

RESEARCH

Making Strides for Highway Safety



State DOTs are committed to using research and innovation to deliver more efficient and safer transportation systems. The projects on these pages are a few among many that exemplify the high return on transportation research investments. The State Planning and Research Program (SPR), the nation's cornerstone state transportation research program, provides federal aid funding to the states to address top concerns and identify solutions at the state level.

These safety highlights, which were compiled from the American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee Value of Research Task Force annual solicitation of High Value Research, showcase projects that are providing "Transportation Excellence through Research."

<http://research.transportation.org/Documents/Task%20Forces/Value%20of%20Research%20Task%20Force/2013HighValueFinalv3.pdf>

Clearer Signs for Safer Streets and Highways Florida

What people see—or don't see—along streets and highways is critical to their safety. To gain a better understanding of the characteristics of traffic signs and signals that are best at attracting driver and pedestrian attention, researchers at the Florida State University Department of Psychology conducted laboratory simulation tests with volunteers in three different age groups, with a focus on those 65 years and older. Study participants were shown current and experimental versions of several signs and signals to determine whether the new approach was worth investing in—based on how real people are likely to respond.



Researchers evaluated participant reactions to different types of sign illumination and retroreflectivity, the effect of word order and letter height in dynamic message signs, and pedestrian warnings at intersections. Based on study results, Florida DOT has begun using fluorescent yellow sheeting on urban road signs to increase nighttime visibility and safety for drivers of all ages.

www.dot.state.fl.us/research-center/Completed_Proj/Summary_TE/FDOT_BDK83_977-09_rpt.pdf

Innovative Bicycle Facilities Improve Cycling Conditions

Washington, D.C.

Washington, D.C. is one of the foremost cities for bicycling in the United States, in part due to its innovative bicycling treatments. The District Department of Transportation (DDOT) evaluated three new bicycle facilities for performance to determine possible improvements:

- a six-way intersection with bicycle boxes, bicycle signals and contraflow bicycle lanes;
- bicycle lanes running down the center median of the eight-lane Pennsylvania Avenue; and
- a separated two-way bicycle lane on the west side of one-way Fifteenth Street.

Overall, bicycle treatments improved conditions for cycling without negatively impacting other modes of traffic. However, although cyclists felt safer (boosting cycling over 200 percent on Pennsylvania Avenue and 500 percent on Fifteenth Street in two years), bicycle accidents increased at two of the facilities, something the DOT plans to monitor.

Additionally, few cyclists used the bike box and bike signal to cross the six-way intersection, so the study recommends modifying signal operations and painting bicycle boxes green so more cyclists stop there, versus the pedestrian crosswalk.

The DDOT also found that contraflow bicycle lanes didn't mesh well with signal timing on Fifteenth Street, so it plans to use a one-way couplet instead for its next cycle track on a one-way street. One-way couplets are pairs of one-way streets that function as a single higher capacity street.

www.dc.gov/DC/DDOT/On+Your+Street/Bicycles+and+Pedestrians/Bicycles/Bicycle+Lanes/Bicycle+Facility+Evaluation



Rumble Strips Reduce Crashes Michigan

Lane-departure crashes are significant, accounting for 61% of all roadway fatalities in Michigan in 2008. To reduce lane-departure crashes, Michigan DOT initiated the largest rumble strip installation in the United States, improving 5,400 miles of 55 mile per hour highway with centerline and shoulder rumble strips. The department followed up with research from 2010-2012 to evaluate the impacts of rumble strips on pavement performance, noise, vehicle speeds and crash reduction.



Research showed that rumble strips did not contribute to short-term transverse cracking in asphalt pavements, nor did they have any impact on average travel speed. Rumble strips did produce more roadside noise, but the noise level was comparable to that of normal truck traffic.

Most significantly, researchers found that safety improved when MDOT installed centerline rumble strips. Drivers typically positioned vehicles more centrally in lanes, leading to fewer encroachments over centerlines and shoulders. Results were measurable, with a combined 36% drop in the number of crashes on roadways where rumble strips were installed compared to before the installation.

http://www.michigan.gov/documents/mdot/MDOT_Research_Administration_Non-Freeway_Rumble_Strips_397765_7.pdf

Reducing Wrong-Way Driving on Freeways Illinois



In Illinois, 217 wrong-way crashes occurred on freeways from 2004 to 2009, killing 44 people. A research project by the Illinois Department of Transportation sought to determine the contributing factors to such accidents and develop cost-effective ways to reduce them.

The study found that wrong-way driving was most likely at diamond and partial cloverleaf interchanges, with the majority of crashes occurring during early mornings and on weekends. More than half of drivers were impaired by alcohol. Research suggested that interchange signage and pavement marking modifications have reduced wrong-way driving in other states.

Researchers developed a new method to rank high wrong-way crash locations and select the top locations for field review. The study established a set of short-term, low-cost countermeasures for improving existing wrong-way signage, pavement markings and geometric designs at 12 study interchanges, which then could be applied statewide to similar type interchanges. A \$7 million project has been initiated to implement the improvements at over 400 interchanges in Illinois.

A wrong-way driving countermeasures summit was also held in July 2013 to share the study findings with other states, and a guidebook is set to be released in early 2014.

<http://cetrans.isg.siue.edu/wwd/>

New Tool Evaluates Accident Risk California

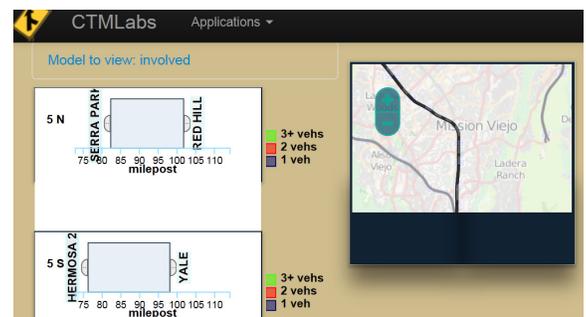
A new software tool developed for the California Department of Transportation estimates the safety performance of a freeway segment. It can evaluate how accident risks changed after a roadway modification, speed limit reduction, or some other improvement.

The Accident Risk Analysis Tool can predict even slight increases or decreases in the risk of a collision as traffic patterns change throughout the day. However, the application is best used to evaluate the likelihood and type of accidents over a longer period of time.

Researchers developed the tool by superimposing accident data over raw 30-second loop detector data to model the relative probability of different types of collisions under various traffic conditions. The tool did a good job of predicting accidents in Caltrans District 12, with the exception of toll roads. The project methods can be used to model other phenomena that are dependent upon traffic flow conditions over time.

An online demonstration tool shows the daily accident risk performance of freeway segments in Caltrans District 12 from 2007 through 2009. "A user could view the risk assessment of a freeway over a full year, or pick out the riskiest sites on a given day," explains researcher James Marca.

<http://ara.ctmlabs.net/docs/report.pdf>



Technology to Help Improve Safety for Novice Teen Drivers Iowa

Because motor vehicle crashes are the leading cause of death for U.S. teens, technology will likely be a part of reducing crashes. Towards this end, the Iowa DOT joined with partners in Kansas and South Dakota for a six-month study to evaluate video feedback to enhance the driving skills and safe driving habits of teen drivers. The system triggers when abrupt steering and braking events occur—those that are associated with good responses or errors.

Half the teen drivers received feedback in the form of an immediate blinking LED when the system was trig-

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Relating License Permits to Motorcycle Crashes

Kentucky

Research conducted by the Kentucky Transportation Center revealed that Kentucky law allowed unlimited renewal of temporary motorcycle permits without



obtaining a full motorcycle license endorsement. This finding was used to support passage of a new law requiring motorcyclists' operator permits to expire after one year if an endorsement was not obtained. Passage of this legislation was a direct implementation of one of several countermeasures recommended to reduce the potential for motorcycle crashes.

Analysis of Kentucky's crash data showed that motorcyclists with temporary permits were overrepresented in crashes. For Kentucky motorcycle operators involved in fatal crashes, only 41 percent had a valid license with a motorcycle endorsement. For motorcyclists involved in fatal crashes, there was a strong positive correlation between helmet usage and having a motorcycle endorsement, and this correlation increased with the age of the operator. Overall, when compared to all types of crashes, motorcycle crashes were 3.2 times more likely to result in injuries and 7.8 times more likely to result in fatalities.

A wide range of potential countermeasures were identified in the research and were presented to the Kentucky Transportation Cabinet. These countermeasures were related to the categories of driver, vehicle, and roadway, and they included helmet laws, skill tests, one-year permits, safety campaigns, and road features.

<http://www.ktc.uky.edu/projects/causes-and-countermeasures-related-to-motorcycle-crashes/>

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gered, a weekly report card comparing the number of events they triggered to their peer group, and a DVD of the 12-second videos recorded that week.



Parents and teens

were encouraged to review the report card and the videos.

The study showed that, compared to a pre-feedback baseline period, receiving feedback lowered the rate of unsafe events by 80%. Such feedback technologies can help make the transition from supervised to independent driving for teen drivers and their families a safer one.

<http://www.pooledfund.org/Document/Download/4682>

Improving Safety at High-Speed Rural Intersections

Indiana

Since 2006, the Indiana DOT has experienced frequent and severe crashes at many rural intersections involving high-speed, multi-lane roads. Research on 625 intersections in Indiana and Michigan examined design and human factors for safety risks such as curves near the intersection, traffic volume, land use, population, median width, angles, and other potential safety factors.



The study identified new and confirmed traditional methods of improving safety at rural intersections, including widening medians to at least 80 feet; adding parallel acceleration lanes for left turns; moving intersections further from curves or railroad crossings; creating indirect left turns (such as J-turns); enhanced guide and warning signs, including dynamic signs; adding intersection lighting; and adding left and right turn bays.

The research outlined specific improvements to be made to new or existing intersections. It also set the framework for pilot studies on safety countermeasures.

<http://docs.lib.purdue.edu/jtrp/1495/>

Variable Speed Limit Systems Provide Safety Benefits

Wyoming

Wyoming sought to create a decision support system to implement a Variable Speed Limit (VSL) system to improve safety while reducing closure frequency/ durations on the I-80 Elk Mountain corridor and reducing the speed variability in the corridor during adverse weather conditions.



Results showed that VSL signs reduced observed speeds by 3.4 to 6.4 mph for every 10 mph of speed reduction on the VSL signs beyond the slowing attributed to weather conditions. The winter after VSL system implementation had the lowest reported crash frequency and crash rates compared with the 10 prior winters. A higher level of speed compliance was observed during winter periods when

the VSL system was used when compared to the seasonal speed limit reduction from 75 to 65 mph.

To date, four new VSL corridors have been implemented, three on I-80 and one on WYO 28. The model found that on I-80, 50.1 crashes per year have been avoided through use of the VSL system. Using Highway Safety Manual values for crash costs and crash severity distributions, it is estimated that the VSL systems generates \$4.7 million dollars in safety benefits per year on high volume routes. Given the average cost of \$1 million per VSL corridor to install sensing and sign technology, the four VSL corridor safety benefits exceeded the capital costs after just one year.

http://www.dot.state.wy.us/files/live/sites/wydot/files/shared/Planning/Research/WYDOT_ElkMtnVSL_FinalReport.pdf

Urban Roadway Re-Striping Leads to Lower Crash Rate

Louisiana

Research sponsored by the Louisiana Transportation Research Center resulted in the development of a Louisiana-specific crash modification factor (CMF) for converting a four-lane urban undivided roadway to a five-lane roadway by re-striping. In the last decade, Louisiana DOTD converted several segments of urban undivided four-lane roadways to five-lane roadways with a center two-way left turn lane by re-striping pavement markings without increasing pavement width. Based on a statistical analysis with six years of crash data, the CMF for all of those segments is estimated to be less than 0.6 with a standard deviation less than 0.07.



Although five-lane roadways are no longer an acceptable roadway type for new construction in Louisiana, the impressive (>50%) crash reductions associated with this lane conversion approach clearly demonstrated it as an effective and feasible solution under financially-constrained conditions to reduce crashes on urban undivided roadways in Louisiana. Considering the huge B/C ratio (>160) from this lane-conversion, LADOTD plans to continue using this crash countermeasure on urban undivided roadways on a case-by-case basis and has recently employed this tactic on a roadway in Baton Rouge near LSU.

http://www.ltrc.lsu.edu/pdf/2013/FR_506.pdf

Science-Based Safety Analysis Illinois

Reducing highway deaths and injuries is a top priority of every department of transportation. But what changes in road design or traffic operations will make the biggest improvement, and save the most lives? The new 2010 Highway Safety Manual (HSM), published by AASHTO, helps states answer these questions with a comprehensive, science-based approach that takes the guesswork out of safety analysis. Statistical tools, developed through the National Cooperative Highway Research Program, enable states to assess and compare the costs and benefits of various safety improvements, from left-turn lanes and traffic signal upgrades to rumble strips and cable median barriers.

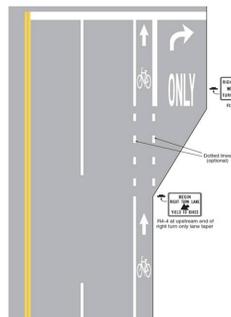
As the HSM was being published, the Illinois Department of Transportation (IDOT) launched a companion technology transfer project in partnership with the Federal Highway Administration to help move the valuable resources of the manual into practice. IDOT hosted a lead state peer-to-peer workshop in November 2010 with 12 other state DOTs interested in rapid implementation of HSM tools. Through 24 presentations and discussion sessions, the 100+ participants shared insights on institutionalizing the HSM's quantitative safety analysis tools in their agencies, identified key challenges, such as data integration and training, and planned for continuing collaboration.

<http://ict.illinois.edu/Publications/report%20files/FHWA-ICT-12-019.pdf>

Improving High-Risk Intersections for Pedestrians and Cyclists

Utah

Utah used Salt Lake County for a case study analyzing high-risk versus low-risk intersections to determine what characteristics make intersections more dangerous for cyclists and pedestrians. Accident rates for nonmotorized users were used to define the risk category.



The analysis found that incorporating longer signal lengths, dedicated right turn lanes, narrower sidewalks, and street trees at intersections can significantly reduce the number of nonmotorized accidents. Construction activity at intersections significantly increased the number of nonmotorized incidents (particularly those involving pedestrians). Addressing these issues and enacting appropriate improvements will not only improve safety conditions for nonmotorized users, but may also provide an enhanced travel experience for automobile travelers and result in additional external benefits of traffic calming and improved flow.

The UDOT Traffic and Safety Division is looking into implementing the results of this study by improving infrastructure and conditions at intersections to promote safety for pedestrians and cyclists. Phase 2 of the research project will be performed in 2014 to extend the study into Davis and Weber Counties, Utah. Additional characteristics of high-risk intersections for pedestrians and cyclists may be identified there, along with opportunities to promote safety at intersections.

<http://www.udot.utah.gov/main/uconowner.gf?n=12134532606961094>



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