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Effectiveness of Traffic Signs on Local Roads

Introduction

The 2009 edition of the Manual on Uniform Traffic Control Devices includes requirements for the management and maintenance of all roadway signs. Management of large numbers of signs can pose administrative and financial challenges for local road authorities. The Minnesota Department of Transportation is reviewing whether the removal of ineffective traffic signs may be part of an overall sign management strategy and has asked CH2M Hill to prepare a best practices guide for removing traffic signs. In support of this work, CTC & Associates was tasked by Mn/DOT with performing a literature search and synthesis of research demonstrating the effectiveness or lack of effectiveness of various types of traffic signs on local roads, including low-volume roads.

Summary

There does not appear to be significant credible research demonstrating the outright ineffectiveness of particular traffic warning signs. The research we identified provides support for opposing points of view: that traffic warning signs have a minimal or neutral effect on safety, or, alternatively, that warning signs are effective at reducing crash rates and severity. National guidance recommends that traffic warning signs be employed based on engineering studies and engineering judgment, and suggests that the excessive use of signs can reduce their effectiveness.

The MUTCD guidance on warning signs begins with the direction that “the use of warning signs shall be based on an engineering study or on engineering judgment.” It further indicates that “the use of warning signs should be kept to a minimum as the unnecessary use of warning signs tends to breed disrespect for all signs.” That directive is not followed by guidance or research indicating what types of signs are actually ineffective.

Traffic sign effectiveness appears to be more a matter of perception and opinion than of fact based on evidence. For example, *NCHRP Synthesis 186, Supplemental Advance Warning Devices* (1993, page 1), found that “the majority of the devices encountered in this project were not evaluated by formal effectiveness studies, but are simply perceived to be effective by the responding agency.” A study of the effectiveness of static warning signs by the Institute of Transportation Engineers (“Static Warning Signs of Occasional Hazards: Do They Work?”) came to a similar conclusion. In that study 18 percent of responding state transportation agencies thought the use of static warning signs for occasional hazards was effective, but 93 percent indicated that no studies had been done to investigate the actual effectiveness of the signs.

On the other hand, Fred Ranck, FHWA safety and design engineer, indicated in an interview that warning signs have proven safety benefits (see the **National Research and Guidelines** section on page 3).

We organize our findings into the following two sections:

- National Research and Guidelines
- State Research and Guidance

The **National Research and Guidelines** section contains research from FHWA, NCHRP, TRB and the Institute of Transportation Engineers. The research includes studies that show particular signs to have minimal impact on safety, and studies that point out that the effectiveness of the signs has simply not been vigorously tested. This section also includes an article from FHWA's *Public Roads* that points to the effectiveness of increasing the number of warning signs in Mendocino County, Calif.

The **State Research and Guidance** section includes studies from Kansas, Iowa and Washington state. The Iowa publication **Guidelines for Removal of Traffic Control Devices in Rural Areas**, addresses many of the issues involved with the removal of traffic signs. The paper is focused exclusively on stop and yield signs and does not present research on the safety effectiveness of other types of signs. The other two studies cited in this section found that the use of particular types of warning signs (such as deer crossing and ice warning) are minimally effective.

National Research and Guidelines

Interview with Fred Ranck, Safety Design Engineer, FHWA Resource Center, Matteson, Ill., fred.ranck@dot.gov, (708) 283-3534.

Mr. Ranck indicated in an interview that warning signs have proven safety benefits. He pointed to the large volume of research data regarding the effectiveness of signs as a crash reduction strategy found at <http://www.cmfclearinghouse.org/resources.cfm>. (Scroll to the sections titled “Resources for Countermeasure Selection” and “Publications.”) The “Publications” section includes issue briefs on the effectiveness of countermeasures—including signs—on intersection crashes, pedestrian crashes and roadway departure crashes. These issue briefs contain tables listing the types of signs, their effectiveness and the research that exists to support those conclusions.

Mr. Ranck also pointed to *NCHRP Report 500, Guidance for Implementation of the AASHTO Strategic Highway Safety Plan*, as a resource for information regarding the use of traffic signs to improve safety. This report consists of 19 volumes pertaining to specific types of highway crashes or contributing factors. Volume 7 is cited on page 4 of this report.

In general, Mr. Ranck said that “signs can be very effective.” He said warning signs that use black lettering on a yellow diamond are the most effective and that the use of larger signs and flashers also increases effectiveness.

While there is research pointing to the effectiveness of warning signs in reducing accidents, there is a distinct lack of research on the effectiveness of regulatory and guide signs. According to Mr. Ranck, “We don’t really know that much about the credibility of regulatory or guide signs.”

Manual on Uniform Traffic Control Devices, FHWA, 2009.

http://mutcd.fhwa.dot.gov/hdm/2009/html_index.htm

The latest version of the MUTCD was adopted in December 2009. Section 5 of the new version is titled “Traffic Control Devices for Low-Volume Roads.”

Section 5: http://mutcd.fhwa.dot.gov/hdm/2009/part5/part5_toc.htm

Section 5A.02, Application, includes this guidance:

“It is possible, in many cases, to provide essential information to road users on low-volume roads with a limited number of traffic control devices. The focus might be on devices that:

- A. Warn of conditions not normally encountered,
- B. Prohibit unsafe movements, or
- C. Provide minimal destination guidance.”

The 2009 MUTCD also includes general guidance for the placement of traffic warning signs.

Section 2: <http://mutcd.fhwa.dot.gov/hdm/2009/part2/part2c.htm>

Section 2C.02, Application of Warning Signs, includes this guidance:

“The use of warning signs shall be based on an engineering study or on engineering judgment.

The use of warning signs should be kept to a minimum as the unnecessary use of warning signs tends to breed disrespect for all signs. In situations where the condition or activity is seasonal or temporary, the warning sign should be removed or covered when the condition or activity does not exist.”

Safety Evaluation of Advance Street Name Signs, FHWA, Frank Gross, Bhagwant Persaud, Andrea Piesse, Nancy Lefler, Kimberly Eccles, James Jenness, June 2009.

<http://ntl.bts.gov/lib/31000/31000/31091/FHWA-HRT-09-029.pdf>

This FHWA-funded study of 26 states evaluated low-cost safety strategies as part of its strategic highway safety effort. The goal was to assess several unproven safety strategies outlined in the *NCHRP 500* series reports. This report focuses on the effectiveness of advance street name signs on the number and severity of crashes. The report includes detailed descriptions of the objective, methodology and data collected in the study.

The report concludes that “advance street name signs have a minimal effect on the total number of crashes at signalized intersections. Similarly, there were no significant changes in rear-end, older driver, or injury-related crashes.” (page 37)

Toolbox of Countermeasures and Their Potential Effectiveness for Intersection Crashes, *FHWA Issue Brief 8*, August 2008.

<http://safety.fhwa.dot.gov/tools/crf/briefs/interissuebrief.pdf>

This issue brief contains data on the effectiveness of a variety of traffic control measures to reduce crashes at intersections. Table 3, beginning on page 9, evaluates the use of signs to reduce traffic accidents. The data included in the table and the literature cited in support indicate engineering research support for the use of traffic warning and regulatory signs to reduce traffic accidents and their severity.

Static Warning Signs of Occasional Hazards: Do They Work? Ahmed Al-Kaisy, Amanda Hardy, Charles P. Nemfakos, Institute of Transportation Engineers, *ITE Journal*, Vol. 78, No. 6, June 2008: 38.

Abstract: <http://ntlsearch.bts.gov/tris/record/tris/01108533.html>

This article discusses the effectiveness of static warning signs of nonpermanent hazards. The study included a literature search and a survey of state departments of transportation. From the abstract: “The literature review revealed that there is a lack of distinction in the literature between warning signs for permanent potential hazards (curves, winding roads, etc.) versus those for occasional hazards.” The authors noted that the studies did not look at the effectiveness of the static warning signs themselves, but used the signs as a comparison to enhanced warning devices.

The survey of transportation departments revealed that “most agencies had not done any evaluations of the effectiveness of [static warning signs for occasional hazards], but that most perceived that SWSOH were only somewhat effective.” (page 38)

The study concludes that “despite the extensive use of MUTCD static warning signs in the highway system, the effectiveness of these signs in improving traffic safety has hardly been investigated.” (page 38)

The authors of the study argue that the extensive use of these signs despite the lack of research on effectiveness “may be attributed in part to the perceived ‘legal obligation’ of using these signs to minimize tort liability in the case of crashes.” (page 38)

Signs Show the Way to Cost-Effective Rural Safety, Gib Peaslee, *Public Roads*, FHWA, January/February 2005.

<http://www.tfhr.gov/pubrds/05jan/08.htm>

This article describes the success Mendocino County, Calif., had in reducing traffic accidents by installing more traffic signs. According to the article, the Mendocino County Transportation Board reduced crashes by 42.1 percent from 1992 to 1998 at a cost of \$79,260 over the same period. The money was spent on installing traffic warning signs on county roads.

Eugene C. Calvert, P.E., former director of transportation with MCDOT and now principal project manager for the Collier County Transportation Services Division in Florida, said, “We believe that the most cost-effective method for enhancing safety on rural roads is to make the driver more aware of road conditions through consistent signing and markings.”

Guidance for the Implementation of the AASHTO Strategic Highway Safety Plan, *NCHRP Report 500*, Vol. 7, 2004.

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v7.pdf

This report analyzes the effectiveness of a variety of strategies used to keep vehicles on the road and to minimize the consequences of leaving the road. A discussion of the effectiveness of traditional advance warning signs ahead of curves begins on page 7 of Section V. The report states:

“Research suggests that the proliferation of curve warning signs, especially those supplemented with advisory speed plates, may have lessened the average motorist’s respect for the messages that they convey.” (page 8)

That finding is tempered by the fact that “none of the studies designed to evaluate the effectiveness of traditional advance warning treatments at horizontal curves question the importance of providing a curve warning sign in

advance of unexpected or sharp curves, but conflicting results have been obtained on the effectiveness of advisory speed signs.” (page 9)

Effectiveness of Do Not Block Intersection Signs, J.L. Gattis, Z. Igbal, *Transportation Research Record*, No. 1456, 1994: 27-33.

Abstract: <http://ntlsearch.bts.gov/tris/record/tris/00677588.html>

This study analyzes the effectiveness of Do Not Block Intersection signs on driver behavior. From the abstract: “The data indicated that at three of the four sites the sign had no effect on driver behavior the proportion of blockages did not decrease after the signs were installed. At the fourth site, a higher-volume shopping center driveway, a minimal impact was associated with the installation of the sign.”

The authors indicate that these findings “may help officials faced with intersection blockages and citizen complaints avoid unproductive and ineffective remedial actions.”

Advisory Speed Signs and Curve Signs and Their Effect on Driver Eye Scanning and Driving Performance, H.T. Zwahlen, *Transportation Research Record*, No. 1111, 1987: 110-120.

Abstract: <http://ntlsearch.bts.gov/tris/record/tris/00464602.html>

This paper discusses the effectiveness of advisory speed signs leading into roadway curves. From the abstract: “It may be concluded that advisory speed signs are not more effective in causing drivers to reduce their speeds through curves than curve and turn signs alone. It appears that the bent black arrow in the yellow diamond of the curve or turn warning sign represents such a strong and primary visual stimulus that an advisory speed sign adds very little additional information for the driver.”

The recommendation based on the conclusion of the research is that “advisory speed sign maintenance and especially new installation be given a low priority.”

State Research and Guidance

Assessing the Effectiveness of Deer Warning Signs, Eric Meyer, University of Kansas, Lawrence, April 2006.

Abstract: <http://ntlsearch.bts.gov/tris/record/tris/01027350.html>

This is a Kansas study that examines the effectiveness of deer warning signs by a comparison of crash rates before and after installation. From the abstract: “In Kansas, the most common countermeasure is the deer warning sign, even though its effectiveness is suspect, and accident records have traditionally been used to identify locations for installation.”

Guidelines for Removal of Traffic Control Devices in Rural Areas, Reginald R. Souleyrette, Ryan Tenges, Tom McDonald, Tom Maze, Center for Transportation Research and Education, October 2005.

http://publications.iowa.gov/3629/1/signs_removal.pdf

This research focused on ultra-low-volume (less than 150 daily entering vehicles) unpaved intersections in rural areas of Iowa. The starting point was the fact that each county had as many as 300 or more stop sign pairs. From the abstract: “Four conclusions are supported by this research: (1) there is no statistical difference in the safety performance of ultra-low-volume stop-controlled and uncontrolled intersections for all drivers or for younger and older drivers (although interestingly, older drivers are underrepresented at both types of intersections); (2) compliance with stop control (as indicated by crash performance) does not appear to be affected by the use or excessive use of STOP signs, even when adjusted for volume and a sight distance proxy; (3) crash performance does not appear to be improved by the liberal use of stop control; (4) safety performance of uncontrolled intersections appears to decline relative to stop-controlled intersections above about 150 daily entering vehicles Subject to adequate sight distance, traffic professionals may wish to consider removal of control below this threshold.”

The report also includes a section outlining an implementation strategy for the removal of excessive stop signs (beginning on page 52). Operational and legal issues are discussed. The legal liability concerns addressed are specific to Iowa but are emblematic of what any state would face in similar circumstances.

It is worth noting that this 2005 study contains 47 citations; 30 relate to traffic sign management or safety studies surrounding traffic signs. Of those 30 citations, 18 are dated prior to 1990.

The Effect of Ice Warning Signs on Ice-Accident Frequencies and Severities, Jodi Carson, Fred Mannering, *Accident Analysis and Prevention*, Vol. 33, No. 1, 2001.

Abstract: <http://ntlsearch.bts.gov/tris/record/tris/00805036.html>

The purpose of this study was to statistically evaluate the effectiveness of ice-warning signs in Washington state and to provide guidance for effective sign placement. The research discusses the challenges of effective warning sign placement and whether the current warning signs in Washington are effective at reducing accident rates and severity.

The authors surveyed other states to determine potential sign placement strategies and found that states have “compensated for the difficulties in predicting ice as a roadway hazard by resorting to oversigning and/or standardized sign placement (placing signs on all bridges, regional boundaries or other standard roadway features).” The authors state that these policies “seem to be intended to protect state transportation agencies from liability as much as they are intended to improve highway safety.”

The authors state, “Too many signs or ice-warning signs posted at potentially inappropriate locations (i.e., locations where the ice hazard is rarely present) can desensitize drivers, thereby negating any safety enhancement the signs may have.” This particular statement regarding the ineffectiveness of oversigning is found in many studies and handbooks, but is not followed by a citation of any studies that support this conclusion.

This study concludes that “ice-warning signs do not have a statistically significant impact on the frequency or severity of vehicular accidents that involve ice. This suggests that current ice-warning sign placement practices are ineffective and that there is an urgent need for standardized sign-placement procedures that will reduce the frequency and severity of ice-related accidents.”

Effectiveness of “Children at Play” Warning Signs, Transportation Synthesis Report, CTC & Associates LLC, WisDOT Research and Library Unit, 2007.

<http://on.dot.wi.gov/wisdotresearch/database/tsrs/tsrchildrenwarningsigns.pdf>

This synthesis report addresses the effectiveness of “Children at Play” warning signs. The report cites U.S. DOT, FHWA, NCHRP, the Institute of Transportation Engineers and several state DOTs to support the conclusion that “there is no evidence that special warning signs of this sort reduce driver speeds or crash rates.”