



# **USE OF PORTABLE CHANGEABLE MESSAGE SIGNS WITH SPEED DISPLAY IN WORK ZONES**

## **A. INTRODUCTION**

Portable Changeable Message Signs (PCMS) with speed display can be effectively used to reduce the speed of vehicles traveling through work zones and to increase speed limit compliance in work zones. Speed detection devices are connected to the signs and provide vehicle speed information to the signs. The vehicle speeds are then displayed to passing motorists. Speeding drivers may feel urged to slow down when the PCMS display a personalized message about their travel speed and the posted speed limit.

## **B. OBJECTIVE**

- Reduce the speed of vehicles traveling through a work zone.
- Encourage speed limit compliance, particularly amongst speeding drivers.
- Increase safety in construction and maintenance work zones.

## **C. LITERATURE REVIEW SUMMARY**

### **C.1. ADVANTAGES**

- PCMS cause passing drivers to reduce their speeds by 1 to 7 mph (see 2, 5, 6, 8, 9, 18 and 20).
- The percentage of speeding drivers is reduced by 3 to 20 percentage points (see 2 and 9).
- PCMS have a positive impact in reducing the number of vehicles approaching the work zone taper who still remain in the closed lane.
- PCMS are effective in reducing speed variance.
- PCMS are relatively inexpensive.
- Drivers consider the PCMS speed warning messages useful.



- PCMS are effective at night and in inclement weather.
- The contractor or state DOT has direct control over the PCMS.

## **C.2. DISADVANTAGES**

- Although effective in reducing speeds, PCMS alone are incapable of reducing vehicle speeds to the desired level.
- PCMS lose some of their effectiveness over time (e.g., usually after one to two weeks).

## **C.3. OTHER RELEVANT FINDINGS**

- Speeds are reduced near the PCMS but the effect is lessened as the passing vehicles move farther away from the signs.

## **D. DEPLOYMENT GUIDELINES**

In addition to the guidelines described herein, deployment of PCMS with speed display shall conform to applicable guidelines contained in the Manual on Uniform Traffic Devices for Streets and Highways (sections 2A.07, 2E.21, 6F.02 and 6F.55); as well as, to SHA's Functional Guidelines for Portable Changeable Message Signs.

SHA recommends the use of PCMS with speed display as an effective work zone speed control measure along expressways/freeways and other high-speed multilane roadways. It is effective in reducing both average speeds, and excessively speeding vehicles in short-term and long-term cases (up to two months of work duration).

- PCMS with speed display should be placed in advance of the work zone location (e.g., workers and equipment very near the traffic stream) where greater compliance with the speed limit is needed.

- When multiple PCMS are used, the signs shall be placed on the same side of the roadway. For speed control, placement of PCMS on both sides of the roadway at the same location may cause driver distraction and conflicting messages.
- If PCMS are to be used for more than 4 weeks, periodic police enforcement should be arranged in order to maintain the effectiveness of the signs.
- Long work zones (i.e., one mile or longer) may warrant the deployment of 2 or more PCMS.
- Due to the large size of the display panel, PCMS should be installed only where shoulder space allows sufficient room for setup outside of the travel way.
- Each PCMS should be delineated/protected with traffic control devices as shown in SHA's Temporary Traffic Control Typical Applications.
- Each time a PCMS is set up, the radar should be checked and adjusted (if necessary) to ensure accuracy.
- The radar should be aimed to measure the speeds of vehicles traveling in the fastest moving lane, at no more than 10 seconds of distance upstream of the radar location.
- On high-speed facilities (i.e., roadways where the posted speed limit is 50 mph or greater) the speeds of vehicles traveling more than 25 mph over the speed limit should not be displayed. This measure is intended to discourage drivers from seeing how fast they can get the speed display trailer to read.
- While PCMS with speed display may be used on all types of highways and work zones, either in rural or urban environments, PCMS deployment is particularly recommended for rural and urban multi-lane divided high-speed roadways.
- PCMS with speed display may be used anytime of the day (daytime or nighttime) and under inclement weather conditions.



## Disclaimer

The information provided in this section of the Maryland State Highway Administration's Work Zone Safety Tool Box is only to provide guidance. The Work Zone Safety Tool Box supplements current practices and standards provided in the current edition of the following documents:

- 1) The Manual on Uniform Traffic Control Devices (MUTCD)
- 2) The Maryland Supplement to the Manual on Uniform Traffic Control Devices
- 3) Maryland State Highway Administration Standard Sign Book
- 4) Maryland State Highway Administration Book of Standards for Highway and Incidental Structures
- 5) Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials

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## **F. CASE STUDY: PORTABLE CHANGEABLE MESSAGE SIGN WITH SPEED DISPLAY EVALUATION**

### **F.1. Introduction**

A study was performed for the Maryland State Highway Administration Office of Traffic & Safety to determine the effectiveness of implementing Portable Changeable Messaging Signs (PCMS) with speed display prior to a work zone. Two (2) full-matrix PCMS were placed prior to a work zone. Results showed the PCMS was an effective measure to reduce both average speeds and the percentage of drivers speeding excessively.

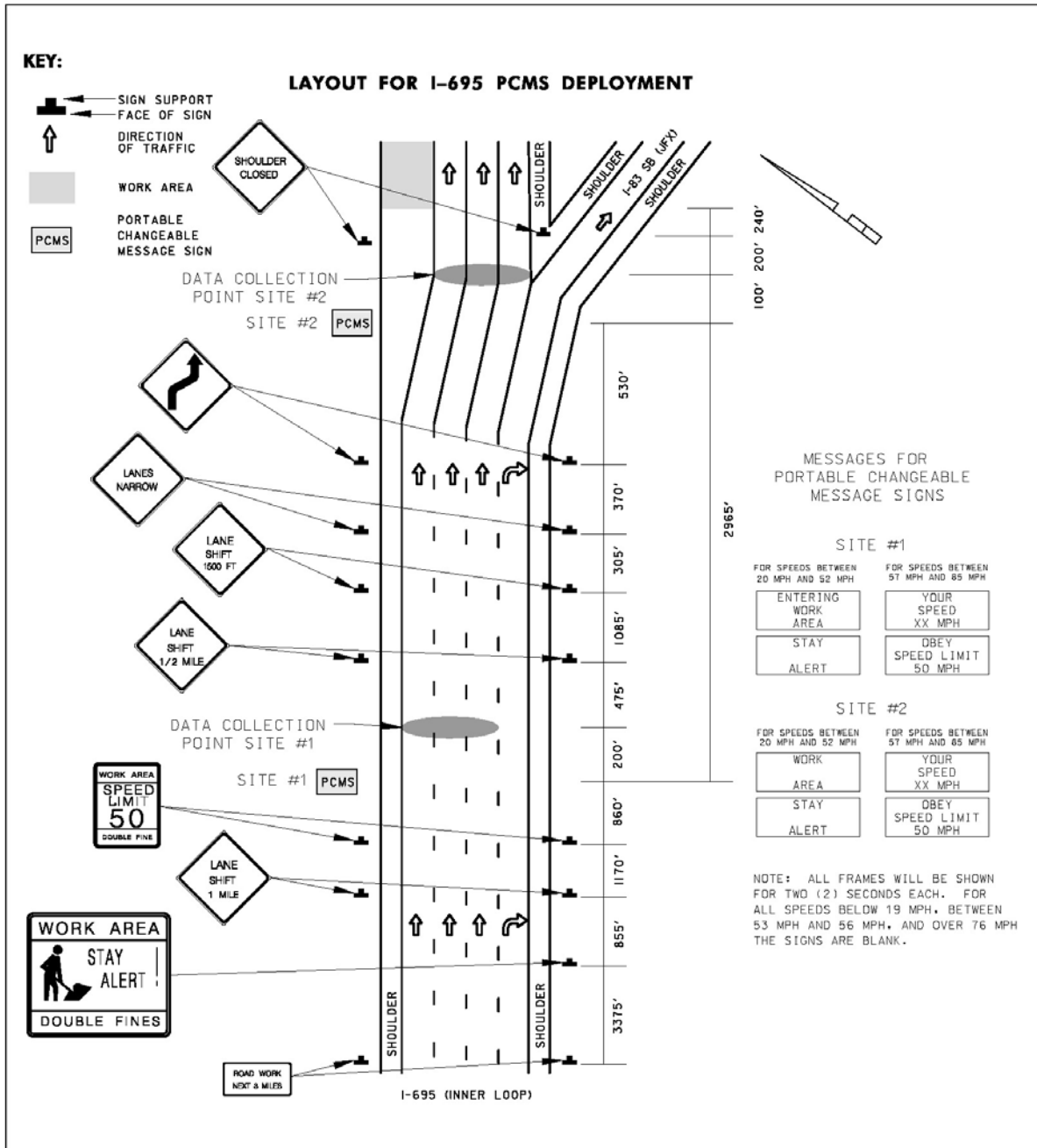


### **F.2. Location**

The study was done on the Baltimore Beltway (I-695, Inner-Loop) between Greenspring Avenue and I-83 (JFX) southbound in Baltimore County, Maryland.

### **F.3. Typical Set-up**

Two (2) PCMS were placed before the work zone; sign #1 being approximately 4,165 feet upstream of the work zone, and sign #2 being approximately 1,200 feet upstream of the work zone. The rental cost for each sign was \$3,000 per month. The following messages were displayed on the signs for the given speed ranges (see layout sheet).



**SHA** Maryland Department of Transportation  
State Highway Administration  
**STATE HIGHWAY ADMINISTRATION**

**PCMS SPEED STUDY**  
**I-695 (INNER LOOP) BETWEEN GREENSPRING AVENUE AND I-83 SOUTHBOUND (JFX)**

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## **F.4. Data Collection/Reduction Methodology**

A spot speed study was performed downstream of the PCMS as shown in the figure on the prior page. Most research studies emphasize analyzing data collected for free-flowing vehicles only, which are commonly defined as those vehicles with more than four seconds of headway. During the selected data collection periods, the Baltimore Beltway (I-695) carried heavy traffic volumes and thus, the application of the four-second rule was not feasible. Instead, to assure uniform and comparable test conditions, the data collected were differentiated in two categories: congested conditions and non-congested conditions. All data in the congested condition category were removed from the analysis in order to create the best model for traffic control measures. Two methodologies were used to analyze the data: (1) average vehicle speed, and (2) the percentage of vehicles speeding excessively. Vehicles were systematically sampled by taking three readings per minute, one per each lane. The studies were conducted before implementation of PCMS, immediately after, one week, three weeks, five weeks, and seven weeks after PCMS implementation, as well as one week after PCMS was removed.

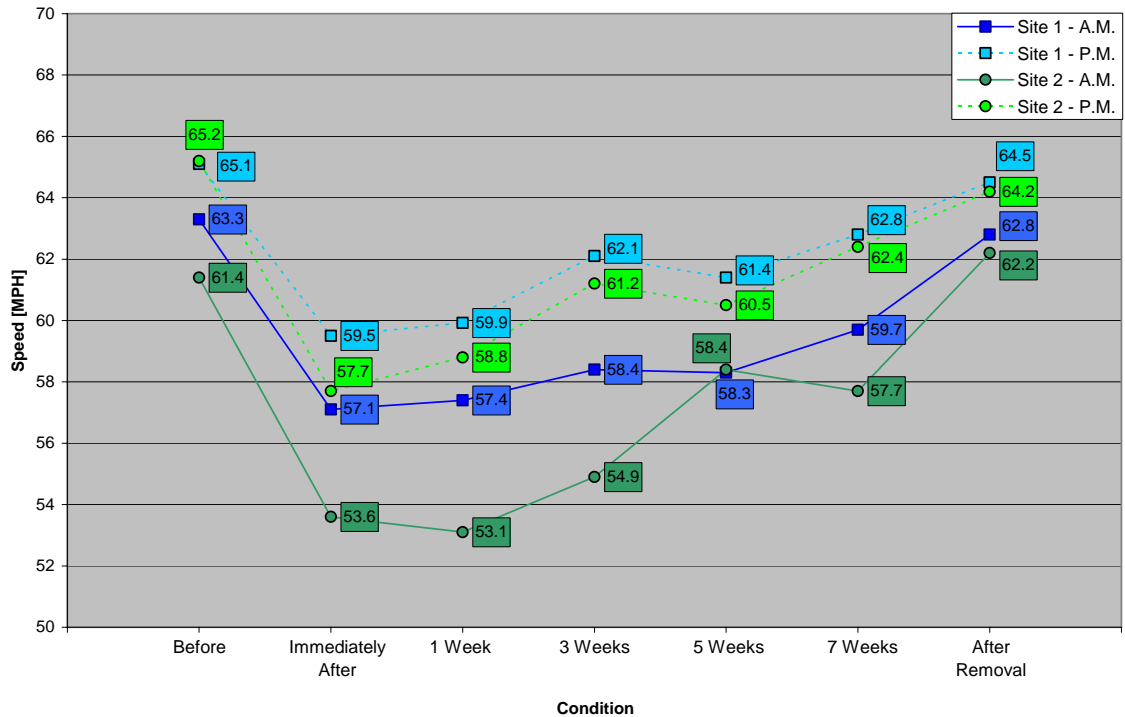
## **F.5. Results**

### **Average Speed:**

The average speed was reduced with the implementation of PCMS. After one week of placing the PCMS, the speed reductions ranged from 5.6 to 7.9 mph depending on time of day. The magnitude of speed reduction gradually decreased over time. Once the PCMS were removed, the traffic speeds returned to normal.



**Average Speed per Condition**



**Proportion of Vehicles Speeding Excessively:**

The proportion of vehicles speeding excessively (i.e. vehicles traveling more than 10 mph over the posted speed limit) was drastically decreased by the use of PCMS. Before the implementation of PCMS the percentage of vehicles speeding excessively was up to 80%. One week after the PCMS were put into place, the percentage dropped from 80% to 44% a percent reduction of 45% at the first PCMS, and the percentage dropped 80% to 33% a percent reduction of 59% at the second PCMS. This speed reduction decreased over time but significant percent reductions of 21% still remained after seven weeks of PCMS implementation.