

Static Warning Signs of Occasional Hazards: Do They Work?

WARNING DRIVERS OF NON-PERMANENT HAZARDS SUCH AS ANIMAL CROSSINGS AND FALLING ROCKS IS A CHALLENGE DUE TO THE UNPREDICTABLE NATURE OF THOSE HAZARDS. CONVENTIONAL STATIC WARNING SIGNS MAY LOSE THEIR EFFECTIVENESS BECAUSE NO REAL HAZARD IS PERCEIVED BY DRIVERS MOST OF THE TIME. MORE THAN HALF OF HIGHWAY AGENCIES USE UNCONVENTIONAL WARNING SIGNS OR DEVICES. MOST AGENCIES ARE UNCERTAIN ABOUT THEIR EFFECTIVENESS FOR OCCASIONAL HAZARDS.

BY AHMED AL-KAISY, PH.D., P.E., AMANDA HARDY AND CHARLES P. NEMFAKOS, E.I.T.

INTRODUCTION

Highway agencies expend significant resources on the installation, upgrading and maintenance of traffic control devices. To ascertain that those resources are well invested, it is important to know whether traffic control devices serve their intended purpose. The answer may be easy for some traffic control devices such as traffic signals, regulatory signs and guide signs, but it may be more difficult for other devices such as warning signs in general and those intended for occasional hazards in particular.

Examples of these occasional hazards are railroad crossings, icy bridges, unexpected alignment and/or geometry, falling rocks, wildlife crossings, etc. For regulatory and guide signs, drivers feel an “obligation” to use the information provided by those signs; in the case of warning signs, the use of information and drivers’ reactions seem to be based more on perception of risk.

The effectiveness of static warning signs for occasional hazards is questionable because those signs typically are posted without the hazard being perceived by drivers. Subsequently, highway agencies have begun to question the feasibility of expending significant resources on the installation and maintenance of these signs when little evidence exists regarding their effectiveness in improving highway safety.

Knowing the effectiveness of these signs in improving safety is important for highway agencies to assess the feasibility of using conventional signs and whether alternative warning devices are required for a safer highway environment.

LITERATURE REVIEW

The *Manual on Uniform Traffic Control Devices* (MUTCD) is the national reference for the use, design and placement of traffic control devices. According to

MUTCD, warning signs “call attention to unexpected conditions on or adjacent to a highway or street and to situations that might not be readily apparent to road users,” usually with the intention of raising driver awareness and lowering speeds.¹ However, drivers may become complacent to the importance or meaning of traditional static warning signs.²⁻⁹

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. In most studies, the effectiveness of warning signs involved non-traditional warning devices such as dynamic message signs (DMS), flashing lights/beacons, retro-reflective fluorescent signs, or the use of advanced intelligent transportation systems (ITS) technologies such as dynamic warning signs activated upon sensing and processing hazard or vehicle information.¹⁰⁻¹⁶

The effectiveness of non-traditional warning devices in comparison with traditional MUTCD warning signs was assessed using surrogate measures such as average travel speed. In one study, crash data were used in investigating the benefit of static ice warning signs in reducing accident frequencies and severity in the state of Washington.¹⁷ Ice-related accident data for a three-year period (1993–1995) as well as traffic and geometric site-specific information were used in the investigation. The presence of ice warning signs was not found to be a significant factor in reducing ice accident frequency or severity.

The lack of research on the effectiveness of conventional static warning signs by highway agencies may be attributed in part to the perceived “legal obligation” of using these signs to minimize tort liability in the case of crashes. Although safety effectiveness of these signs ultimately is of interest, the proximate motive of applying such signs may be related to liability issues.

Another important observation is the lack of distinction in the literature between warning signs that are used for permanent hazards (such as sharp curves, winding roads, etc.) and those used for occasional hazards. The latter group of signs is posted all the time, although hazards may occur only in a few instances. This situation may make most drivers complacent to such warning signs and may reduce their effectiveness in influencing driver behavior to avoid potential hazards.

SURVEY OF HIGHWAY AGENCIES

The state of the practice was examined for the use of static warning signs at occasional hazards. An online questionnaire survey was sent to all 50 state departments of transportation (DOTs) and two Canadian provinces (Manitoba and Nova Scotia) to request their participation in the study. A total of 28 highway agencies answered the questionnaire, representing a 54-percent response rate. The survey attempted to address the following aspects of using traffic control devices for warning drivers of occasional hazards:

- Effectiveness of static warning signs as perceived or as evaluated by state DOTs;
- Criteria for the use of static warning signs and the frequency of placement; and
- Use of enhanced or unconventional warning devices and their effectiveness.

Survey responses were analyzed, and results are discussed in the following sections.

EFFECTIVENESS OF STATIC WARNING SIGNS FOR OCCASIONAL HAZARDS

When asked about their perception of the effectiveness of static warning signs for occasional hazards (SWSOH), 18 percent of survey respondents thought these signs were effective, 7 percent thought the signs were ineffective and 4 percent were not sure about the answer. The majority of respondents (71 percent) viewed the signs as “somewhat effective.” These results are shown in Figure 1. The lack of a definite answer by most respondents may be largely due to insufficient information on the safety benefits of these signs.

This finding was clearly demonstrated in the results of another survey question

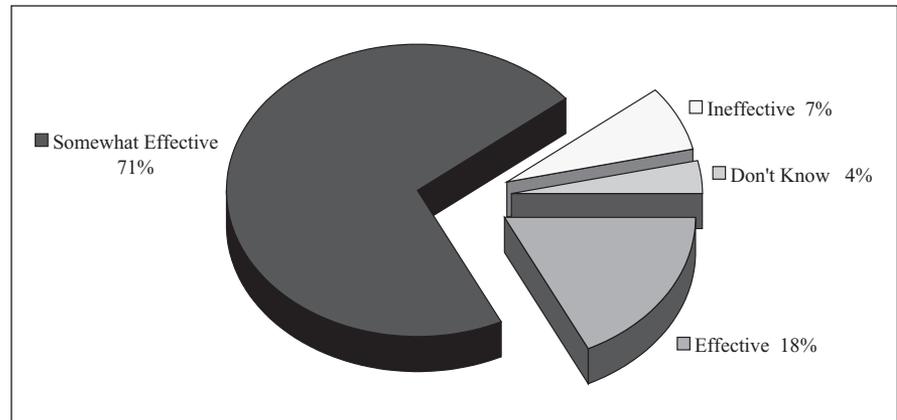


Figure 1. Effectiveness of static warning signs for occasional hazards as perceived by responding agencies.

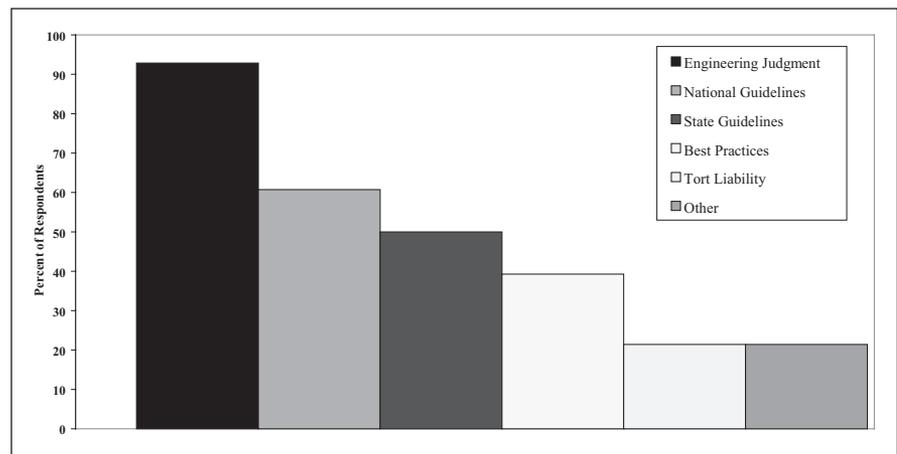


Figure 2. Criteria used in determining the need for static warning signs for occasional hazards.

that asked highway agencies about any evaluation studies they have done to assess the safety benefits of SWSOH. In answering this question, 26 agencies (93 percent) replied that no studies were done to investigate the effectiveness of those signs. Only two agencies (7 percent) reported the existence of such studies.

The Arkansas Highway and Transportation Department conducted a before-and-after crash investigation and Arizona DOT conducted an investigation in the “early 1990s describing the ineffectiveness of Animal Warning Signs.” The lack of efforts to evaluate these signs is important. As MUTCD states, “the effectiveness of the placement of warning signs should be periodically evaluated under both day and night conditions.”¹⁸

CRITERIA FOR USE OF SWSOH AND FREQUENCY OF PLACEMENT

MUTCD provides limited guidance on the use of warning signs and stipulates that “the use of warning signs shall be

based on engineering study or engineering judgment.” In addition, “the use of signs should be kept to a minimum so that the signs do not lose their effectiveness” and subsequent placements after first location are to be determined at “appropriate intervals.”¹⁹ Further, MUTCD adds: “In situations where the conditions or activity are seasonal or temporary, the warning sign should be removed or covered when the condition or activity does not exist.”²⁰

As for guidance regarding the installation of SWSOH, 26 of the responding agencies (93 percent) reported use of engineering judgment, which is consistent with the MUTCD guidance. Also, 17 of the respondents (61 percent) listed use of the national guidelines (MUTCD) versus 14 respondents (50 percent) using state guidelines such as state traffic engineering manuals and supplements. Furthermore, a relatively large number of respondents (11 states; 39 percent) indicated best practices.

Also of note was that around 20 percent of respondents (six states) considered tort

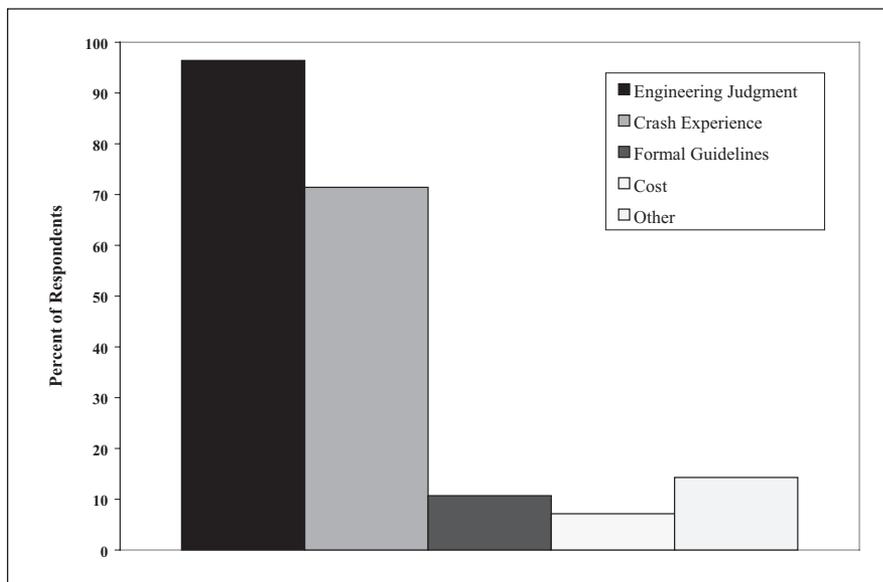


Figure 3. Criteria used by responding agencies for frequency of placement of static warning signs for occasional hazards.

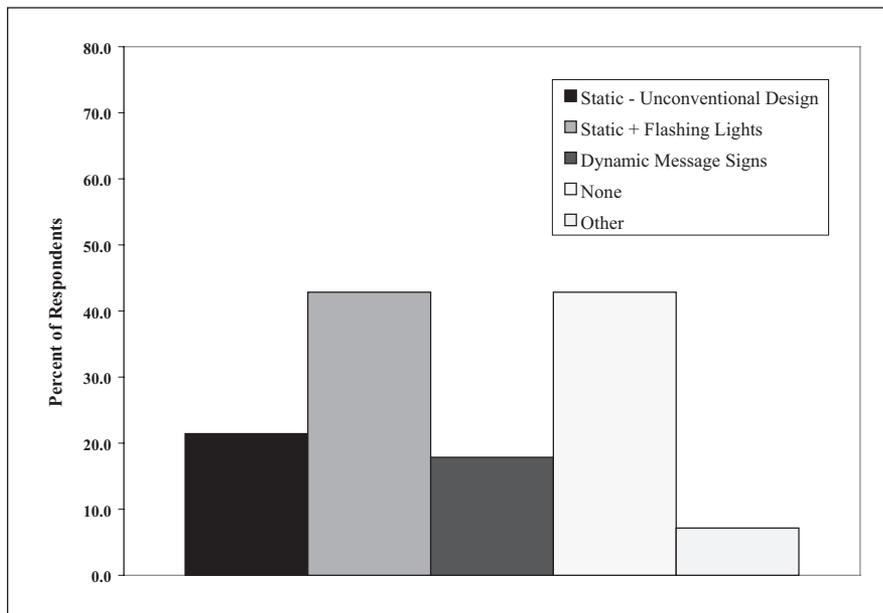


Figure 4. Use of unconventional warning devices by state DOTs.

liability and litigation as having an important role in the decision to use SWSOH. Among other criteria mentioned by respondents was the use of crash data as well as requests from the public. As related to the latter criterion, one agency stated: “Sometimes we fall victim to the *political* warrant: We don’t believe the signs will have any effect, but it makes local residents feel good to have them installed.” These results are shown in Figure 2. Respondents were allowed to select more than one criterion in answering this question.

In regard to the frequency of placement

of SWSOH when a hazard exists over an extended segment of highway, 96 percent of respondents reported use of engineering judgment; 72 percent reported use of crash experience to determine where to place these signs (see Figure 3). Only three responding states (11 percent) reported use of national or state guidelines.

USE OF UNCONVENTIONAL WARNING DEVICES

Highway agencies were asked about the use of enhanced warning signs or devices other than the traditional MUTCD

static warning signs (see Figure 4). More than half of the respondents (15 agencies; 57 percent) indicated the use of enhanced devices. Around 21 percent of respondents (six agencies) indicated the use of static signs with unconventional design features such as different size, color, or enhanced with reflectors or other altered features that deviate from the standard MUTCD warning signs.

A similar percentage of respondents indicated the use of DMS. A higher percentage of respondents (13 agencies; 43 percent) indicated the use of static signs with flashing lights. Those signs may flash at specific times or seasons or, in some instances, when the occasional hazard is in effect. Examples include fog warning systems that detect fog and actuate flashers on static signs in times of reduced visibility and wildlife-detection systems that trigger flashers when animals are on or crossing the road.

The survey also solicited input from state DOTs that have implemented enhanced warning devices about the effectiveness of those devices. Sixty-four percent of the responding agencies using enhanced devices found those devices effective; 21 percent stated that the devices had not been effective. For the remaining respondents (around 14 percent), no evaluations of advanced devices were performed. One respondent agency expressed concern that the unconventional or innovative signing or devices usually prove effective initially but lose their impact over time.

SUMMARY OF FINDINGS

Literature Review

In the literature review, several studies were identified that investigated the effectiveness of static warning signs for occasional hazards. Two important observations are outlined below:

- There is lack of distinction in the literature between warning signs for permanent potential hazards versus those for occasional hazards.
- The investigation of the effectiveness of SWSOH was primarily done in comparison to unconventional or enhanced warning devices. The conventional static warning signs in many of those studies provided a reference against which the effectiveness of enhanced devices was evaluated.

Practice Review

A state DOT questionnaire survey was conducted to review the current national practice concerning the use of SWSOH. The most important findings are summarized below:

- An overwhelming majority of agencies surveyed perceived the effectiveness of SWSOH as only “somewhat effective.”
- Around 93 percent of responding agencies had not done any evaluation of the effectiveness of SWSOH. While state DOTs may perceive the practice to be somewhat effective, there generally are no data to support that notion. In reality, the effectiveness of those signs is uncertain.
- The criteria for the installation of SWSOH are vague and arbitrary at best. The practice largely relies on engineering judgment. While this method is consistent with MUTCD, little definitive guidance is available in this regard.
- Besides engineering judgment, crash history is a key criterion for determining the frequency of sign placement. Also, the cost of installing and maintaining signs was found to be an insignificant criterion in the frequency of sign placement.
- Around 20 percent of responding agencies considered tort liability and litigation as having an important role in the decision to use SWSOH.
- More than 50 percent of responding agencies reported the use of unconventional warning devices. This fact could be an indicator of implicit dissatisfaction with, or lack of assurance concerning, the effectiveness of the SWSOH.
- The use of static signs with flashing lights was the most frequently reported unconventional warning device. Around two-thirds of responding states considered unconventional warning devices effective.

RECOMMENDATIONS

The authors recommend further research into the effectiveness of various warning devices for occasional hazards including conventional and unconventional static and dynamic signs. While practical difficulties exist in utilizing crash data for establishing

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this effectiveness, human factors research in simulated environments may provide a feasible alternative in many situations.

Establishing the effectiveness of warning devices is critical in advancing current standards and providing better guidance to highway agencies for improving safety on the highway system. Also, it provides accountability to the public regarding expenditures of highway funding on installation and maintenance of static warning signs or, alternatively, will justify the investment in other techniques to increase driver safety when and where unexpected and occasional hazards may result in accidents.

ACKNOWLEDGMENTS

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AHMED AL-KAISY,

Ph.D., P.E., is an associate professor in the Civil Engineering Department at Montana State University in Bozeman, MT, USA.

He has widely published in many areas of traffic and transportation engineering and is an associate member of ITE.



AMANDA HARDY

has a B.S. and an M.S. in fish and wildlife management from Montana State University. As a research ecologist at the Western Transportation Institute at Montana

State University, her research focused on interactions between highway infrastructure, traffic dynamics, drivers and wildlife. She is currently pursuing a Ph.D. in ecology at Colorado State University, studying the interactions between national park transportation systems, park visitors and wildlife.



CHARLES P. NEMFAKOS,

E.I.T., is currently a highway design engineer working for the Montana Department of Transportation in Helena, MT. He graduated from Montana State University with a B.S. in civil engineering in 2007.

ITE REPORT SUMMARY

Survey of Practice for Signing and Markings near Schools: An Informational Report of the Institute of Transportation Engineers

This feature summarizes an informational report of the Institute of Transportation Engineers (ITE) prepared by a subcommittee of the ITE Traffic Engineering Council. The full report provides a detailed summary of the results of a survey of school-related traffic control devices.

The Traffic Engineering Council of the Institute of Transportation Engineers (ITE) developed a 37-question Web-based survey to gather information on: the state of the practice for school speed zones; signing and markings for schools; and engineering judgment on when to install a school speed zone. As part of the survey, several states and cities provided copies of their school speed zone procedures. Searches of the remaining states' Web sites also were conducted to identify additional materials and general guidance materials on schools or pedestrians.

The committee's activities concluded with producing an informational report that documents the survey findings and subsequent research. The resulting report, *Survey of Practice for Signing and Markings near Schools*, is now available through the ITE Bookstore.

This report was prepared by ITE's Traffic Engineering Council Committee TENC-106-01. Members of this committee were: Kay Fitzpatrick (F), chair; Steven J. Stuart (M); Jacob Benfield (M); David G. Gerard (F); Shauna L. Hallmark (M); Michael R. Hendrix (M); Thomas K. Mericle (M); Avani C. Patel (M); Terrence J. Rice (F); Allen E. Swanson (M); and Anthony P. Voigt (M).

Additional reviewers for this report were: W. Scott Wainwright (F), Russell G. Brownlee (F), James T. Harris (M) and Lawrence T. Hagen (F).

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