 Speed Limit

As shown in Figure 67, around 59.0 percent of vehicles involved in speeding-related fatal rollover/overturn crashes were on roadways posted 50 mph or higher. Facilities signed lower than 50 mph accounted for 38.6 percent of these crashes.

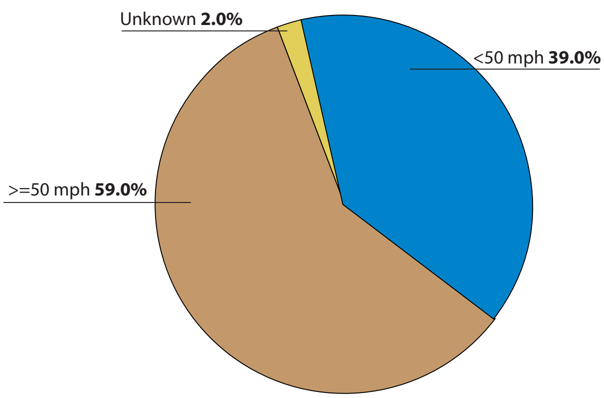

Figure 67: Distribution of Vehicles Involved in Speeding-related Rollover/Overturn Fatal Crashes by Speed Limit (Source: FARS 2010 – 2012)

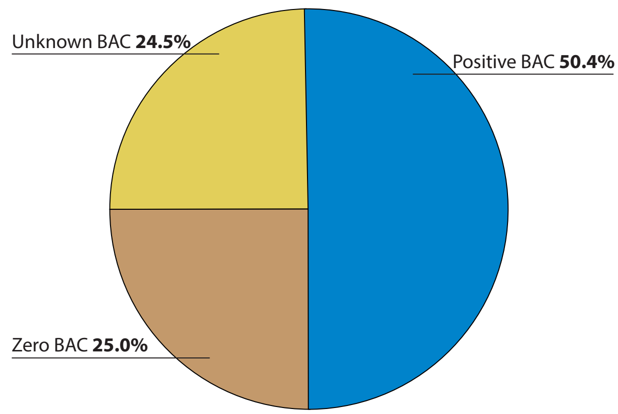

Figure 68: Distribution of Drivers Involved in of Speeding-related Rollover/Overturn Fatal Crashes by BAC (Source: FARS 2010 – 2012)

4.6.2 Blood Alcohol Concentration

Driver alcohol involvement in fatal rollover/overturn crashes that are speeding-related are shown in Figure 68. A positive BAC was present for 50.4 percent of drivers involved in fatal speeding-related roadway departure crashes, and BAC was unknown about a quarter of these crashes.

4.6.3 Surface Condition

The distribution of vehicles involved in speeding-related fatal roadway departure crashes which were coded as rollover/overturn by roadway surface condition is shown in Figure 69. As can be seen, the majority of vehicles were on roadways with dry road conditions (80.6 percent) and 11.4 percent of vehicles were on wet roads.

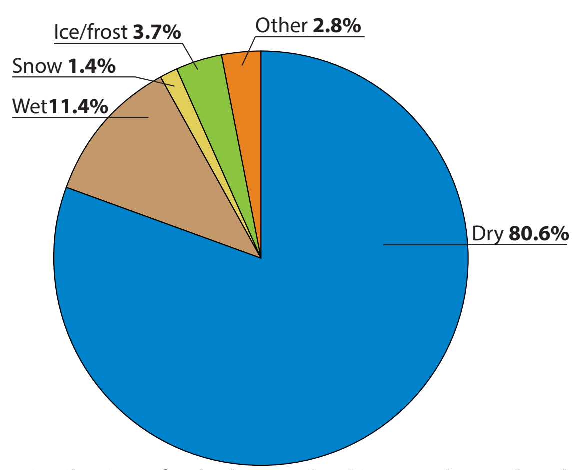

Figure 69: Distribution of Vehicles Involved in Speeding-related Rollover/Overturn Fatal Crashes by Roadway Surface Condition (Source: FARS 2010 – 2012)

4.6.4 Vehicle Type

Vehicle involvement in fatal roadway rollover/ overturn crashes that are speeding-related are shown in Figure 70. Light trucks are involved in the majority of speeding-related rollover/ overturn fatal crashes (51.4 percent) followed by passenger vehicles, which are involved in 43.5 percent of these crashes.

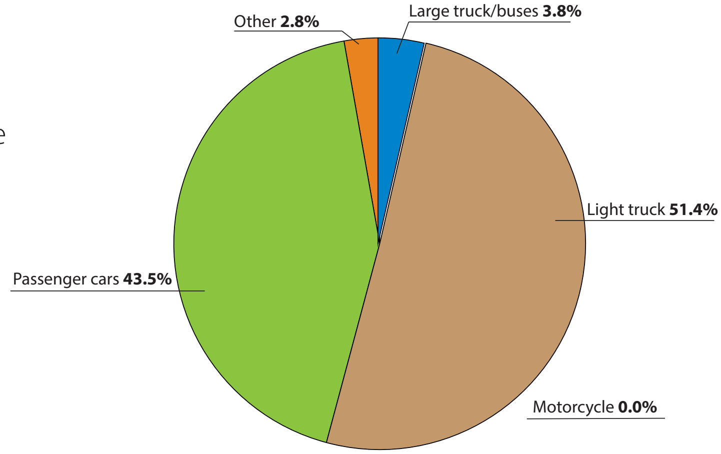

Figure 70: Distribution of Vehicles Involved in Speeding-related Rollover/ Overturn Fatal Crashes by Vehicle Type (Source: FARS 2010 – 2012)

4.7 CHARACTERISTICS OF OPPOSING DIRECTION CRASHES

Opposing direction crashes make up 3.6 percent of all fatal crashes, but make up 14.5 percent of speeding-related fatal roadway departure crashes. Around 67 percent of opposing direction crashes were in rural areas.

4.7.1 Speed Limit

Around 58.4 percent of vehicles involved in speeding-related, fatal, opposing-direction crashes were on roadways posted 50 mph and higher as shown in Figure 71. More than 40 percent were on facilities signed lower than 50 mph.

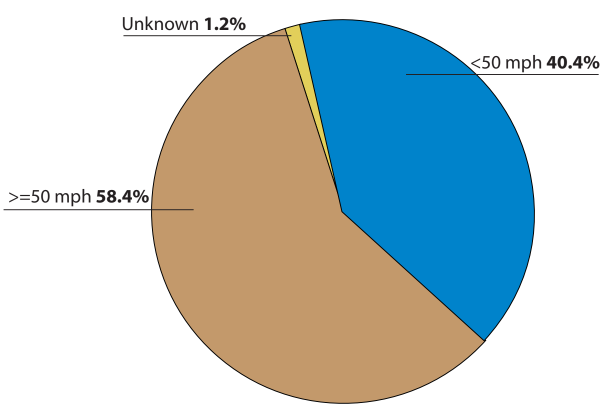

Figure 71: Distribution of Vehicles Involved in Speeding-related Fatal Opposing Direction Crashes by Speed Limit (Source: FARS 2010 – 2012

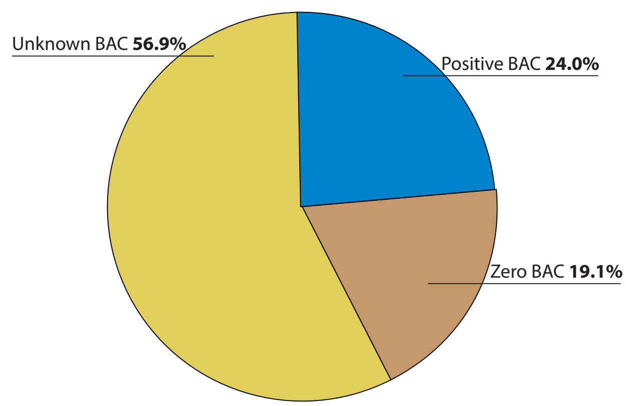

Figure 72: Distribution of Vehicles Involved in Speeding-related Fatal Opposing Direction Crashes by BAC (Source: FARS 2010 – 2012)

4.7.2 Blood Alcohol Concentration

Driver alcohol involvement in fatal opposing-direction crashes that are speeding related are shown in Figure 72. Blood alcohol concentration was not known in the majority of crashes (56.9 percent) while 24.0 percent had a positive BAC.

4.7.3 Surface Condition

Roadway surface condition for speeding-related, fatal, opposing-direction crashes is shown in Figure 73. As noted, the majority of vehicles were traveling on dry road conditions (56.1 percent). A large number of vehicles involved in opposing-direction crashes were also on wet (23.8 percent), snow-covered (8.6 percent), or ice/frost-covered (7.7 percent) roadway surfaces.

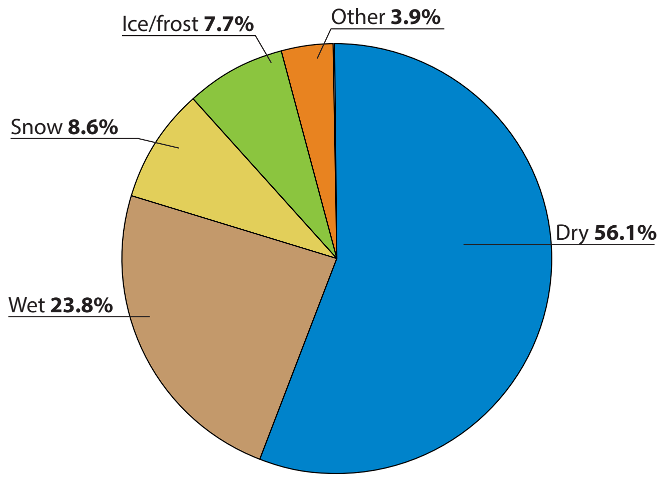

Figure 73: Distribution of Vehicles Involved in Speeding-related Fatal Opposing Direction Crashes by Roadway Surface (Source: FARS 2010 – 2012)

4.7.4 Vehicle Type

Vehicle involvement in fatal opposing-direction crashes that are speeding related is shown in Figure 74. As noted, light trucks make up the majority of fatal-involvement crashes (81.8 percent) followed by passenger vehicles at 14.5 percent.

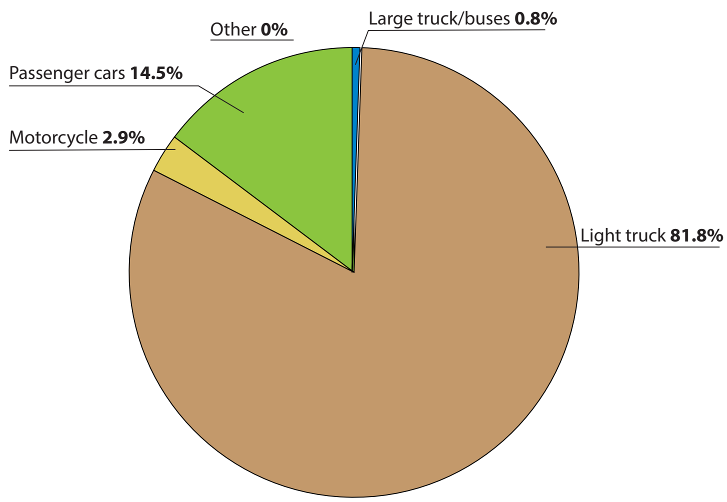

Figure 74: Distribution of Vehicles Involved in Speeding-related, Fatal, Opposing-Direction Crashes by Vehicle Type (Source: FARS 2010 – 2012)

4.8 CHARACTERISTICS OF TREE CRASHES

Crashes involving trees as the first harmful event make up 14.1 percent of all fatal roadway departure crashes and account for 18.0 percent of those that are speeding related. Tree crashes occur predominantly on rural roadways (68.8 percent), with 31 percent occurring in urban areas.

4.8.1 Speed Limit

Figure 75 shows the distribution of vehicles involved in fatal roadway departure crashes that were coded with hitting a tree as the first harmful event by speed limit. As shown, around 43 percent of vehicles involved in speeding-related tree-impact crashes were on roadways posted 50 mph or higher. Fifty-four percent of vehicles were on facilities signed lower than 50 mph.

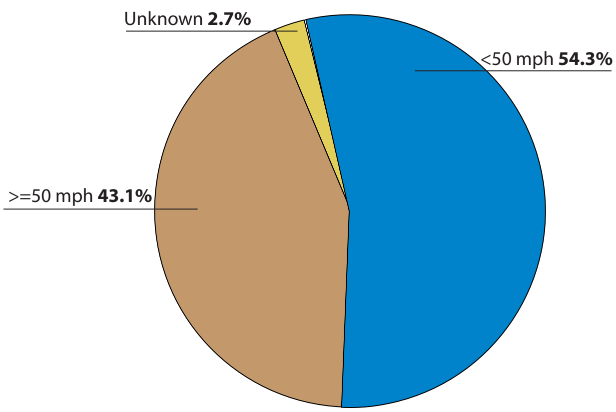

Figure 75: Distribution of Vehicles Involved in Speeding-related, Tree-Impact, Fatal Crashes by Speed Limit (Source: FARS 2010 – 2012)

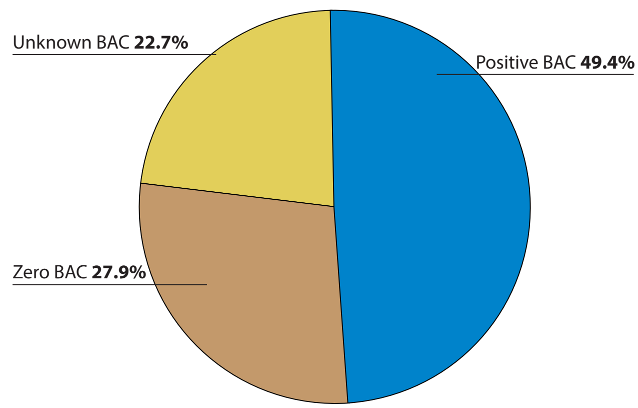

Figure 76: Distribution of Drivers Involved in Speeding-related Tree Impact Fatal Crashes by BAC (Source: FARS 2010 – 2012)

4.8.2 Blood Alcohol Concentration

Driver alcohol involvement in fatal tree-impact crashes that are speeding-related are shown in Figure 76. Around 49 percent of drivers involved in fatal speeding-related roadway departure crashes had a positive BAC while almost 30 percent had no BAC. BAC was unknown for 22.7 percent of crashes.

4.8.3 Surface Condition

Roadway surface condition for speeding-related, fatal, rollover/overturn crashes is shown in Figure 77. As noted, the majority of vehicles involved in these crashes were on dry roads (77.7 percent) and 16.3 percent were on wet roads.

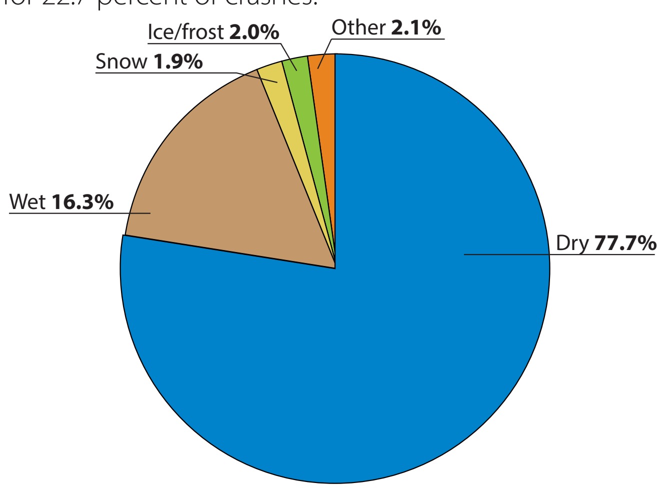

Figure 77: Distribution of Vehicles Involved in Speeding-related Tree Impact Fatal Crashes by Roadway Surface Condition (Source: FARS 2010 – 2012)

4.8.4 Vehicle Type

Vehicle involvement in fatal tree-impact crashes that are speeding related are shown in Figure 78. Passenger cars are involved in the majority of tree-impact, speeding-related, fatal crashes (57.6 percent) followed by light trucks at 32.1 percent.

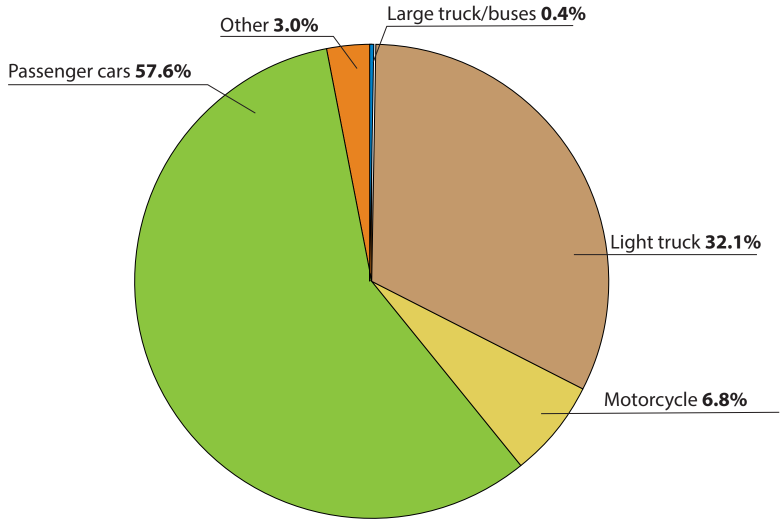

Figure 78: Distribution of Vehicles Involved in of Speeding-related, Tree-impact, Fatal Crashes by Vehicle Type (Source: FARS 2010 – 2012)

5. SPEEDING-RELATED CRASH DATA FOR PEDESTRIAN AND BICYCLISTS

This section describes speeding-related crash characteristics for pedestrian and bicycle crashes. Crashes were extracted for 2010 to 2012 in the FARS database as described in Chapter 2.

Only 8.3 percent of fatal crashes involving a pedestrian or bicyclist were speeding related. Pedestrian and bicycle crashes were predominantly urban (73 percent). Around 16.9 percent of all fatal pedestrian and bicycle crashes were coded as hit and run, while 30.4 percent of all speeding-related crashes were coded as such. As a result, speeding-related crashes were almost twice as likely to be hit and run.

5.1 ROADWAY CHARACTERISTICS

Roadway characteristics for fatal crashes involving bicyclists and pedestrians are summarized in the following sections.

5.1.1 Location

Location for speeding-related, pedestrian and bicycle fatal crashes is provided in Figure 79. The sum of all bars equals 100 percent. As noted, 46.4 percent of fatal speeding-related pedestrian and bicycle crashes were non-intersection crashes and did not occur in a crosswalk. A small number (1.2 percent) occurred at a non-intersection location within a marked crosswalk and 6.8 percent were at an unknown location away from an intersection. These locations may indicate mid-block crossings and, together, make up 54.4 percent of fatal speeding-related pedestrian and bicycle crashes.

Around 2.5 percent were located within a marked crosswalk at an intersection, 1.5 percent were at an intersection but in an unmarked crosswalk, and 3.3 percent were at an intersection within an unmarked crosswalk. A small share were at an unknown location within an intersection.

Shoulders, roadsides, or parking lanes accounted for 14.3 percent of fatal, speeding-related, pedestrian and bicycle crashes. Non-trafficways made up 4.8 percent and the remainder were in various other facilities.

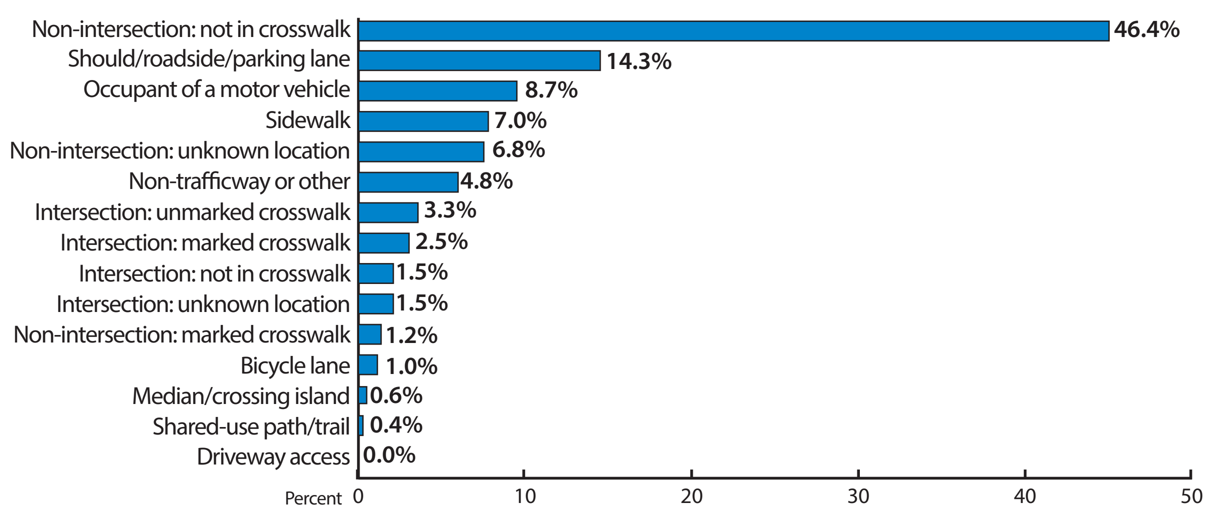

Figure 79: Distribution of Speeding-related Fatal Pedestrian and Bicycle Crashes by Location (Source: FARS 2010 – 2012)

5.1.2 Roadway Type

Figure 80 shows pedestrian and bicycle fatal crashes that were speeding-related by roadway type. As noted, other principal arterials which excludes freeways/expressways and interstates accounted for 24 percent of pedestrian and bicycle fatal crashes.

5.1.3 Speed Limit

The distribution of vehicles involved in pedestrian and bicycle fatal crashes by posted speed limit that were speeding-related are shown in Figure 81. Vehicles on roadways posted 30 to 35 mph had the highest share of pedestrian and bicycle fatal crashes that were speeding-related (31.1 percent) followed by roadways posted 40 to 45 (20.5 percent).

Figure 82 shows the percentage of vehicles involved in fatal bike/ped crashes by speed limit category that were speeding-related. Each bar shows the percentage that were speeding and non-speeding related for a particular speed limit category.

As shown, the category of 25 mph or less had the highest percentage with 11.2 percent of vehicles involved having been coded as speeding-related.

Vehicles traveling on roadways posted 40 to 55 mph were the least likely to be coded as speeding-related for pedestrian and bicycle crashes while almost 8 percent of vehicles involved that were on roadways posted 60 mph or higher were speeding-related.

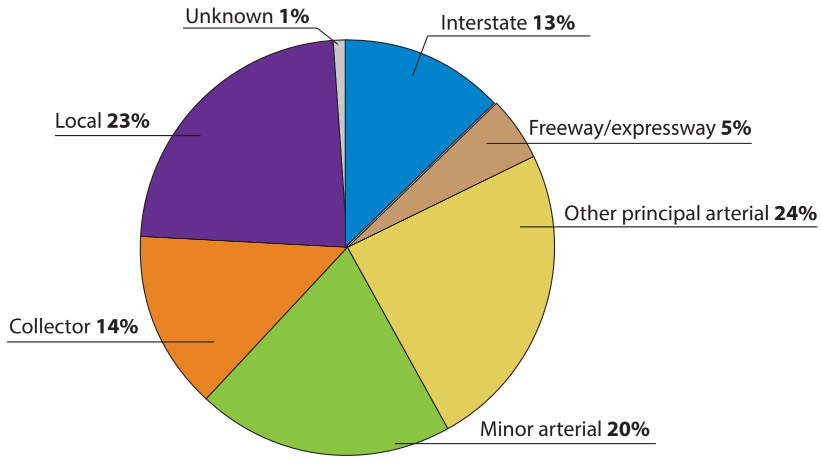

Figure 80: Distribution of Speeding-related Fatal Pedestrian and Bicycle Crashes by Type of Roadway (Source: FARS 2010 – 2012)

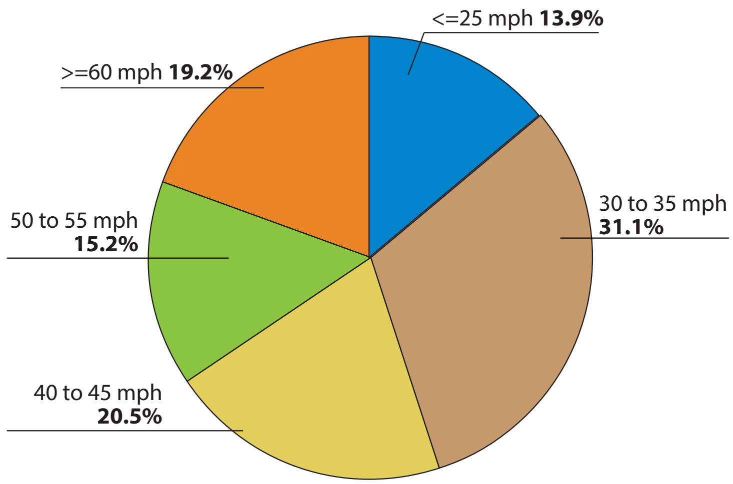

Figure 81: Distribution of Vehicles Involved of Speeding-related Fatal Pedestrian and Bicycle Crashes by Posted Speed Limit (Source: FARS 2010 – 2012)

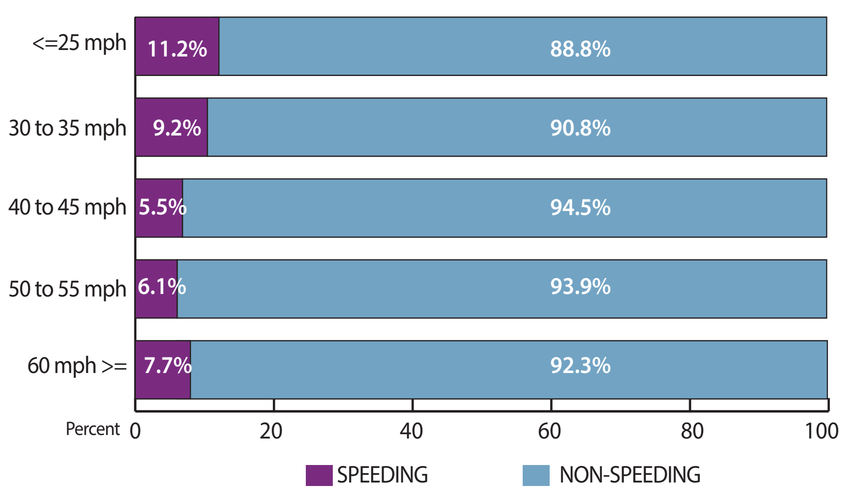

Figure 82: Percentage of Fatal Pedestrian and Bicycle Crashes that are Speeding-related by Posted Speed Limit (Source: FARS 2010 – 2012)

5.2 DRIVER CHARACTERISTICS

Males made up 72.3 percent of drivers in all pedestrian and bicycle fatal crashes and 72.5 percent of drivers in speeding related pedestrian and bicycle fatal crashes.

5.2.1 Age and Gender

The distribution of drivers involved in all fatal pedestrian and bicycle crashes is illustrated in Figure 83. This includes both speeding and non-speeding and the sum of all bars equals 100 percent. Males accounted for more fatal bike/ped crashes than females for all categories. As noted, males aged 45 to 54 made up 16.0 percent of all fatal pedestrian and bicycle crashes while females in that same age category accounted for 5.2 percent of crashes.

Male drivers aged 55 to 64 accounted for the next highest number of fatal pedestrian and bicycle crashes. They accounted for 12.1 percent of these crashes. Females aged 21 to 24 accounted for the lowest amount of crashes (1.8 percent).

Figure 84 shows the distribution of drivers involved in speeding-related fatal bike/ped crashes. All the bars summed would equal 100 percent. Female drivers of all ages were less likely to have been involved in speeding-related crashes than males. The highest category for females was ages 45 to 54 which accounted for 5.5 percent of speeding-related fatal bike/ped crashes. Female drivers aged 65 to 74 were the least likely to have been involved accounting for 1.8 percent of speeding-related crashes.

Males in all age groups made up a higher percentage of speeding-related crashes than females. Male drivers aged 45 to 54 accounted for 15.9 percent of speeding-related bike/ped crashes and male drivers aged 55 to 64 made up 11.8 percent.

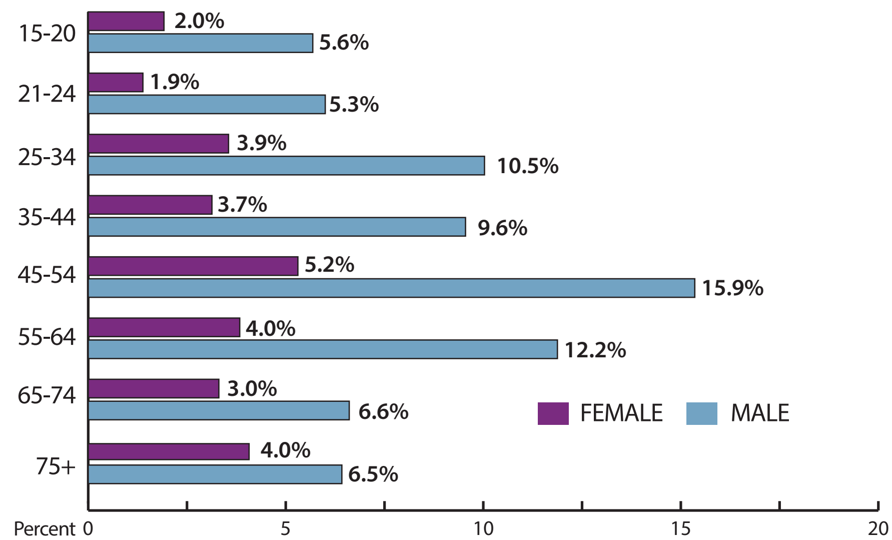

Figure 83: Distribution of Drivers Involved in All Fatal Pedestrian and Bicycle Crashes by Age and Gender (Source: FARS 2010 – 2012)

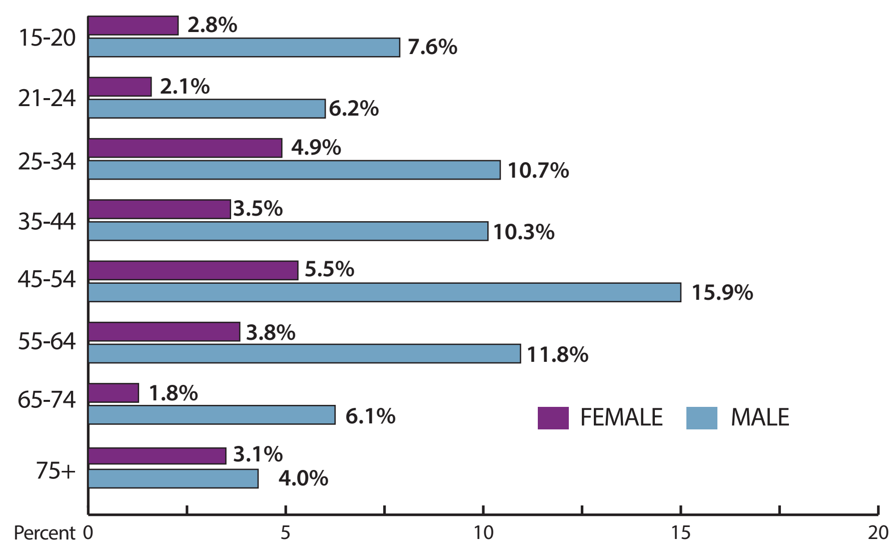

Figure 84: Distribution of Drivers Involved in Speeding-related Fatal Pedestrian and Bicycle Crashes by Age and Gender (Source: FARS 2010 – 2012)

5.2.2 Blood Alcohol Concentration

Figure 85 provides blood alcohol concentration for drivers involved in pedestrian and bicycle crashes. The left column shows fatal crashes for positive BAC. As noted 22.5 percent of pedestrian and bicycle crashes where BAC was positive were speeding-related. The center column shows the percentage of drivers with zero BAC involved in pedestrian/bicycle crashes.

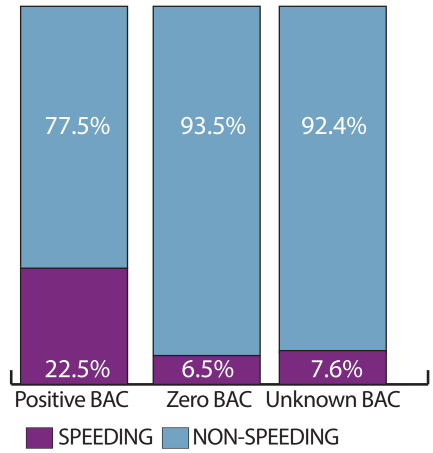

Figure 85: Percentage of Speeding-related Fatal Pedestrian and Bicycle Crashes by Driver BAC (Source: FARS 2010 – 2012)

5.3 ENVIRONMENTAL CHARACTERISTICS

5.3.1 Time of Day

Fatal pedestrian and bicycle crashes that were speeding-related by time of day were summarized in Figure 86. As noted, around 37.6 percent of speeding-related crashes occurred during the nighttime with roadway lighting and 22.3 percent occurred at nighttime with no roadway lighting. Daytime crashes represented 35.0 percent with the remaining crashes occurring during nighttime or at dawn or dusk (5.0 percent).

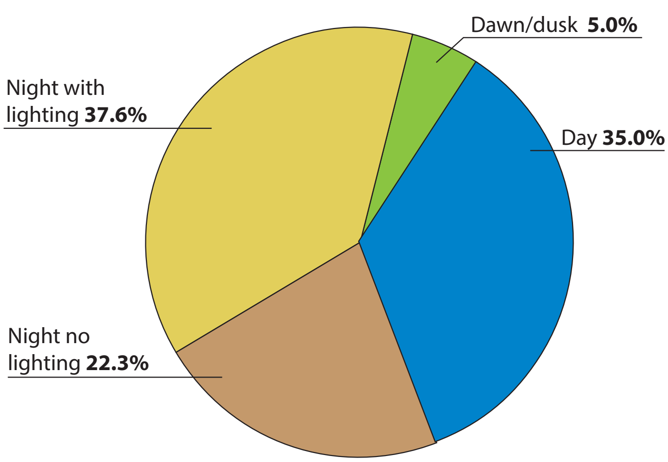

Figure 86: Distribution of Speeding-related Fatal Pedestrian and Bicycle Crashes by Time of Day (Source: FARS 2010 – 2012)

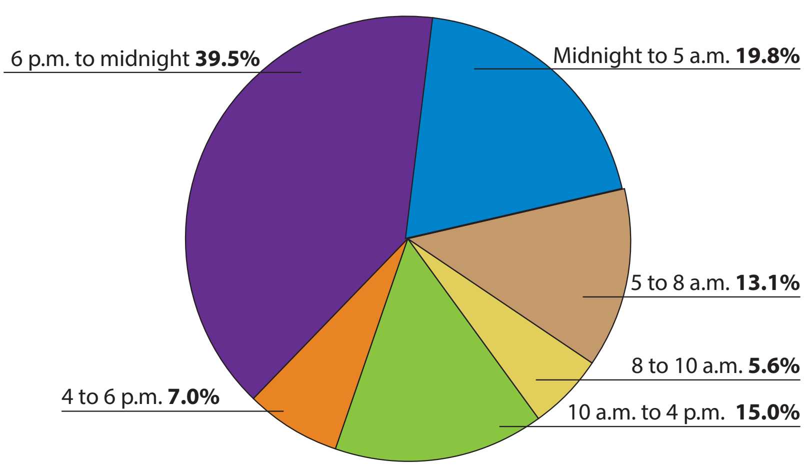

Figure 87: Distribution of Speeding-related Fatal Pedestrian and Bicycle Crashes by Hour of Day (Source: FARS 2010 – 2012)

5.3.2 Hour of Day

Figure 87 shows the distribution of fatal pedestrian and bicycle crashes by hour of the day that were speeding-related. The most problematic time period was 6 pm to midnight which accounted for 39.5 percent of speeding-related fatal pedestrian and bicycle crashes. Midnight to 5 am accounted for 19.8 percent of these crashes. The next highest period was 10 am to 4 pm with 15.0 percent of fatal speeding-related bike/ped crashes.

5.4 VEHICLE TYPE

The distribution of vehicles involved in speeding-related fatal pedestrian and bicycle crashes is provided in Figure 88. Passenger vehicles were the most likely to be involved in speeding-related pedestrian and bicycle fatal crashes making up 46.7 percent of vehicles involved in these types of crashes. Large trucks represented 4.8 percent and motorcycles made up the smallest share (1.7 percent).

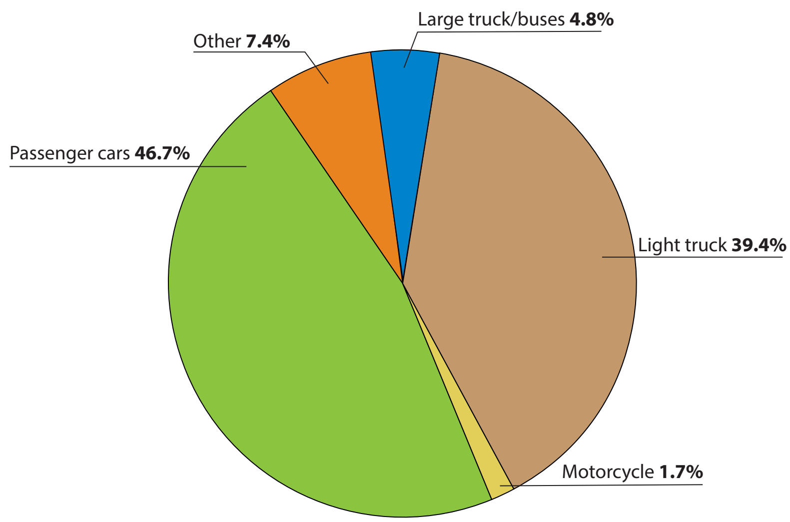

Figure 88: Percentage of Speeding-related Fatal Pedestrian and Bicycle Crashes by Vehicle Type (Source: FARS 2010 – 2012)

6. ANALYSIS OF THE ROLE OF SPEEDING IN SAFETY-CRITICAL EVENTS USING SHRP 2 DATA

The following summarizes two different types of analyses which were used to assess speeding characteristics of roadway departure, intersection, and bicycle and pedestrian events using the the Strategic Highway Research Program (SHRP) 2 naturalistic driving study (NDS). Baseline and safety critical (crash, near-crash, crash relevant) events were queried or extracted from the InSight Data Access Website (insight.shrp2nds.us).

In the first analysis, the rate of speeding in safety-critical events was compared to speeding in baseline events. In the second analysis, safety-critical events were further evaluated and characteristics of those events summarized.

6.1 DESCRIPTION OF DEFINITIONS

Event characteristics were determined by the Virginia Tech Transportation Institute (VTTI), which reduced events from the NDS data which was collected by SHRP 2. Reduced events are available on the InSight web site which can be accessed by qualified researchers. A set of driver, roadway, and environmental characteristics was reduced for crashes, near-crashes, and crash-relevant events. Hereafter, these events are termed “safety-critical events.” Data were also reduced for a set of baseline events. A video clip of the forward roadway view and a narrative description is provided for safety-critical events, and as a result, some additional information can be extracted. Video is not provided for baseline events, and a narrative is only provided for a limited number of baseline events. As a result, additional information could not be extracted for baseline events.

Relevant definitions for the analyses presented in this memo are provided below in italics as described on the InSight web site (insight.shpr2nds.us).

Currently, the posted or advisory speed is not provided for each event. The posted or advisory speed could be determined from the forward road view clip for some safety-critical events and was described in the narrative for others but was not consistently provided. Speed limit was not identified at all for baseline events. As a result, the definition of “speed-related” is based on VTTI’s definitions for driver behavior. Advisory speed is not provided and the definition for exceeded speed limit does not account for drivers traveling over the curve advisory speed.

Exceeded speed limit: *Subject vehicle traveling at a speed greater than the posted speed limit (not in a work zone). In Variable Speed Zones, this is relative to the speed limit in effect at the time of the event. Coded when more than 10 mph above posted speed limit.*

Exceeded safe speed but not speed limit: *Subject vehicle traveling at a speed close to or under the posted speed limit, but still too fast to maintain a safe driving environment given current environmental conditions (e.g., weather, traffic, lighting). (Not in a work zone.)*

Ex. during conditions that may require slower speeds such as weather, traffic situation, etc.

Roadway characteristics are derived from several different fields rather than using a common definition such as rural 2-lane arterial or 4-lane urban collector. For instance the field “locality” provides some indication of location (urban versus rural) as well as roadway type using definitions such as open residential or interstate/bypass/divided highway with no traffic signals. Other roadway characteristics such as number of lanes or presence of median, curve, intersection etc. have to be determined using a range of fields. This makes it difficult to compare by roadway types which are more familiar to traffic engineers (e.g. 4-lane arterial).

Open county: *other than the roadway, there is nothing but vegetation visible, road is not an interstate or bypass/divided road with traffic signals.*

Open residential: *rural to semi-rural areas with just a few houses.*

Moderate residential: *area with multiple homes/apartment buildings present.*

Business/industrial: *any type of business or industrial structure is present but is not as dense as urban.*

Urban: *higher density where blocks are shorter, streets are a mix of one and two-way, and traffic can include buses and trams.*

Interstate/bypass/divided highway with no traffic signals: *interstate, bypass, or divided highway where no traffic signals are present.*

Bypass/divided highway with traffic signals: *bypass or divided highway with traffic signals and no other category description is visible.*

Three other types of localities were coded including “church”, “playground”, and “school”, which indicated a church, playground, or school was present. Since this definition is very vague, events coded with these localities were not included in the comparison described in Section 2. The appropriate corresponding locality (i.e. open residential) was extracted for Section 3 to ensure consistency between the types of locations where events took place.

Driver distractions were coded and drivers may have included more than distraction. The definitions provided in Section 3 are general but are similar to the language used for coded events.

Impairment was coded and was an assessment of why drivers engaged in a particular behavior. The terms used in Section 3 include:

Drowsy, sleepy, asleep, fatigued: *driver exhibits obvious signs of being asleep or tired or is asleep.*

Angry: *driver exhibits obvious signs of anger.*

6.2 COMPARISON OF SPEEDING FOR SAFETY-CRITICAL EVENTS TO BASELINE EVENTS

In the analysis described in this section, the rate of speeding in safety-critical events was compared to speeding in baseline events. This was obtained by querying the number of events that met a particular set of filters (i.e. baseline events on moderate residential roads coded as exceeded speed limit). The following tables compare crash, near-crash, and crash relevant (safety critical) events to baseline events. Both types of events were queried for specific roadway types as defined below. Safety-critical events were also disaggregated by crash type (i.e. roadway departure).

The definition of “exceeded safe speed” was relatively subjective and was highly correlated to roadway surface condition. As a result, for this analysis, events were defined as speeding if they met the criteria of “exceeded speed limit.” Additionally only events coded as having dry or wet surface conditions were included.

Speeding versus not speeding is compared for various roadway types (non-intersection) and for intersections. Presence of pedestrians and bicyclists are not indicated in baseline events and are not included in this analysis (see Section 3).

Table 2 shows speeding versus not speeding by various roadway categories. Data are provided for non-intersection baseline and safety-critical events. Safety-critical events may have included rear-ends, near rear-ends, roadway departures, loss of control, etc. Information is compared by roadway types. VTTI defined roadway types. In most cases, these did not correspond to commonly understand roadway types (e.g. rural 2-lane arterial). As a result, roadway types which seemed to be similar were combined.

The percentage of speeding related events is provided next to the number of speeding related events and was calculated as (speeding related events/all events) for a particular category.

The odds of a driver having "exceeded the speed limit" for safety-critical events compared to baselines events for the same roadway type were compared. The 95 percent confidence interval (CI) for the odds are also provided. When the confidence interval contains 1.0, the odds are not statistically significant.

As noted in Table 2, safety-critical events were more likely to be speeding related than for corresponding baseline events. For instance, safety-critical events in general that occurred on two-lane roadways where a curve is present were 6.6 times more likely to be speeding related than baseline events on similar roadways. Around 14 percent of safety-critical events were speeding related while 2.4 percent of baseline events were speeding related.

Table 2: Speeding versus Not Speeding by Roadway Type for All Safety-critical Events

	Baseline	Crash/near crash	Odds (CI)
2-lane (open county, open residential, moderate residential, business/industrial)			
curve (left or right)			
not speeding	486	61	**6.64 (2.75, 16.01)**
speeding	12 (2.4%)	10 (14.1%)	
tangent			
not speeding	2768	351	**2.67 (1.64, 4.34)**
speeding	68 (2.4%)	23 (6.1%)	
Divided and one way (open county, open residential, moderate residential, business/industrial)			
curve (left or right)			
not speeding	97	26	NA
speeding	2 (2.0%)	0 (0%)	
tangent			
not speeding	880	154	**3.05 (1.27, 7.31)**
speeding	15 (1.7%)	8 (4.9%)	
Interstate/bypass/divided no signal			
curve (left or right)			
not speeding	353	11	**6.02 (1.53, 23.71)**
speeding	16 (4.3%)	3 (21.4%)	
tangent			
not speeding	2032	152	**1.24 (0.67, 2.30)**
speeding	129 (6.0%)	12 (7.3%)	

Baseline		Crash/near crash	Odds (CI)
Bypass/divided with signal			
curve (left or right)			
not speeding	56	4	NA
speeding	0 (0%)	0 (0%)	
tangent			
not speeding	342	27	**3.45 (0.91, 13.13)**
speeding	11 (3.1%)	3 (10.0%)	
Entrance exit ramps			
not speeding	260	54	**1.60 (0.16, 15.72)**
speeding	3 (1.1%)	1 (1.8%)	

Table 3 evaluates the types of safety-critical events that are typically roadway departures (roadway departure, sideswipe, opposite direction, animal). Information is shown for curves and tangents separately for two-lane roadways, but were combined for other roadway types due to the small sample size.

As noted, roadway departure safety-critical events were more likely to be speeding than baselines events on similar roadways for two-lane curves and interstate/bypass/divided with no signal. The results were not statistically significant for the remaining roadway types.

Table 3: Speeding versus Not Speeding by Roadway Type for Roadway Departure Safety-critical Events

Baseline		Crash/near crash	Odds (CI)
2-lane (open county, open residential, moderate residential, business/industrial)			
curve (left or right)			
not speeding	486	37	**7.67 (2.85, 20.63**
speeding	12 (2.4%)	7 (15.9%)	
tangent			
not speeding	2768	147	**1.66 (0.71, 3.89)**
speeding	68 (2.4%)	6 (3.9%)	
Divided and one way (open county, open residential, moderate residential, business/industrial)			
not speeding	977	51	1.13 (0.15, 8.64)
speeding	17 (1.7%)	1 (1.9%)	
Interstate/bypass/divided no signal			
not speeding	2385	38	**3.03 (1.33, 6.90)**
speeding	145 (5.7%)	7 (15.6%)	
Bypass/divided with signal			
not speeding	56	9	NA
speeding	0 (0%)	2 (18.2%)	
Entrance exit ramps			
not speeding	260	21	**4.13 (0.41, 41.43)**
speeding	3 (1.1%)	1 (4.5%)	

Table 4 evaluates the types of rear-end safety-critical events. Information was combined for curves and tangents due to the small sample size. Rear-end safety-critical events were more likely to be speeding-related than baseline events for two-lane roadways, and results were not statistically significant for the other roadway types.

Table 4: Speeding versus Not Speeding by Roadway Type for Rear-End Safety-critical Events

Baseline		Crash/near crash	Odds (CI)
2-lane (open county, open residential, moderate residential, business/industrial)			
curve (left or right)			
not speeding	3254	166	**3.43 (1.90, 6.18)**
speeding	80 (2.4%)	14 (7.8%)	
Divided and one way (open county, open residential, moderate residential, business/industrial)			
not speeding	977	108	1.60 (0.46, 5.54)
speeding	17 (1.7%)	3 (2.7%)	
Interstate/bypass/divided no signal			
not speeding	2385	119	**0.97 (0.44, 2.11)**
speeding	145 (5.7%)	7 (5.6%)	
Bypass/divided with signal			
not speeding	56	17	NA
speeding	0 (0%)	0 (0%)	
Entrance exit ramps			
not speeding	260	30	NA
speeding	3 (1.1%)	0 (0%)	

Table 5 shows events which occurred at an intersection or were intersection-related where the traffic control type was a signal. They are additionally broken down by roadway type. As noted, safety-critical events at signalized intersections were more likely to be speeding-related than baseline events for signalized intersections on business/industrial/urban roadways and when all roadways were combined.

Table 5: Speeding versus Not Speeding at Signalized Intersections by Roadway Type

Baseline		Crash/near crash	Odds (CI)
Business/industrial/urban			
not speeding	747	332	**6.75 (1.36, 33.62)**
speeding	2 (0.3%)	6 (1.8%)	
Moderate residential/ open country/open residential			
not speeding	142	40	NA
speeding	0 (0%)	3 (7.0%)	
Divided hwy with traffic signal			
not speeding	38	15	NA
speeding	1 (2.6%)	0 (0%)	
All			
not speeding	927	384	7.24 (1.95,26.90)
speeding	3 (0.3%)	9 (2.3%)	

Table 6 shows events which occurred at an intersection or were intersection-related where the traffic control was a stop sign. They are additionally broken down by roadway type. It is unknown whether events which occurred on the major approach for a two-way, stop-controlled intersection were coded with traffic control as being "stop sign" or "no-control." Safety-critical events at stop signs on business/industrial/urban roadways and for all roadways combined were more likely to be speed-related.

Table 6: Speeding versus Not Speeding at Stop-controlled Intersections by Roadway Type

Baseline		Crash/near crash	Odds (CI)
Business/industrial/urban			
not speeding	105	41	**2.56 (0.16, 41.92)**
speeding	1 (0.9%)	1 (2.4%)	
Moderate residential/ open country/open residential			
not speeding	225	42	NA
speeding	0 (%)	2 (4.5%)	
Divided hwy with traffic signal			
not speeding	0	0	NA
speeding	0	0	
All			
not speeding	330	83	11.93 (1.22, 116.14)
speeding	1 (0.3%)	3 (3.5%)	

Table 7 shows events which occurred at an intersection or were intersection-related where the traffic control was a yield sign. They are additionally broken down by roadway type. No safety-critical events were speeding-related, so the odds could not be calculated.

Table 7: Speeding versus Not Speeding at Yield-controlled Intersections by Roadway Type

Baseline		Crash/near crash	Odds (CI)
All			
not speeding	16	14	NA
speeding	2 (11.1%)	0 (0%)	

6.3 TYPOLOGY OF SAFETY-CRITICAL EVENTS

In the analysis described in this section, each crash and near-crash were reviewed. Characteristics such as roadway type, crash type, etc. were compared against what was coded, and adjustments were made when a different set of characteristics seemed more appropriate.

Time series data are provided and speed before the beginning of each event was coded. As noted in section 2, speed limit was not provided as an attribute. In some cases speed limit or advisory speed was available from the narrative and in some cases it could be viewed from the forward view. However, it could not be determined in a sufficient sample size to conduct additional analyses. Although the posted/advisory speed was not universally available, the actual speed of the vehicle just prior to the safety-critical event was extracted from the time series data.

The sections below summarize safety-critical events by roadway type.

6.3.1 Non-intersection

Rear-end or near rear-end

Thirteen coded as business/industrial, moderate residential, open country, open residential:

- Six coded as "exceeded speed limit"
- Seven coded as "exceeded safe speed but not speed limit"
- Majority were daytime (92 percent) and all were under dry/wet roadway conditions
- Pre-incident speeds ranged from 18 mph to 61 mph (38 percent were traveling ≤45 mph)

Twenty-two coded as bypass/divided highway with traffic signal or interstate/bypass/divided no signals:

- Thirteen coded as "exceeded speed limit"
- Nine coded as "exceeded safe speed but not speed limit"
- Majority were daytime (82 percent) and all were under dry/wet roadway conditions (100 percent)
- Pre-incident speeds ranged from 29 mph to 101 mph (27 percent were traveling ≤70 mph before the incident)

Roadway Departure (includes typical ROR, animal in roadway, head-on, sideswipe)

Seventy-five coded as business/industrial, moderate residential, open country, open residential:

- Thirty-four coded as "exceeded speed limit"
- Forty-one coded as "exceeded safe speed but not speed limit"
- Fifty-three percent were daytime and 82 percent were under dry/wet roadway conditions
- Pre-incident speeds ranged from 14 mph to 100 mph (24 percent were traveling ≤50 mph; 3 percent were traveling ≤70 mph)

Sixteen coded as bypass/divided highway with traffic signal or interstate/bypass/divided no signals:

- Nine coded as "exceeded speed limit"
- Seven coded as "exceeded safe speed but not speed limit"
- Eighty-one percent were daytime and 88 percent were under dry/wet roadway conditions
- Pre-incident speeds ranged from 37 mph to 84 mph (53 percent were traveling ≤70 mph)

Eleven coded as exit/entrance ramp:

- Three coded as "exceeded speed limit"
- Eight coded as "exceeded safe speed but not speed limit"
- Fifty-five percent were daytime and 55 percent were under dry/wet roadway conditions
- Pre-incident speeds ranged from 27 mph to 70 mph (36 percent were traveling ≤ 50 mph)

6.3.2 Signalized Intersection

Rear-end or near rear-end

Fourteen coded as business/industrial, moderate residential, open residential, bypass/divided hwy

- Five coded as "exceeded speed limit"
- Nine coded as "exceeded safe speed but not speed limit"
- Majority were daytime (71 percent) and most (93 percent) were under dry/wet roadway conditions
- Pre-incident speeds ranged from 19 mph to 55 mph (57 percent were traveling ≤ 45 mph)

Roadway Departure (includes typical ROR, loses control, sideswipe)

Twenty-two coded as business/industrial, moderate residential, open residential, bypass/divided hwy

- Six coded as "exceeded speed limit"
- Sixteen coded as "exceeded safe speed but not speed limit"
- Fifty-nine percent were daytime and 77 percent were under dry/wet roadway conditions
- Pre-incident speeds ranged from 8 mph to 67 mph (33 percent were traveling ≤ 45 mph)

6.3.3 Stop or Yield Controlled Intersection

Rear-end or near rear-end

None were coded as rear-end or near rear-end.

Roadway Departure (includes typical ROR, loses control, sideswipe)

Four coded as business/industrial, moderate residential, open residential, bypass/divided hwy

- Two coded as "exceeded speed limit"
- Two coded as "exceeded safe speed but not speed limit"
- Twenty-five percent were daytime and 75 percent were under dry/wet roadway conditions
- Pre-incident speeds ranged from 17 mph to 40 mph

Broadside

One coded as near-broadside (nighttime, dry), where speed just before the event was 44 mph.

6.3.4 Roundabout/Traffic Circle

Rear-end or near rear-end

One coded as moderate residential (exceeded speed limit, dry roadway, daytime) at 19 mph before incident.

Roadway Departure (includes typical ROR, loses control, sideswipe)

Six coded as business/industrial, moderate residential, open residential

- One coded as "exceeded speed limit"
- Seven coded as "exceeded safe speed but not speed limit"
- Sixty-seven percent were daytime and all were under dry/wet roadway conditions
- Pre-incident speeds ranged from 20 mph to 38 mph

6.3.5 Pedestrian

No speeding or speed-related events that involved pedestrians were reported. Since pedestrian and bicyclist safety is of particular concern, all pedestrian crashes and near crashes involving a subject driver were assessed and relevant characteristics summarized below.

Midblock Crosswalks

Six events involved pedestrians crossing in a midblock cross walk. The subject driver went around vehicles stopped at the cross walk and nearly struck pedestrians in two instances. Both were during the day, one on wet roads and one on dry. One driver was moving or reaching for an object and the other driver had no coded distractions. Both were traveling almost 20 mph.

Three of the six events involved drivers nearly striking pedestrians in midblock crosswalks (speeds were 23 to 34 mph). All three occurred during the day on dry roads. One driver was interacting with a passenger and one driver was looking down or engaged in an external distraction. One event occurred during the nighttime with the driver traveling at 27 mph along a business/industrial road. The crosswalk is midblock, has on pavement "Ped Xing" markings, flashing beacons, and a painted crosswalk. The driver was engaging with a passenger and engaged in an external distraction. The driver failed to noticed the pedestrian and braked hard to avoid striking the person.

Midblock but not Crosswalk Crossings

Eleven events involved a pedestrian crossing midblock but not in a cross walk. A child darted into the street in three of those events. All were residential/moderate residential with driver speeds between 17 and 19 mph. It was daytime for two events and dawn/dusk for one. The roads are dry for two events and wet for one. All three drivers were engaged in a distraction (personal hygiene, interacting with rear seat passenger, and using cell).

Eight of the 11 events involve a pedestrian crossing the street or entering the street in front of the driver and nearly being struck. In all cases the roads were dry or wet. Two drivers were texting, one was interacting with a passenger, and one driver was coded as drowsy. The roadways are urban, moderate residential, or business/industrial.

Intersection Straight

Four pedestrians crossed perpendicular to the driver who was traveling straight during the green phase at a signal. In these cases, the driver had the right of way. Driver speeds just prior to the event ranged from 7 to 32 mph, and roadways were urban or business/residential. Two occurred at night with lighting and two occurred during the day with three coded as having dry roads and one with wet roads. One driver was engaged in personal hygiene and an external distraction, and one driver was talking or browsing on a cell phone.

Three events occurred at a stop-controlled intersection or driveway with the pedestrian crossing in front of the driver on the roadways in areas coded as being moderate residential. Speeds just before the event were 0 to 12 mph. Two events occurred during the day with one occurring at night with lights, and all were on dry roads. One driver was texting and another driver was talking on a cell phone.

Intersection Left Turning

Nine events involved a driver nearly striking a pedestrian while turning left, with the pedestrian crossing being parallel to the driver's original travel path. Five were at signals, two were at locations with stop control, and one occurred at the entry to a driveway. Two drivers were interacting with front seat passengers, one was dialing a cell phone, and one was looking down at a cell phone. The roadways were moderate resident, urban, or business/industrial and speeds just prior to the event ranged from 6 to 18 mph. In six cases the roadways were mostly dry and in two they were wet.

Intersection Right Turning

Drivers were turning right and nearly struck a pedestrian in seven cases that occurred at urban, moderate residential, or business/industrial roadways. Four were at signals, two at stop controlled approaches, and one was turning into a driveway. The majority (6 cases) occurred during the day on dry roads with one event occurring at night with wet roads. One driver was talking/singing to self and engaged in an external distraction while the remaining drivers were not coded as having distractions.

6.3.6 Bicyclist

Only two speed-related events were reported. Since pedestrian and bicycle safety is of particular concern, all bicycle crashes/near crashes involving a subject driver were assessed and relevant characteristics summarized below.

Twenty safety-critical events involving bicyclists were reported.

Midblock but not Crosswalk Crossings

In one near crash, the subject driver exceeded the posted speed limit by 5 to 10 mph along an urban roadway. A bicyclist crossed the roadway midblock in an area with a cross-walk and railroad crossing. The driver nearly struck the bicyclist. Just prior to the event, the driver was traveling 39 mph. The driver was listed as "dancing."

Edge of Roadway

In another scenario the driver is listed as exceeding a safe speed but not the speed limit, driving 39 mph during the daytime. The driver nearly struck a bicyclist traveling along the edge of the roadway (listed as business/industrial). One other event listed the driver nearly striking a bicyclist traveling on the shoulder along a rural roadway while traveling at 40 mph. In both situations, it was dark and bicyclist was difficult to see. In one event the driver was talking/singing to self, but no distraction is listed for the other event.

Intersection Straight

The remaining bicycle-related events occurred at intersections. Six of the events occurred at a signalized intersection when the bicyclist crossed the road perpendicular to the driver, who was traveling straight during the green phase with the driver nearly striking the bicyclist. In these cases, the driver had the right of way. Driver speeds just prior to the event ranged from 4 to 30 mph. Five occurred during the day with one occuring at dawn/dusk. All were on dry roads. One driver was interacting with a passenger, one was coded as having a cognitive distraction, and one was coded as having "internal eye glance." No distractions are coded for the other events.

Two events occurred at stop-controlled intersections with the bicyclist crossing the road perpendicular to the driver, who had the stop sign. One occurred at night with lighting present (traveling 7 mph prior to event) and one occurred during the day (traveling 14 mph). One driver was listed as talking/singing to self while the other has not reported distraction. In both cases the driver appears to execute a rolling stop.

Intersection Left

Six drivers were turning left at a signal (5 cases) or stop sign (1 case) and nearly struck bicyclists who were crossing the adjacent roadway (parallel to the drivers' original travel paths). Drivers were traveling 7 to 19 mph just prior to the event. Five occurred during the day, with one occurring at night with lighting. All were on dry roads. One driver was texting and one was looking at something outside the vehicle.

Intersection Right

Two drivers were turning right; one at a signal and one from a driveway, and nearly struck bicyclists who were crossing the adjacent roadway (parallel to the drivers' original travel paths'). The drivers were traveling 4 to 7 mph just prior to the event. Five occurred during the day with one occurring at night with lighting. All are on dry roads. One driver was holding a cell phone and talking, the other had no distraction.

Red Light Running

One driver ran a red light and nearly struck a bicyclist is in the intersection. The vehicle was traveling 58 mph prior to the event, which occurs in a business/industrial area during the daytime on dry roads. No driver distractions were coded.

6.4 STUDY LIMITATIONS

The analyses presented in the following sections were based on data from drivers observed in the SHRP 2 NDS and may not be representative of all drivers.

Data can only be queried on the InSight website unless a data-sharing agreement and additional resources are provided to download event information, which was beyond the scope of this project. As a result, analyses were based on those that could be obtained from manual reduction of information or by query of the available attributes.

The major limitation to the analyses is that speed limit was not available for individual events which limited the ability to assess speeding. With additional resources, speed limit could be obtained by requesting GPS coordinates for baselines and near-crash events.

Although there were some limitations due to project resources and the type of data there were available, these analysis provide valuable insight into the role of speeding in safety-critical events.

6.5 RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

In order to fully utilize the SHPR 2 NDS data to investigate the relationship between speed and crash risk, several recommendations are offered.

First, the major limitation to this study was the lack of speed limit information. As a result, it would be very helpful if speed limit and advisory speed (when present) were coded for all crashes and near-crashes and were provided as attributes in the event detail table. This would allow speeding to be determined.

Second, although baseline events were provided in the data available on the InSight website, speed limit data were not provided, and little information is available about where the event actually occurred. Additionally, as noted in Section 6.1, roadway types used in the InSight website do not correspond well to traditional definitions used by traffic engineers. Since a forward view was not provided, there was no manner in which roadway type could be coded. As a result, it is difficult to compare safety-critical events to normal events in a meaningful manner. Providing speed limits for the baseline and a forward snapshot showing roadway location would be very helpful in conducting speed related analyses.

The SHRP 2 NDS dataset does provide a unique way to evaluate the impact of speeding. If speed limit for safety-critical events could be obtained, a reasonably simple analysis could be conducted to identify the role of speeding in crashes and near crashes using the "Event Detail Table" in the InSight website.

If additional resources were available, an ideal research project would identify roadways where safety-critical events had occurred and then select normal driving events for the same roadways so that the relationship between speeding and crash risk could be determined.

7. REFERENCES

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Appendix B – Safety Focus Groups

Pedestrian Focus Group		
Peter Eun	FHWA Resource Center	Safety & Design Team – Pedestrian and Bicyclist expert
Lauren Blackburn	North Carolina DOT	TRB Standing Committee on Pedestrians
Trenda McPherson	Florida DOT	State Bicycle/Pedestrian Safety Program Manager
Luis Montoya	City of San Francisco, CA	San Francisco Municipal Transportation Agency
Joe Marek	Clackamas County, OR	Traffic Engineering Supervisor
George Branyan	District of Columbia DOT	TRB Standing Committee on Pedestrians
Dongho Chang	City of Seattle, WA	City Traffic Engineer
Cara Seiderman	City of Cambridge, MA	TRB Standing Committee on Pedestrians
Roadway Departure Focus Group		
Dick Albin	FHWA Resource Center	AASHTO Technical committee on Roadside Safety
Jim Brewer	Kansas DOT	AASHTO Technical committee on Geometric Design
R. Scott Zeller	Washington State DOT	TRB Operational Effects of Geometrics
Darren McDaniel	Texas DOT	Focus State
David Brand	Madison Co, OH	National Association of County Engineers
Tim Barnett	Alabama DOT	Focus State
Intersections Focus Group		
Tim Taylor	FHWA Resource Center	Safety & Design Team
Mike Reese	North Carolina DOT	TRB Intersections Joint Subcommittee
Daniel Pass	Georgia DOT	TRB Intersections Joint Subcommittee
Jeff Wentz	Maryland State Highway Admin.	TRB Intersections Joint Subcommittee
Scott Davis	Thurston Co, WA	National Association of County Engineers
Ida Van Schalkwyk	Washington State DOT	TRB Traffic Speed and Safety Joint Subcommittee

Summaries of Interviews

Roadway Departure Summary

Has speeding been considered as an issue/challenge for Roadway Departure safety?

Yes.

What are the predominate characteristics of Roadway Departure crashes in your jurisdiction where speed management may be an issue? (road type, area type, etc.)

More in rural areas.
Multi-lane highways at intersections.
Blind spots (poor sight distance).
Two-lane rural roads.
Over-representation in curves.
Head-on crashes.
Hitting a tree.

What are some speed management actions or measures your agency has implemented or is trying to implement to improve Roadway Departure safety?

Use high friction surface treatment.
Curve warning & chevrons.
Dynamic curve signs.
Centerline and shoulder rumble strips ("noise" can be an issue).
Wide edge lines, speed feedback signs.
Increased friction.
Provide shoulders.
Reduce edge drop off.
Clear zone.
Flatten slopes.
Widen roadways, rumble strips, high friction pavement, LED chevrons.
Intersections use transverse rumble strips.

Were they successful, unsuccessful or do you not yet know the outcome? Why do you think they succeed or failed? What problems or issues did you encounter?

Speed feedback signs only provided 1 or 2 mph decrease.
Lowering speed limit - 0 mph change.
Cable barrier on Interstate median (initially used 3-strand, but now use 4-strand cable).
Develop plans for Focus Area States.

What are some of the major knowledge gaps in engineering safer speeds to reduce Roadway Departure fatalities and injuries?

Do not have funding for widening shoulders or changing superelevation.
Roadway inventory data not very good.
Transition zones are a problem.
Need a tool box, such as Roundabouts or Chicanes.
Removing trees in clear zone or should trees be left in to slow traffic down?
Effectiveness of wide edge lines.
What is the right package of improvements for high-speed roundabout approaches?

What information, research, or other resources are needed to close the gaps?

Downward grade on curves.
What is the correlation of reduction of speed to reducing crashes or the severity of crashes?
Understanding the effects speed reduction on crashes.
Engineering, enforcement, and judicial.
Driver attention and speed.
Surface condition, wet weather.
CRF.

What information, research, or other resources are needed to close the gaps?

Lower noise patterns for rumble strips.
Money & funding.
Need systematic approach.
Data on variable speed limits.
No real time data on speed.

What do you feel are the most significant challenges or issues to making speed management strategies and actions an integral part of improving Roadway Departure safety?

Cannot post a speed and expect people to obey it.
What is the speed of vehicles 5 mph, 10 mph over? Perception of speeding.
Need research to be able to determine speeds.
How do you address when a highway is designed for 70 mph and posted for 50 mph?
One of the largest challenges is to develop crash testing criteria for the higher speeds. Vehicle designs come into play and we as an agency cannot predict that development.

Intersection Summary

Has your agency done any analysis of speeding related Intersection crashes?

No, we look at speeding as a contributing factor.

Has speeding been considered as an issue/challenge for Intersection safety?

Not a high percentage of crashes.
Not that much. Speeding is a cause.
Speed compounds another issue.
Is speeding a primary or just a contributing factor?

What are the predominant characteristics of Intersection crashes in your jurisdiction where speed management may be an issue? (road type, area type, etc.).

Two-lane rural roads.
Rural high speed with isolated intersections.
Urban arterials with coordinated signals. Do not have staff to maintain.
More in suburban areas, and higher severity in rural.
Rural 50 mph roadways

What are some speed management actions or measures your agency has implemented or is trying to implement to improve Intersection safety?

Getting funding where the needs are which are on the local roads. Funds go to National Highway System (NHS).
HSIP funds for speed enforcement.
Speed management course for law enforcement, judges, etc.
"Super Street" J-turns.
Traffic calming.
Roundabouts.
Roundabouts with speed reduction.
Wide edge lines.
Rumble strips.
3D pavement markings.
Basic Human Factors Knowledge. Surprise driver crashes will happen.
Wide dash lines through intersections.
Lane narrowing.
LED stop signs.
USLIMITS2 as a guide.

School zones with beacons.
Transverse rumble strips.
Targeted enforcement.
Speed trailer.
Set speed limit to 85th percentile as a policy.
Urban standards revised. Narrower streets.

Were they successful, unsuccessful or do you not yet know the outcome? Why do you think they succeed or failed? What problems or issues did you encounter?

Rumble strips get complaints of too much noise and little reduction of speed.
80 roundabouts, 1 fatal and 1 serious crash.
3D pavement markings are short-lived and costly to replace.

What are some of the major knowledge gaps in engineering safer speeds to reduce intersection fatalities and injuries?

Not every jurisdiction has a traffic engineer.
Police do not ask the right questions.
Choosing design speed. Why 5-10 mph higher?
Uniformity and consistency of data.
Quantify features of roadway. A speed management factor similar to crash modification factor.

What information, research, or other resources are needed to close the gaps?

Need more data on the effectiveness of wider edge lines and lane narrowing
The impact of speed on a crash (i.e., if they were going 5 mph less, would it have made a difference?)
Raising awareness for speed management similar to safety. There are tools for safety like Highway Safety Manual (HSM); need something similar for speed management.
Outreach tools for the public (i.e., video & handouts)
What is the proper speed?
Police training.
Information on teaching students the right way.
Policies dealing with perceptions instead of science.

What do you feel are the most significant challenges or issues to making speed management strategies and actions an integral part of improving Intersection safety?

How we communicate with the public.
Sharing data from other states. Having uniformity and consistency of data.
Law enforcement ticketing at 15 mph over speed limit. Difficult to have consistent speeds limits.
Over designing a highway; making the decision to construct a 20-year design now, or wait and utilize phase construction.

Pedestrian Summary

Has your agency done any analysis of speeding related Pedestrian crashes?

Yes.
No, we need to.
Yes, pedestrian crashes occurring on roadways that are high speed.

Has speeding been considered as an issue/challenge for Pedestrian safety?

Yes, the higher the speed, the higher the severity.
It is difficult to determine if a vehicle was speeding.
Enforcement on all speeding and aggressive driving.

What are the predominate characteristics of Pedestrian crashes in your jurisdiction where speed management may be an issue? (road type, area type, etc.).

High-speed ramps to arterial roads.
Intersections where there is a high volume of pedestrians.
High-speed to lower-speed transition areas.
Urban intersections.
Non-roadway (i.e., parking lots)
Midblock.
Major arterials with no medians.
Downtown arterials.

What are some speed management actions or measures your agency has implemented or is trying to implement to improve Pedestrian safety?

Speed humps in residential areas.
Street redesign over last 20 years, traffic calming, reduced speeds, and narrow streets.
Signal timing to slow down traffic.
Bulb outs, lane narrowing, edge lines.
Road Diets.
Complete Streets.
Lane width reduction.
Retiming signals.
Revising speed limits 30mph to 25mph.
Rapid rectangular flashing beacons
Automated speed enforcement.
Education and Enforcement campaigns.

Were they successful, unsuccessful or do you not yet know the outcome? Why do you think they succeed or failed? What problems or issues did you encounter?

A lot of success in cities.
Before and after studies.
Fatal crashes down, but pedestrian crashes up.

What are some of the major knowledge gaps in engineering safer speeds to reduce Pedestrian fatalities and injuries?

Why design for peak hour?
Countermeasures for high speed roadways.
Knowledge gap regarding countermeasures for arterial and commercial streets; there are more speed management countermeasures for residential streets.

What information, research, or other resources are needed to close the gaps?

Automated speed enforcement is perceived as a revenue generating tool by the public. Need data and information showing safety benefits.

Toolbox for arterial streets. Need information showing effectiveness.

Find good data on speed humps and reduction of lane width 12’ to 11’.

Table intersection crossings.

How to choose between rapid rectangular flashing beacon or a signal for mainline.

Mid-block crossing toolbox.

More guidelines for arterials and countermeasure effectiveness.

Appendix C – Additional Resources

- Bike Safe – Bike Smart, http://www.nhtsa.gov/Driving+Safety/Bicycles/Bike+Safe+-+Bike+Smart+(25MB+and+146MB,+WMV+format)
- Context Sensitive Solutions website - http://contextsensitivesolutions.org/
- *A Desktop Reference of Potential Effectiveness in Reducing Speed*, 2014 http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm, and
- *A Desktop Reference of Potential Effectiveness in Reducing Crashes*, 2014 http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_crashes.cfm
- *Evaluation of Dynamic Speed Feedback Signs on Curves: A National Demonstration Project*, FHWA-HRT-14-020, January 2015. https://www.fhwa.dot.gov/publications/research/safety/14020/index.cfm
- *Evaluation of Low Cost Traffic Calming for Rural Communities – Phase II [Updated]*, S. Hallmark, S. Knickerbocker, and N. Hawkins, 2013. http://lib.dr.iastate.edu/intrans_reports/94/
- FHWA Road Diet website - http://safety.fhwa.dot.gov/road_diets/
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- High Friction Surface Treatments. https://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/hfst.cfm
- Jurisdiction Speed Management Action Plan Development Package, FHWA-SA-15-017, January 2015 http://safety.fhwa.dot.gov/speedmgt/ref_mats/docs/fhwa_speedmanagementpackage_final.pdf
- *Low-Cost Treatments for Horizontal Curve Safety*, FHWA-SA-07-002, Dec 2006 http://safety.fhwa.dot.gov/roadway_dept/horicurves/fhwasa07002/
- *Methods and Practices for Setting Speed Limits: An Informational Report*, FHWA-SA-12-004, April 2012. http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa12004/
- Motorcycle Safety Training Program Examples:
  - BikeSafe North Carolina - http://www.bikesafenc.com/
  - BikeSafe UK - http://www.bikesafe.co.uk/
- NCHRP Report 500, Volume 23 – A Guide for Reducing Speeding-related Crashes http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v23.pdf
- NCHRP Report 504: Design speed, Operating Speed, and Posted Speed Practices http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_504.pdf
- NCHRP Report 613: Guidelines for Selection Speed Reduction Treatments at High-Speed Intersections (2008). http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_613.pdf
- NCHRP Report 650: Median Intersection Design for Rural High-Speed Divided Highways http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_650.pdf
- NCHRP Report 737: Design Guidance for High-Speed to Low-Speed Transition Zones for Rural Highways (2012). http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_737.pdf

- NCHRP Synthesis 412: Speed Reduction Techniques for Rural High-to-Low Speed Transitions (2011) http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_412.pdf
- PEDBIKESAFE – Pedestrian and Bicycle Safety Guides and Countermeasure Selection Systems http://pedbikesafe.org/
- *Resident's Guide for Creating Safer Communities for Walking and Biking*, FHWA-SA-14-099, January 2015. http://safety.fhwa.dot.gov/PED_BIKE/ped_cmnity/ped_walkguide/index.cfm
- Safety Edge$_{SM}$. http://www.fhwa.dot.gov/everydaycounts/technology/safetyedge/intro.cfm
- *Separated Bike Lane Planning and Design Guide*, FHWA-HEP-15-025, May 2015 https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page00.cfm
- *Speed Enforcement Camera Systems Operational Guidelines*, DOT HS 810 916, March 2008. http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa09028/5.htm
- USLIMITS2 - http://safety.fhwa.dot.gov/uslimits

Appendix D – Gaps and Needs in Research

A list of gaps and needs relating to speed management, effectiveness of countermeasures, and speeding-related crash risks emerged during the comprehensive literature review, crash data analysis, and focus group interviews.

The following table lists some critical gaps in our understanding of the problem and initiatives needed to more effectively manage speed to improve roadway departure, intersection, and pedestrian and bicyclist safety.

Gaps/Needs	Overall Speed Management	Roadway Departure Focused	Intersection Focused	Pedestrian/ bicyclist Focused
A better understanding of the relationship between travel speed and crash risk is needed to better define unsafe travel speeds and estimate changes in safety due to changes in speed that are expected from implementing engineering countermeasures.	X			
The long-term effects of many traffic engineering and design measures on reducing speed are not well defined or evaluated.	X			
NCHRP Report 613, Guidelines for Selection of Speed Reduction Treatments at High Speed Intersections, presents a wide variety of treatments for reducing speed at intersections, but insufficient data is published on the long-term speed and safety impacts. Rigorous evaluation is needed to better understand the safety effects of the following treatments: • Dynamic warning signs • Longitudinal rumble strips • Wider longitudinal pavement markings • Approach curvature • Splitter islands • Speed tables and raised intersections • Reduced lane width • Visible shoulder treatments		X		
Current speed activated warning systems on curves do not take into account vehicle type or weather conditions		X		
The effects of variable speed limits on operating speeds, compliance, and safety are not well known and are needed to advance the concept, especially in work zones and for adverse weather conditions.	X			
Develop strategies for the mitigation of crash risk of trees, utility poles, and other fixed objects in the clear zone		X		
Research is needed to determine the effects of wider edge lines or narrowing lane width	X			
The safety effectiveness of posting appropriate speed limits and advisory speeds on intersection approaches has not been quantified for signalized and unsignalized intersections			X	
The effects of variable speed limits at intersections on operating speeds, compliance, and safety are not well known and are needed to advance the concept.			X	
The reduction of speed limits and use of advisory speeds at intersections have little effects on speed, and their impact on safety is not known			X	

Gaps/Needs	Overall Speed Management	Roadway Departure Focused	Intersection Focused	Pedestrian/ bicyclist Focused
A rigorous evaluation of the safety effects of automated speed enforcement at intersection in the United States is needed to convince legislators and transportation officials of its efficacy. Also, a mechanism is needed to ensure engineering and traffic investigations are performed prior to implementation of automated speed enforcement.			X	
The inferred design speed profile based on American Association of State Highway and Transportation Officials (AASHTO) criteria and average driver, vehicle, and road friction characteristics should be developed and incorporated into the IHSDM and related training.	X			
Operating speed estimation models based on roadway design characteristics are available for two-lane highways to assist designers in assessing design consistency based on the magnitude of speed reduction on curves relative to the approach road section. Similar operating speed estimation models need to be developed for rural multilane roadways and incorporated into the Interactive Highway Safety Design Model (IHSDM). In addition to assessing design consistency and potential safety problems on curves, the model would also be helpful in assessing the need for climbing lanes, justification of maximum grades, and evaluating proposed capacity-expansion projects.		X		
National roadway design guidance does not provide criteria for design speeds above 80 mph. • Brake reaction time and deceleration rate for drivers and various vehicle types with initial speeds of 80 mph and higher are needed to verify whether current values used in road design are sufficient. • Detection and recognition distance between a high speed vehicle and a slower moving vehicle are needed to assess whether they are sufficient to permit evasive maneuvers or stopping. • Additional research is needed to determine the potential for rollover and skidding at the higher design speeds on curves, especially as applicable to ramp design. • Research is needed to determine side friction demand on horizontal curves on high-speed roadways and how much, if any, drivers slow down. • Evaluating the impacts from raising speed limits to 80 mph and higher on roadside safety features.	X	X		
Roadside Safety Analysis Program (RSAP), an encroachment-based computer software tool for cost-effectiveness evaluation of roadside safety improvements, includes speed limit as variable affecting encroachment speed, angle and severity, but is largely based on data collected on roadways with speed limits of 70 mph or less. There is a need to develop encroachment speed or angle distributions for roadways with prevailing speeds of 75 mph and higher and identify roadside slopes and ditch configurations that are recoverable, traversable, and non-traversable at high speeds.		X		
The safety impacts of speed limit changes based on USLIMITS2 need to be evaluated; providing before and after studies of corridors when agency used USLIMITS2 as basis for setting speed limit; success stories.	X			
A national speed limit database and a curve geometry database are needed to support advanced safety applications such as in-vehicle speed monitoring and curve speed warning.	X	X		

Gaps/Needs	Overall Speed Management	Roadway Departure Focused	Intersection Focused	Pedestrian/bicyclist Focused
As connected vehicle (CV), vehicle-to-infrastructure (V2I) and related technologies develop, researchers and developers need to consider integrating solutions for addressing speed and roadway departure, intersection, and pedestrian and bicyclist crashes.	X	X	X	X
NCHRP Report 731, Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections, and a draft ITE proposal recommended practice advises that yellow change intervals be timed using the speed limit + 7 mph to approximate the 85th percentile speed if speed data are not measured and that 1 second be subtracted from the calculated red clearance time to account for driver start-up delay in entering the intersection after green onset. The crash effects of retiming yellow change and red clearance intervals following the new guidelines need to be quantified and crash modification factors updated for inclusion in the HSM.			X	
A much better understanding of perception-reaction, deceleration, red-light running behaviors, etc. at signalized intersections could be determined using the 2nd Strategic Highway Research Program Naturalistic Driving Study (SHRP2 NDS) data.			X	
More robust research on vehicle or speed activated devices is needed.	X			
There is a need for a toolbox of countermeasures and details of the effectiveness of each on speed management.	X	X	X	X
A better understanding of the relationship between travel speed and crash risk is needed in low and moderate speed environments to better define unsafe travel speeds and estimate changes in pedestrian safety, due to changes in speed that are expected from implementing engineering countermeasures.				X
Speed prediction models are needed for urban streets to assist designers in developing context-sensitive road designs and incorporating features that result in operating speeds that are consistent with the target speed environment.	X			X
The engineering toolbox for managing speed is limited, except for residential streets. Cost-effective methods are needed to better manage speeds on urban arterial streets.	X			
USLIMITS2 does not address school zones or provide guidance on actions to take if the recommended speed limit is higher than desired. There is a need to incorporate a countermeasure selection tool such as the Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE) and speed prediction models that could assist users in reducing the road speed to a level that would support a lower speed limit.				X
Speed management needs to be integrated into current training courses on pedestrian safety in order to reach a broader audience and achieve positive outcomes.				X
Research recently recommended bicycle lane widths and parking lane widths for low-speed streets. There is a need to develop guidance for bicycle lane widths for various roadway characteristics based on vehicle speeds and grade.				X
There needs to be more guidance on determining the best pedestrian safety tool or countermeasure for a specific condition				X
There is a need for research to determine what countermeasures can be used to reduce pedestrian crashes cause by turning vehicles at intersections.				X
Research is needed to determine if there is a correlation between the effect of signal timing and whether pedestrians choose to wait and cross at the intersection or instead, cross at midblock locations or illegally.				X

For more information:

Visit http://safety.fhwa.dot.gov/speedmgt/

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Federal Highway Administration
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