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Maine Department of Transportation

Transportation Research Division

Technical Report 01-16

Evaluation of Radar Activated Changeable Message Sign for Work Zone Speed Control

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Introduction

The Maine Department of Transportation recently tested new equipment designed to help reduce the incidence of speeding in construction work zones. The project utilized a radar-activated, trailer mounted, changeable message sign (CMS). The CMS speed trailer cost nearly $27,000 and was purchased with funding through the Federal Safety Incentive Grants Program which rewards states based on an independent assessment of driver compliance with state seat belt laws. The funds can be used at the discretion of the awarded state.

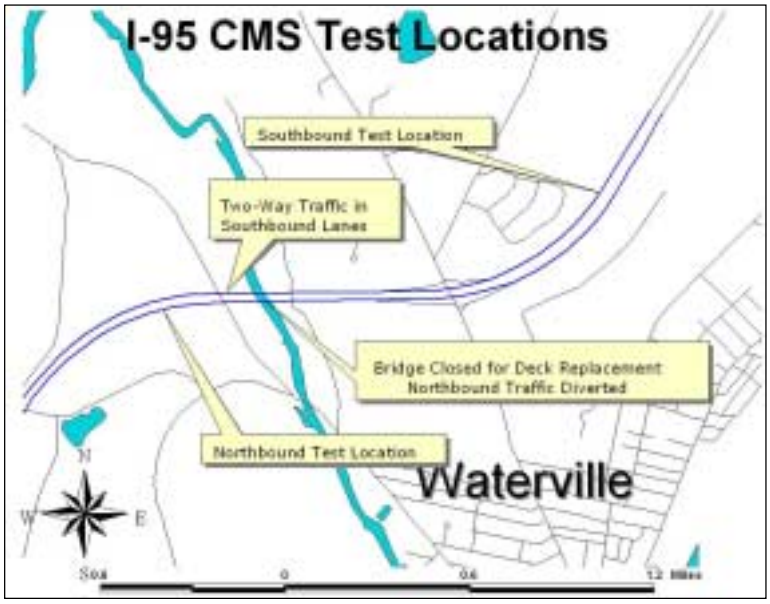
Maine DOT, like other state transportation agencies relies on portable CMS trailers to warn drivers of roadway and traffic conditions on construction or maintenance projects. The unit tested in this experimental project utilizes a radar unit to detect vehicle speeds. If the unit detects a speeding vehicle a selected sequence of warning messages is displayed. The unit is solar powered backup. It is programmed and operated using a hand-held controller. Optionally a lap-top computer can also be used

Several states have used similar radar activated signs. Recent research done in Texas, Virginia, Nebraska, and Montana has shown that speed trailers are effective in reducing average speeds. Radar speed trailers have also been used effectively by municipal police in many states.

I-95 Test Location

The pilot test for MDOT was completed during the 2001 construction season on an Interstate 95 bridge deck replacement project in the town of Waterville. The experimental CMS trailer supplemented the extensive traffic control measures used during the first phase of the multi-year bridge deck replacement

project. The project involved lane closures on both northbound and southbound lanes and also a lane diversion. The northbound travel lanes were diverted through a median crossover lane into the southbound passing lane, so that the normal southbound lanes were carrying two-way traffic. Numerous signs indicate reduced speeds ahead; the work zone speed limit was posted at 45 mph.



The CMS unit was tested using a "before-and-after" test design. In the test, speeds of passing vehicles were measured using a time vs. distance method. First, speeds were measured with the sign in place but not activated. Then the sign and radar unit was switched on and speeds were measured with the sign activated. Several sets of tests were completed on different dates and at different times of the day. The study focused on the southbound lanes. The northbound lanes were the subject of a brief test, however it was determined that excessive speed was more prevalent on the southbound lane. Presumably drivers were exercising more caution on the northbound lane due to the need to maneuver through a lane cross-over. This fact lessened the need for additional warning signs on that approach. The CMS was placed at the end of a tapered section where barrels were used to close the left lane. Beyond that point the left lane carried the diverted northbound oncoming traffic. The following photographs show the traffic control measures and different perspectives of the experimental installation.


YOU ARE
SPEEDING
!!!


SPEED
LIMIT
45 MPH


62 MPH


SPEED
LIMIT
45 MPH

Results

The initial testing was done immediately after the unit arrived at the site; several weeks were allowed to pass before more tests were done. This delay was in response to concerns that the effectiveness of the unit would degrade over time as drivers become accustomed to it's operation. The message chosen for this project included the text, "You are speeding…" because other published research had concluded that it was one of the most effective messages for this application.

The results of the southbound tests were very positive, based on the aggregate pooled data from the test sessions. The proportion of speeding vehicles was reduced from about 65% to 54%, a reduction of 11%. The overall average speed of southbound vehicles was reduced from 55 mph to 48 mph, a 7 mph reduction when the sign was activated. Average speed of the sample of vehicles was 55 mph with the sign inactive and 48 mph with the sign activated. The table below summarizes the data.

Analysis of Mean Speeds of Sample of Vehicles			
CMS Off		***CMS On***	
Mean	54.7	Mean	48.2
Standard Error	0.90	Standard Error	0.69
Standard Deviation	14.7	Standard Deviation	11.2
Sample Variance	214.8	Sample Variance	125.1
Range	61.6	Range	54.9
Minimum	28.2	Minimum	28.6
Maximum	89.8	Maximum	83.5
Count	265	Count	265
t-Test (Assuming Unequal Variances)		df	494
		t Stat	5.78410203
		P(T<=t) one-tail	6.47419E-09
		t Critical one-tail	1.647945282

Analysis of Observed Speeds				
	Sign Status			
	CMS Off	***CMS On***	***CMS On***	***CMS On***
			(1st half of sample)	(2nd half of sample)
Over 45 mph	172	144	107	36
Total	265	266	133	132
% Over 45	64.9%	54.1%	80.5%	27.3%
	t-Test (CMS On half samples)	Mean	54.5	41.9
		Variance	112.59	58.95
		Observations	133	132
		Df	241	
		t Stat	11.03879639	
		P(T<=t) one-tail	1.69098E-23	
		t Critical one-tail	1.651201273	
		P(T<=t) two-tail	3.38197E-23	
		t Critical two-tail	1.969856385	

The preceding table shows the difference between the first half of the sample and the latter half. The sign continued to be effective throughout the experiment, in fact, data in the second half, shows a lower overall mean speed, 54.5 mph vs. 41.9 mph. This result however, may not be due to the CMS alone. Unrelated to this experiment, there was an increase in speed enforcement activity by police as work progressed in the work zone. Police patrols using radar speed detection were in the work zone on a daily basis. This probably caused a heightened driver awareness, and a greater degree of speed compliance.

Another factor, in addition to the police enforcement, also could have affected these results. An interstate off ramp was located less that a mile beyond the location of the CMS location. It became apparent that some drivers were slowing in anticipation of the upcoming exit ramp and forming a platoon of vehicles. Some drivers were already slowing as they passed through the radar beam, regardless of the warning message. On some days this was more noticeable than on other days. For this experiment the CMS location was dictated by the constraints imposed by the location of the work zone and also the one lane section, therefore this complication could not be eliminated.

Recommendations for Future Use

Due to the size of the display board, the sign is most appropriate for future Interstate or arterial construction projects, where sufficient shoulder space allows room for setup outside the travel way. As can be seen in first photograph on page 2 of this report, the trailer jacks allow setup on very sloping shoulders, however steeper embankments would be more difficult and would necessitate blocking, a more time consuming setup, especially for short duration projects. The CMS trailer can also be used as a conventional message board for routine maintenance projects. The software capabilities allow a variety of custom messages to be created for a variety of situations. Remote communication from a PC modem connection is also possible. This feature was not used during this test, since the onboard cell phone modem connection didn't allow remote control of the radar unit. Smaller CMS units could also be used in this application; cost savings could probably be realized if multiple units were purchased. The sign performed well in this experiment. It's effectiveness was also noted in anecdotal comments from the construction project managers and law enforcement personnel who were at the site on a daily basis.

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