



Systemic Approach to Wrong Way Driving Safety: Effective Practices Brief

CALTRANS

Wrong way driving crashes occur randomly and less frequently than other crash types; however, they often involve multiple vehicles and result in multiple fatalities and/or serious injuries.

Many transportation agencies currently implement wrong way driver detection and deterrence tools and practices, but the variety of potential tools and practices vary, are often expensive, and are, in some cases, adopted as “spot treatments,” typically at the corridor scale. The wide variety of tools and price factors are significant barriers to adoption, and disconnected implementation has a high potential for limited results.

Recent research has found that risk factors for wrong way driving do not limit themselves to high-volume corridors. A AAA Foundation for Traffic Safety’s analysis of National Highway Traffic Safety Administration Fatality Analysis Reporting System (FARS) data for divided highways found that the following risk factors were associated to a greater degree with wrong way drivers than their right way driver counterpart:

- Imputed Blood Alcohol Content (BAC) – risk increases with BAC
- License status – risk increases for drivers with suspended or revoked licenses
- Driver’s age – risk increases for those ages 70 and over
- Vehicle age (based on model year) – risk increases with the age of the vehicle

On average there are **432 deaths annually** from wrong way driving crashes on controlled-access highways (2010–2018).¹

This is a **20% increase** over previously reported data from 2004–2009.²

¹ AAA Foundation for Traffic Safety

² National Transportation Safety Board

Further, wrong way driving is not limited to divided highways or freeways and should be considered along prioritized arterials where wrong way driving crashes occur more frequently (though with a lower risk of fatality due to slower travel speeds).

THE SYSTEMIC APPROACH

A systemic approach to wrong way driving considers an agency’s entire roadway system. The approach holistically applies proven methods, physical improvements, and technologies to mitigate wrong way driving. These countermeasures can integrate into existing approaches and programs for safety and help achieve agency safety objectives.

Recent agency experience among four states (California, Florida, Iowa, and Michigan) highlights a range of proven and emerging countermeasures that respond to different roadway characteristics (such as interchange type) as well as demographic and land use factors. Many of these treatments are low-cost countermeasures, and readily implemented without substantial investment in technology.

Though infrequent, wrong way driving crashes come at high costs from serious injuries and fatalities. Reducing these crashes through a systemic approach to wrong way driving countermeasures can yield highly cost-effective safety benefits, and agencies can learn from and adopt the practices of states leading a systemic approach to wrong way driving. This brief focuses on the effective practices of Caltrans.

Why the Focus?

Prior to a series of research initiatives and pilot projects, fatal crashes and injuries from wrong way driving events had been a growing concern in California. The first six months of 2015 were particularly deadly in the Sacramento and San Diego regions, with 24 people killed in 10 wrong-way crashes—well above the statewide average. Media reporting at the time drew significant attention to the problem and scrutiny from the State Legislature.

Approach Taken

Beginning in May 2015, Caltrans took a number of steps to address the issue of wrong way driving. It established a multidisciplinary working group that included the California Highway Patrol (CHP) to guide a series of pilot projects and research studies, specifically recommending countermeasures and evaluation locations. Further direction came from a preliminary investigation that identified the most common characteristics of wrong-way drivers (69% were driving under the influence), the most problematic interchange type (partial cloverleaf), and findings from national and state research reporting.

Caltrans launched Wrong-Way Deterrence and Detection Pilot projects in District 3 (Sacramento and Yolo Counties) and District 11 (San Diego County). These projects variously installed countermeasures at 16 ramps along I-80 and US-50 in Sacramento and 60 ramps along SR-15 and I-15 between I-805 and SR-78 in San Diego. The countermeasures included:

- Two-way, red/clear retroreflective raised pavement markers



- Enlarged DO NOT ENTER / WRONG WAY signage



- LED-illuminated DO NOT ENTER signs placed on 24-hour flash



- Active detection and notification systems with radar detectors that detect wrong-way drivers, activate red flashing lights bordering local wrong way signage, and transmit real-time notifications to Caltrans and the CHP at their joint traffic management center (6 ramps in each district)



To specifically evaluate the effectiveness and accuracy of the active detection and notification systems, Caltrans Division of Research, Innovation and System Information (DRISI) and the University of California, Davis developed and installed zone-triggered video image processing systems on eight of the district off ramps equipped with active monitoring systems.

Outcomes and Benefits

Retroreflective raised pavement markings

- 44% reduction in CHP-reported wrong way driving events on 60 exit ramps (comparing 15 months before installation to 15 months after installation)
- Addition of detail drawings for retroreflective raised pavement markings on exit ramps to the California Manual on Uniform Traffic Control Devices (MUTCD) and Caltrans Standard Plans; approved for all new highway construction and maintenance projects
- Installation of the signs and pavement markings according to the new standards on 1,013 exit ramps as of March 2023

LED-Illuminated DO NOT ENTER signs

- 60% reduction in CHP-reported wrong way driving events on 5 exit ramps (comparing 15 months before installation to 15 months after installation)
- 62% effective in reducing reported wrong way drivers at ramps where placed (limited sample size)

Active detection and notification systems

- 53% reduction in wrong way driving events per year on 6 exit ramps in District 3, as detected by the video image processing system
- False positives also detected, such as bicycles, motorcycles and pedestrians traversing the ramp the wrong way and other intentional movements
- Upgraded versions of the tested systems have demonstrated a reduction in false positives in other states
- Approved for use in the California MUTCD, but the systems are expensive and not always reliable, so ramps should be evaluated for lower cost countermeasures first

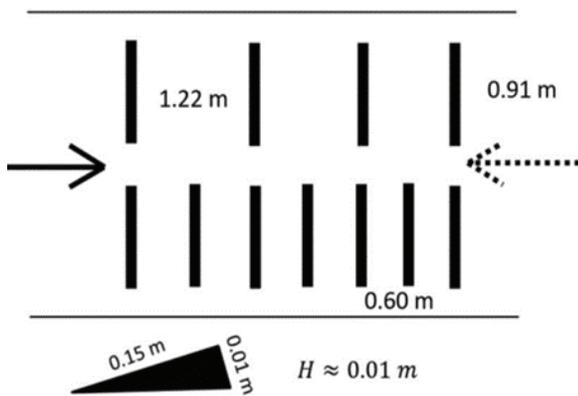
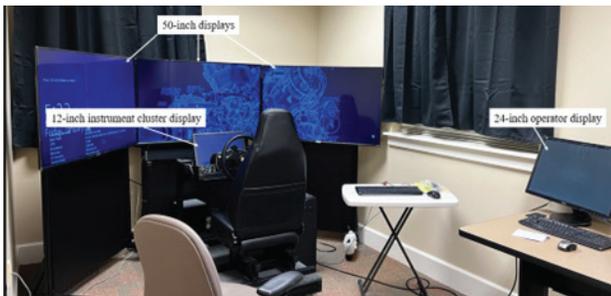
Further Investigation

Beginning in 2019, Caltrans has examined several other wrong way driving countermeasures.

- Districts 11 and 3 have been piloting bidirectional pavement markings. These pavement markings have a biangular profile that produces bidirectional visibility with unidirectional messaging. The thermoplastic panels are pressed directly onto preheated pavement.



- Caltrans DRISI and Auburn University have investigated countermeasures specifically targeting intoxicated drivers in a nighttime environment, including those previously piloted, the bidirectional pavement markings, and directional rumble strips that generate vibrations to provide haptic feedback alerts to those who may not be able to recognize visual warnings.



- Caltrans DRISI, Bosch Mobility Solutions, and UC Davis have been testing a Bosch cloud-based mobile device wrong way driver detection and alert system on California state highways.

Additional Conclusions

- Funding constraints were not a significant issue because there was external impetus for investigating and addressing wrong way driving. A well-publicized increase in wrong way driving events and fatalities in Sacramento and San Diego, along with scrutiny from the State Legislature, drove the formation of a working group and pilot projects to study countermeasures. Successful pilot project results have led to updates to design standards and encouragement to incorporate the countermeasures, particularly those that are low-cost, into applicable highway construction and maintenance projects.
- Additional wrong way driving countermeasures and initiatives continue to be studied within Caltrans' safety programs and districts.

RESOURCES

John Slonaker, *Division of Research, Innovation and System Information, Caltrans*, John.Slonaker@dot.ca.gov

[Caltrans Wrong Way Pilot Projects Reports and Resources](#)

[CAMUTCD – Exit Ramp with Enhanced Pavement Markers for Wrong Way Details \(p. 667\)](#)