

Wrong-Way Driving on Freeways in Texas: Problems, Issues, and Countermeasures

Drivers who make wrong-way entries onto freeways or other restricted roadways pose a serious risk to the safety of other motorists and themselves. Wrong-way driving often leads to head-on collisions. Wrong-way crashes are relatively infrequent, but they are more likely to produce serious injuries and fatalities compared to other types of freeway crashes. This research involved gathering information on the issues, causes, and consequences of wrong-way movements on freeway facilities in Texas.

What We Did...

The research team developed a work plan for this project with the goal of producing guidelines and recommended practices to reduce wrong-way crashes and movements in Texas. Based on this goal, researchers performed the following tasks:

- established state-of-the-practice on safety, design, and operational issues related to wrong-way movement on freeways based on review of previous and ongoing studies;
- surveyed state departments of transportation (DOTs) to gather information on typical wrong-way signing and marking plans and any innovative practices or countermeasures;
- quantified the frequency, severity, and other important characteristics of wrong-way crashes in Texas based on review of Department of Public Safety (DPS) crash reports;
- identified available countermeasures to reduce wrong-way movements and crashes;
- evaluated the feasibility and applicability of the available countermeasures and treatments based on cost information and potential to address Texas problems;
- documented typical situations that were likely to produce wrong-way entry issues;
- developed guidelines and recommended practices for the application of wrong-way countermeasures and treatments; and
- developed a checklist for engineers and field crews to use for reviewing wrong-way entry issues or suspected problem locations.



Several states use ITS applications like this changeable message sign to deter wrong-way movements.

What We Found...

The state-of-the-practice literature review revealed that a significant amount of the research associated with wrong-way driving on freeway facilities occurred in the late 1960s to late 1970s. Researchers gathered information from previous studies of wrong-way crashes to create a profile of a typical wrong-way crash on freeways. A compilation of this research suggested the following profile:

- The most frequent origin of wrong-way incidents is the freeway exit ramp (i.e., a driver travels the opposite direction on an exit ramp onto the freeway main lanes).
- Crashes tend to be more severe and have a greater proportion



resulting in death or serious injury than most other crash types on freeway facilities.

- Elderly drivers are over-represented compared to their proportion of the driving population and their proportion of involvement in other crashes.
- Male drivers are significantly more likely to be involved than female drivers.
- Between 50 and 75 percent involve an impaired wrong-way driver who had been drinking or was under the influence of alcohol or drugs.
- Crashes are more prevalent during non-daylight hours, particularly the early morning hours following midnight.

Survey of State Departments of Transportation and TxDOT Districts

Respondents to the survey included 29 state DOTs (56 percent) and 12 Texas Department of Transportation (TxDOT) districts (48 percent). The survey gathered information regarding current practices for signing and pavement marking and other treatments to prevent wrong-way driving. Some of the key findings included:

- Most state DOTs used the standard DO NOT ENTER (DNE) and WRONG WAY (WW) signs and WW pavement arrows from the *Manual on Uniform Traffic Control Devices* (MUTCD).
- Three states used lowered DNE and WW signs mounted together on the same post. The rationale for this countermeasure was that the vast majority of wrong-way crashes occurred at night and lowered signs are more visible if placed within the area covered by a vehicle's headlights and visible to the driver from the decision point on each likely approach. The survey also revealed that there were no crash tests to support the safety of the lowered mounting height.

Analysis of Freeway-Related Wrong-Way Crashes in Texas

The research team obtained the original Texas Peace Officer Accident Reports (ST-3s) for wrong-way crashes that occurred in Texas from January 1, 1997, to December 31, 2000, from DPS.

Researchers performed a review of each crash to determine which ones were related to the freeway main lanes and/or ramps. This process resulted in the examination of 323 freeway-related wrong-way crashes over the 4-year analysis period.

The Texas wrong-way crash data profile revealed the following:

- Crashes were five times more likely to occur during early morning hours (i.e., 12:00 to 5:59 a.m.) versus the statewide average for all crashes. Also, the most frequent time for wrong-way crashes (16.7 percent) was the 2:00 to 2:59 a.m. hour that corresponds to closing time of most Texas bars.
- Approximately 50 percent of crashes resulted in an incapacitating injury or fatality, which is significantly higher than the statewide severity proportion for all other types of crashes. The data suggest that wrong-way crashes account for a serious economic impact of almost \$21 million per year based on the average cost of crashes used by TxDOT.
- Males accounted for slightly over two-thirds of the wrong-way drivers, and almost half of the wrong-way drivers were under the age of 34.
- Almost 61 percent of the wrong-way drivers had some influence of alcohol and/or drugs cited by the investigating officer.
- For approximately one out of every three crashes, researchers were able to get some specific information from the investigating officer's diagram and narrative about where the wrong-way movement first occurred. This information is important because it makes it easier to inventory existing treatments and to develop ideas for other countermeasures based on a specific location.

In addition to the crash statistics from the DPS database, researchers obtained information from 911 public safety answering points (PSAPs) regarding reports they receive about wrong-way drivers, typically from other drivers with wireless phones. Officials from three PSAPs provided information (e.g., roadway where wrong-way movement was observed, time of day, direction of travel, etc.) on wrong-way driving

reports that occurred on freeways in their jurisdictions. Some of the findings from this effort included:

- The two smaller PSAPs averaged one to two reports of wrong-way drivers on freeways per month over the one-year monitoring period.
- The large PSAP had a range of four to ten reports of wrong-way drivers on freeways per month.
- The common protocol was to dispatch a nearby officer to the location of the reported driver; however, in most cases the officer never encountered the wrong-way vehicle.
- There were only a few cases in which the report was followed by a crash. In most cases the wrong-way drivers eventually corrected themselves and proceeded in the right direction.

Countermeasures and Treatments for Mitigating Wrong-Way Entries

The research team gathered information on wrong-way countermeasures and treatments using published studies, Internet searches, and the DOT surveys. To facilitate the evaluation of feasibility and potential effectiveness, the countermeasures and treatments were divided into four categories: traditional signing and pavement marking, innovative signing and pavement marking, geometric modifications, and intelligent transportation system (ITS) applications.

Traditional signing and pavement marking countermeasures included DNE and WW signs on separate posts, oversized DNE and WW signs, red-backed raised pavement markers, WW pavement arrows, yellow edge lines on left sides of exit ramps, one-way signs, and turn restriction signs. Innovative signing and pavement marking treatments included lowered DNE and WW signs mounted together on the same post, supplemental placards or flashers on the DNE and WW signs, overhead-mounted DNE and WW signs, internally illuminated DNE and WW signs, non-standard WW pavement arrows, WW pavement lights, red reflective tape on the backs of freeway signs, and red delineators on each side of the ramp up to the WW sign. Researchers also identified several geometric treatments aimed at discouraging wrong-way entries onto freeway facilities. The two





Three states use lowered signs mounted on the same posts to increase visibility.

most prominent were offset entrance and exit ramps and off-ramp throat reductions. Researchers obtained information on ITS applications for wrong-way detection and warning being used in California, Florida, New Mexico, and Washington.

Typical Problem Locations

Based on the review of crashes for which some specific information on wrong-way origin was available, researchers developed a list of typical problem locations. This analysis showed:

- Most of the collisions occurred in the inside lane (i.e., leftmost) of the correct direction. This seems logical when you consider that the wrong-way drivers are staying as far to the right as possible just like they normally would if they were going the right way.
- Several locations with left-side exit ramps produced multiple wrong-way crashes during the analysis period — this finding suggests that further countermeasures might need to be considered at locations with left-side exit ramps.
- Another problem type occurs when a one-way street, typically in a downtown area, transitions directly into a freeway section. Several locations with this configuration experienced multiple wrong-way crashes during the analysis period.
- In a few situations, staged construction freeways had wrong-way crashes during the time period when only the frontage roads were in place. The large offset distance between the

frontage roads and lack of main lanes may create a confusing situation that needs to be carefully considered for appropriate countermeasures.

- The majority of crashes occurred in major urban areas, with slightly more than 60 percent in the three largest metropolitan areas — Dallas/Fort Worth, Houston, and San Antonio.

The Researchers Recommend...

Guidelines and Recommended Practices for Wrong-Way Countermeasures

Based on the results of the literature review, surveys, analysis of freeway-related wrong-way crashes in Texas, and evaluation of available countermeasures, the research team developed some guidelines for wrong-way treatments and countermeasures. The major guidelines are provided in the following list:

- Install reflectorized wrong-way pavement arrows on left-side exit ramps.
- Revise the TxDOT Typical Standard Freeway Pavement Markings with Raised Pavement Markers Standard Plans Sheet FPM (1)–00A wrong-way arrow detail. Change “reflectorized wrong-way arrows, not to exceed two, may be placed on exit ramps” to “reflectorized wrong-way arrows, not to exceed two, should be placed on exit ramps for new construction and at locations with multiple wrong-way entries per year.”

- Repair deficient wrong-way pavement arrows and make their maintenance a priority, particularly in the urban districts of Dallas/Fort Worth, Houston, and San Antonio.
- Consider the use of lowered DO NOT ENTER and WRONG WAY signs mounted together on the same post to address alcohol and nighttime problem locations.
- Develop a wrong-way crash monitoring system and field review similar to California’s process.

Wrong-Way Entry Checklist

Researchers also developed a wrong-way entry checklist for engineers and field crews to use when reviewing wrong-way entry issues or suspected problem locations. This checklist was based on one currently used by Caltrans (California Department of Transportation) with some additions based on project findings.

Future Actions

The research team recommends the following actions as a result of this project:

- further research on the crashworthiness and alternative designs for DO NOT ENTER and WRONG WAY signs mounted at lower than standard heights together on the same post;
- coordination between TxDOT Traffic Management Centers (TMCs) in the urban areas (i.e., Austin, Dallas, Fort Worth, El Paso, Houston, and San Antonio) and the primary 911 public safety answering points to share information on reports of wrong-way movements on freeway facilities (if the information sharing is in real time, further research is needed to examine what, if any, type of warning should be given to motorists traveling in the correct direction in the vicinity of the wrong-way driver); and
- consideration of implementing inductive loops or other detectors on exit ramps in future construction (these detectors could be used for wrong-way detection and could also be used for traffic counts).



For More Details . . .

The research is documented in [Report 4128-1, Countermeasures for Wrong-Way Movement on Freeways: Overview of Project Activities and Findings](#), and [Report 4128-2, Countermeasures for Wrong-Way Movement on Freeways: Guidelines and Recommended Practices](#).

Research Supervisor: Scott Cooner, TTI, s-cooner@tamu.edu, (817) 462-0525

Key Researchers: Scott Cothron, TTI, s-cothron@tamu.edu, (817) 462-0535
Steven Ranft, TTI, s-ranft@tamu.edu, (817) 462-0520

TxDOT Project Director: Roy Parikh, rparikh@dot.state.tx.us, (817) 370-6617

To obtain copies of the report, contact Nancy Pippin, Texas Transportation Institute, TTI Communications, (979) 458-0481, or e-mail n-pippin@tamu.edu. See our online catalog at <http://tti.tamu.edu>.

TxDOT Implementation Status—January 2004

The objective of this research project involved gathering information on the issues, causes, and consequences of wrong-way movements on freeway facilities in Texas. One product was required for this project: guidelines for wrong-way countermeasures. These countermeasures have been submitted as part of Report 4128-2.

Installation of wrong-way pavement arrows at left exits and repair of deficient wrong-way pavement arrows can be implemented immediately if maintenance funds are available. Revision of TxDOT Typical Standard FPM(1)-00A will require the review and approval of the Traffic Operations Division prior to implementation. The use of low-mounted warning signs and the development of a wrong-way crash monitoring system will require further research.

For more information, contact Mr. Wade Odell, P.E., RTI Research Engineer, at (512) 465-7403 or e-mail wodell@dot.state.tx.us.

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Texas Transportation Institute/TTI Communications
The Texas A&M University System
3135 TAMU
College Station, TX 77843-3135