



Project Summary Report O-4748-S  
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Project O-4748: Effective Use of Portable  
Changeable Message Signs in Work Zones

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## Improved Work Zone Portable Changeable Message Sign Usage

Portable changeable message signs (PCMSs) are an important part of traffic control within many Texas work zones. When used properly, these signs can command good attention from motorists, provide important information about current and future roadwork activities, and help motorists make proper driving decisions (see Figure 1). When used improperly, however, they quickly lose credibility with the motoring public and contribute to motorist confusion.

In this project, researchers developed specific, user-friendly implementation guidelines that will assist field personnel in selecting and using proper portable changeable message sign messages in work zones on a day-to-day basis.



Figure 1. Work Zone Traffic Control Is Improved with Good PCMS Use.

### What We Did...

Researchers first conducted field reviews of PCMS usage and talked to Texas Department of Transportation (TxDOT) personnel in several districts statewide to determine PCMS message design issues for which specific guidance was needed. Two key issues were identified.

The first issue pertained to how best to format and

display calendar dates about roadwork activities that will occur more than seven days in the future. Specifically, should field crews present calendar dates as numerals only (i.e., 09/05) or as text and numerals (i.e., SEP 5)? Also, should day and date information be presented together on the sign (i.e., MON SEP 5)? Should times be included in the message (i.e., 7 PM TO 5 AM)?



The second issue involved the use of PCMSs in sequence on a roadway. The *Manual on Uniform Traffic Control Devices* indicates that multiple PCMSs should be used in sequence when more than two phases of information need to be displayed. However, the effectiveness of this practice had not been verified through objective research, and no guidance was available as to how field crews should split the information between two sequential PCMSs.

To address the calendar date and day issue, researchers designed and conducted laboratory human factors studies in Arlington, Austin, El Paso, Houston, Laredo, and San Antonio, Texas. Researchers tested driver interpretations of different calendar day, date, and time information formats using laptop computers configured to mimic PCMS displays.

To evaluate the effectiveness of sequential PCMS messages, researchers used the Texas Transportation Institute (TTI) driving simulator in College Station, Texas. Drivers were recruited to drive the simulator vehicle through a computer-generated travel route where sequential PCMS messages were portrayed. Again, researchers evaluated the effectiveness of the displays based on the ability of drivers to correctly comprehend the PCMS messages.

Once the human factors studies were completed, researchers developed a one-page field guide that identifies acceptable PCMS phases to display under different current and future work zone conditions.

### What We Found...

Researchers found that drivers are better able to interpret calendar dates presented as a combination of letters and numerals (i.e., SEP 5) than as an entire string of numerals. As shown in Table 1, a higher percentage of drivers were able to assess whether the dates presented via text and numeral format meant that the work activity was occurring that day, or if work would be occurring the following week. Also, a large percentage of drivers expressed a strong preference for the text and numeral format. However, consistent with past studies, researchers found that drivers were generally unable to determine what day or days of the week a calendar date corresponds to, regardless of the format used.

The study results also showed that field crews must be very careful not to put too much information onto a single PCMS panel because doing so overloads the driver and leads to poor comprehension of all information presented. This can be seen very clearly in Table 2, which shows correct

response rates to a PCMS phase that displays calendar dates, days, and times of future work activity. Whereas 84 percent of drivers could recall the calendar dates presented in Table 1, only 29 percent could do so for the dates presented in Table 2. Meanwhile, only 7 percent of drivers could recall the times of work activity presented. Drivers were also less likely to correctly interpret whether the PCMS phase in Table 2 meant that work was occurring on the current day, or if work would be occurring the following week.

The effects of information overload were also evident in the results of the driving simulator study of sequential PCMS messages. Researchers found that drivers were able to correctly recall and interpret information presented on two two-phase PCMSs placed in sequence along a travel route, as long as the total amount of information presented on both PCMSs did not exceed four units of information (a unit of information is the answer to a simple question such as “What is the problem?”, “Where is the problem located?”, etc.). Overall, attempts to present five units of information on sequential PCMSs yielded driver comprehension rates of only 54 percent, compared to 78 percent correct comprehension of four units of information presented on sequential PCMS displays.



## The Researchers Recommend...

Researchers used the results of the human factors studies and existing national and state guidelines to develop a one-page field guide to assist crews in selecting appropriate PCMS messages for a variety of current and future work zone activities. The guide provides a bullet list of general application considerations and a series of acceptable phases for the following:

- roadway/lane/ramp closures,
- other general problems,
- driver actions/effect on travel,
- locations,
- general warnings, and
- advance notice of future work activities.

The field user simply selects the first phase from the most appropriate roadway/lane/ramp closure phase or the general problem phase, and a second phase (if needed) from the driver actions/effect on travel, location, general warning, or advance notice phases. Researchers recommend that this guide be distributed to field personnel statewide and incorporated in current construction contract standard plans and special specifications for PCMSs as appropriate.

Table 1. Driver Comprehension of Alternative Calendar Date Formats.

Percent of Subjects Who...	Numeral Format <div>4/21 TO 4/25</div>	Text/Numeral Format <div>APR 21 TO APR 25</div>
Correctly recall dates?	88%	84%
Correctly recognize if activity is occurring today?	72%	92%
Correctly recognize if activity is 1 week from tomorrow?	79%	81%
Correctly identify days of the week of activity?	12%	13%
Prefer this format?	17%	83%

Table 2. Driver Comprehension of Combined Day, Date, and Time Message.

Percent of Subjects Who...	Date, Day, and Time Format <div>MAY 9-11 MON-WED 11AM-8PM</div>
Correctly recall days?	47%
Correctly recall dates?	29%
Correctly recall times?	7%
Correctly recognize if activity is today?	70%
Correctly recognize if activity is 1 week from tomorrow?	69%



## For More Details...

Human factors research results to improve PCMS messages in work zones are included in Report 0-4748-1, *Advanced Notification Messages and Use of Sequential Portable Changeable Message Signs in Work Zones*. Efforts to develop improved guidance on PCMS use are documented in Report 0-4748-2, *Development of a Field Guide for Portable Changeable Message Sign Use in Work Zones*.

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