Evaluation of a Motorist Awareness System
by

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ABSTRACT
The objective of this study was to determine the effects of a Motorist Awareness System (MAS) on vehicle speeds in highway work zones. Spot speed studies were conducted prior to, within, and near the end of work zones along Interstate 10 and Interstate 95 in Florida which utilized the traditional Maintenance of Traffic plan and the MAS plan. Both the mean and 85th percentile speeds were consistently lower at the locations where the MAS was utilized and speeds were reduced by an average of 1.5 mph. Combining MAS with targeted speed enforcement resulted in reductions of 3 to 4 mph. The speed variance within the work zones and the proportion of speeding drivers were also shown to decrease due to the MAS. These results demonstrate that the use of MAS for construction work zones may be a practical countermeasure to reduce vehicular speeds and improve work zone safety.

INTRODUCTION AND BACKGROUND

Highway temporary traffic control measures create a restricted driving environment for the motorists in the midst of an otherwise familiar situation. Work zones typically provide narrower driving lanes and require the road users to travel at lower speeds. It is widely accepted by law enforcement and traffic safety professionals that excessive speeds and speed variance are contributing factors in traffic crashes, injuries and fatalities. While many highway work zones are either marked for a reduced speed limit or are covered by a statewide law, driver adherence to such reduced speed limit regulations in highway work zones is sporadic at best, especially during low traffic volume conditions. A variety of traffic control devices and special countermeasures are often used in varying degrees in work zones, but sometimes they fail to adequately impact operating speeds. Both excessive speeding (as measured by the difference between the actual speed and the posted regulatory speed limit) and a high variance in speed (as measured by the speed difference between one vehicle and another) are contributing factors in crashes occurring in work zones.

In 2005, the State of Florida experienced 137 fatalities and 4,136 crashes in highway work zones (*1*). While construction workers are exposed to heightened risk in work zones, ninety percent of those killed in highway work zones in Florida are motorists or pedestrians (*1*). Speeding and inattentive driving are some of the factors that cause work zone crashes. Due to many factors, including abrupt changes in horizontal or vertical alignment, slow moving vehicles leaving and entering the traffic stream from the construction area, and a reduced clear recovery area, drivers need to be alert and travel at a slower speed to be able to safely negotiate often-unexpected situations in the work zone.

In an effort to make work zones safer, the Florida Department of Transportation (FDOT) has developed an enhanced Maintenance of Traffic (MOT) system for work zone traffic control, referred to as “Motorist Awareness System” (MAS), to alert motorists of ongoing work zone activities. The MAS was tested on two segments of Florida interstate highways from June 2005 through July 2007. These segments include a suburban section of Interstate 10 (I-10) in Baker County, and a rural section of Interstate 95 (I-95) in Flagler County. Both I-10 and I-95 are four lane-divided freeways with 70 mph posted speed limits, though I-95 increases to six lanes in some locations.

The traditional maintenance of traffic (MOT) plan consists of a sequence of five advance warning signs and a series of channelizing devices leading up to the work area. The first warning sign indicated the impending work zone one mile ahead of its location, followed by a sign indicating that speeding fines are doubled when workers are present, and a series of three signs indicating the upcoming lane closure. The traditional MOT plan is displayed in detail in Figure 1.

The purpose of the MAS is to inform motorists of important work zone characteristics, such as lane closure information and work zone speed limits. The MAS is designed for implementation at work zones where: (1) the adjacent highway is a multilane facility, (2) the posted speed limit is 55 mph or greater, (3) work operations require a lane closure, and (4) workers are present. The MAS includes many of the same elements of the traditional MOT plan, in addition to a portable changeable message sign (PCMS), which displays two messages reading “WORKERS PRESENT AHEAD” and “SPEED REDUCED NEXT 3MI”, a portable regulatory sign (PRS), a radar speed display unit (RSDU), and a speed law enforcement official (SLEO) who patrols the active work area. The MAS plan is displayed in detail in Figure 2.

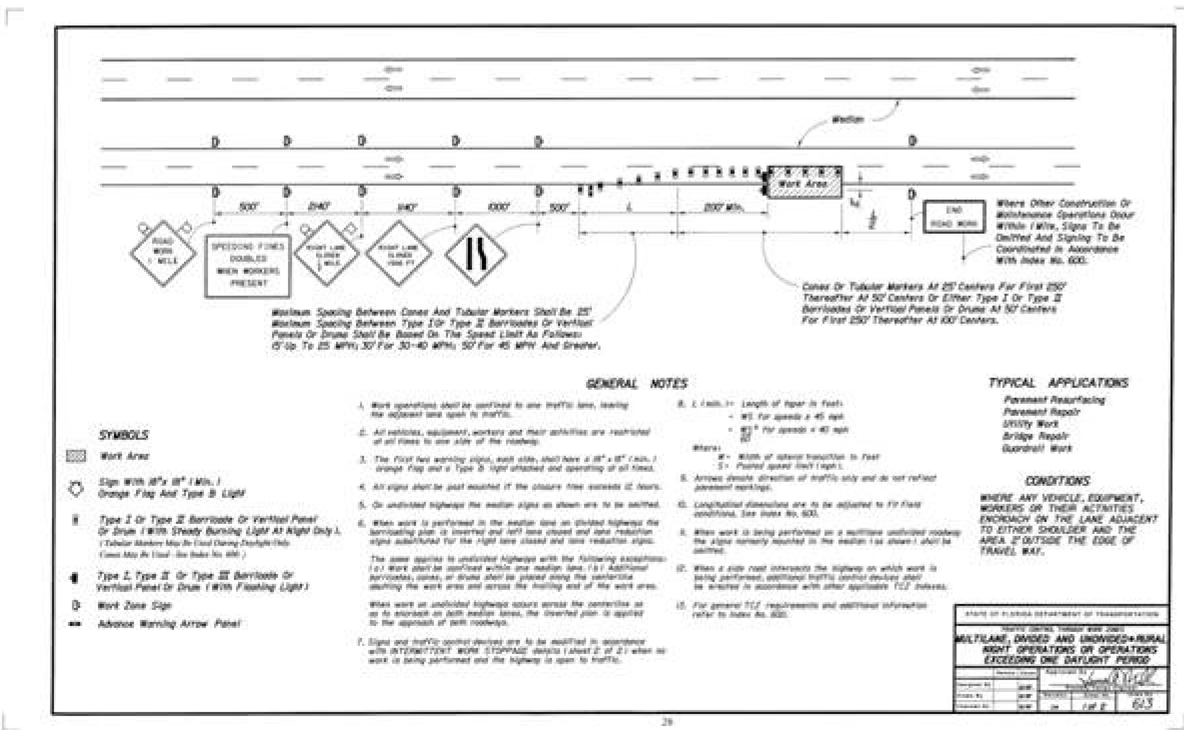

FIGURE 1 Traditional MOT.

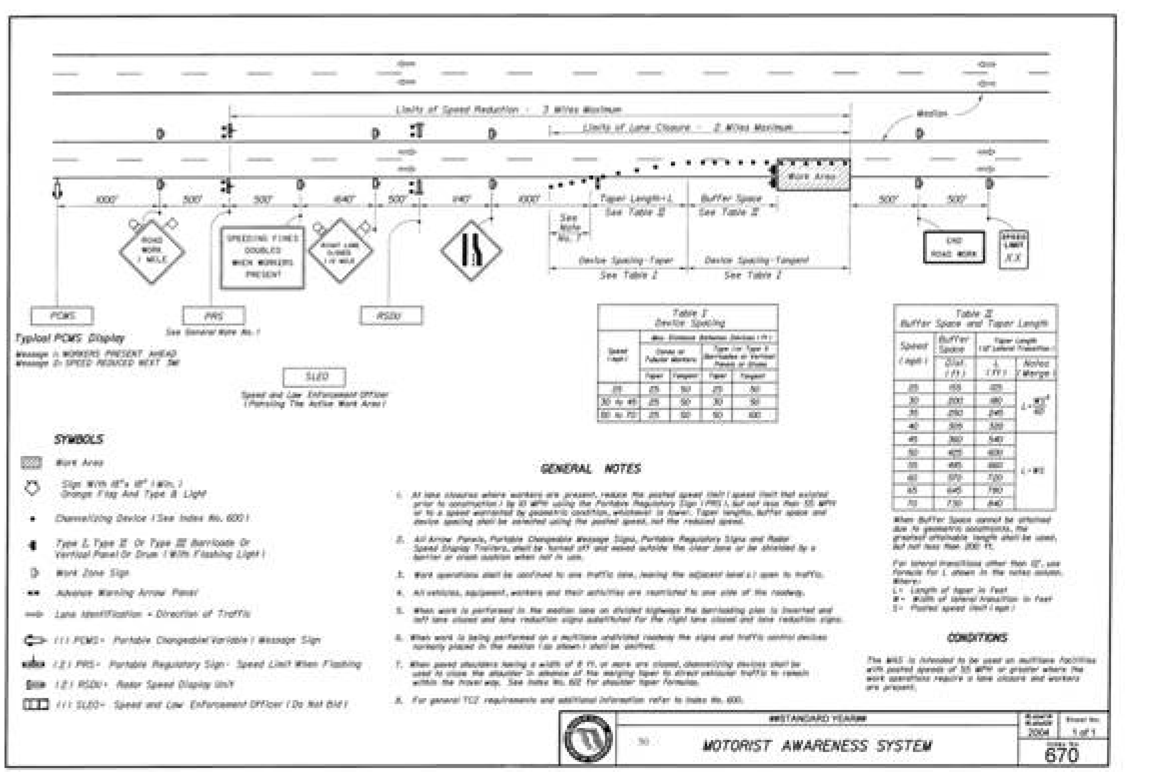

FIGURE 2 Motorist Awareness System (MAS).

The objective of this research was to determine the effectiveness of the Motorist Awareness System in reducing travel speeds approaching highway work zones in order to improve both motorist and worker safety. The effectiveness of the MAS was determined through a field experiment conducted on I-10 and I-95 at various "test" (condition with the MAS) and "control" (condition without the MAS) locations in combination with targeted speed enforcement. Prior to conducting this analysis, past research related to the individual devices utilized as a part of the MAS was reviewed and a brief discussion of each of these elements follows.

Portable Changeable Message Sign

Portable Changeable Message Signs (PCMS) provide drivers with special instructions, warnings, and other information relative to upcoming work zones. The use of PCMS have been shown to reduce speeds by 2.8 mph for trucks and 1.4 mph for passenger cars while reducing the number of speeding violations by 20 percent (*2*). Other studies have shown reductions of 3 mph to 7 mph due to PCMS (*3*).

Portable Regulatory Sign

Portable Regulatory Signs (PRS) are portable trailer units that have the regulatory speed sign mounted on top with flashing lights on each side of the sign. The lights are used to draw the driver's attention to the regulatory speed and to highlight the regulatory speed for the work zone.

Radar Speed Display Unit

Radar Speed Display Units (RSDU), also known as Speed Monitoring Displays (SMD) consist of a trailer unit equipped with a radar device to determine the speeds of approaching vehicles and then display these speeds to approaching drivers. A study of RSDUs in North Dakota showed mean speed reductions of 4 mph for passenger cars and 5 mph for heavy vehicles (*4*). A similar study in Nebraska found 3 to 4 mph reductions in mean speeds and 2 to 7 mph reductions in 85th percentile speeds (*5*).

Speed and Law Enforcement Official

The effects of law enforcement on speeding have been widely studied. Speed reductions of between 4 and 12 mph have been realized using a stationary police officer while the use of a roaming officer who travels through the work zone has been associated with more modest 2 to 3 mph reductions (*3*). Once law enforcement leaves, speeds are often found to approach or even exceed the pre-enforcement levels (*6*).

Highway Advisory Radio

Highway Advisory Radio (HAR) has also been implemented in previous work zone safety efforts. The Iowa DOT experimented with the Wizard CB Alert System, which alerts drivers via CB radio frequencies of upcoming work zone activities from distances of up to 4 miles away (*7*). A similar evaluation was conducted in Texas, which found reductions in mean speeds between the start and middle of the work zones (*8*).

STUDY METHODOLOGY

The purpose of the MAS is essential to reduce travel speeds within work zones as the underlying hypothesis is that speeding is one of the contributing causes to crashes at work zones. In this situation, travel speeds in the work zone are considered a surrogate measure of safety, and therefore the treatment is intended to reduce travel speeds through work zones and hence improve safety by reducing the potential for crashes. This study compares various speed characteristics under the following scenarios:

- Traditional Maintenance of Traffic (MOT)
- Traditional MOT in combination with police enforcement
- Motorist Awareness System (MAS)
- MAS in combination with police enforcement

Speed data from each of these four scenarios were compared to determine the effect of the MAS on work zone travel speeds. Speed studies were conducted at three different locations for each work zone to assess changes in the speed profiles through the work zone: (1) prior to the work zone, (2) in the middle of the work zone, and (3) near the end of the work zone. By comparing travel speeds at different locations, one can see whether motorists are temporarily reducing their speed in response to signage or police presence at the beginning of work zone and resume to normal speed as they travel through the work zone.

In order to compare the effectiveness of the Motorist Awareness System, a comparative parallel evaluation methodology was utilized. Data were compared for conditions where the MAS was utilized and for similar road conditions where the MAS was not utilized. A “test” condition refers to a work zone that utilized the MAS, and a “control” condition refers to a work zone that did not utilize the MAS (*2*). Additional comparisons were also made between locations of each type with and without police enforcement.

The Maintenance of Traffic (MOT) plan utilized was the same for each condition (“control” and “test”), except for the use of the MAS. The outer lane(s) in each direction were closed at these study sites. The majority of the installations, including all of the I-10 sites and most of the I-95 sites, were comprised of freeways with two lanes in each direction, which were reduced to one lane during the construction period. Seven of the I-95 sites were three lane (in each direction) facilities that were reduced to two lanes (in each direction) and these data were analyzed separately from the other I-95 data.

Measures of Effectiveness

A comparison was made between the speeds of vehicles traveling through construction zones with and without MAS. The effectiveness of the MAS was evaluated by comparing the changes in the mean speed, 85^{th} percentile speed, and the characteristics of the speed distribution. Tests were also performed to determine whether there was a significant reduction in the proportion of motorists driving above the posted speed limit. The measures of effectiveness (MOEs) that were used in this study were as follows:

- Mean speed
- 85^{th} percentile speed
- Variance of the speed distributions
- Proportion of vehicles exceeding posted speed limit

The “test” and “control” work zone was dynamic in nature in that it changed position every day. Thus, researchers were able to collect data at similar locations with and without MAS; however, not necessarily at the identical location. Because geometric, traffic, and weather conditions are similar along the study sections of I-95 and I-10, it was possible to compare the “test” and “control” data collected at these sites.

DATA COLLECTION

Spot speed data were collected for the "control" sites (without MAS) along I-95 between June 2005 and May 2007, during which time researchers conducted 48 speed studies at different times of the day and for various days of the week. The road contractor began to apply the MAS as a part of setting up the MOT each day starting in the second week of August 2005. The researchers began data collection for the "test" sites (with MAS) in August 2005 and concluded studies at these sites in May 2007. Once again, speed data for the "test" condition were collected at different times of the day and for various days of the week over this period, with a total of 63 speed studies conducted for "test" sites.

Similar speed data were collected for the "control" and "test" sites on I-10 between May 2007 and July 2007, during which time researchers conducted an additional 68 speed studies at different times of the day and for various days of the week. For both the I-95 and I-10 locations, speed studies were collected at three locations in each work zone (with and without MAS):

- As vehicles approach the work zone
- As vehicles are within the work zone
- As vehicles exit the work zone

The posted speed limits prior to the work zone were 70 miles per hour at all locations on both I-10 and I-95. The speed limits within the work zone and as vehicles exited the work zone were 60 miles per hour for both the traditional MOT and MAS study locations on I-10. For the I-95 locations, the speed limits within the work zone and as vehicles exit the work zone were 70 miles per hour for the traditional MOT studies and 55 or 60 miles per hour for the MAS studies.

The average numbers of vehicles observed per speed study are presented in Table 1 along with the number of speed studies conducted within each group (I-10, I-95: 2 lanes per direction, and I-95: 3 lanes per direction). Before determining the effectiveness of the Motorist Awareness System (MAS), the sample size data from Table 1 was combined with speed variance data to determine how small of a difference could be detected for each scenario using a standard two-group sample size equation.

In order to determine this "minimum detectable difference", the variability inherent in spot speed studies was accounted for by determining the error that is introduced both within the individual speed studies and between the independent studies in both the "test" and "control" groups. In the context of this evaluation, there are two sources of error that must be examined independently.

TABLE 1 Number of Vehicles Observed and Spot Speed Studies Conducted

Study Location	Average Number of Vehicles Observed with Respect to Work Zone Location			Number of Speed Studies Conducted with Respect to Work Zone Location		
	Prior	Within	End	Prior	Within	End
I-10	204	200	199	16	26	26
I-95 2 Lane	105	107	108	32	31	29
I-95 3 Lane	109	105	104	11	12	12

First, there is measurement error associated with the number of vehicles observed at each study location. To ensure that the sample speeds are representative of the true speeds at these locations, a minimum number of vehicles must be observed. As the number of vehicles in the sample increases, the variability of the vehicle speeds decreases and the confidence level of any subsequent statistical test increases. This measurement error is generally the only error source considered in the design of past speed studies.

However, in addition to specifying the minimum number of vehicles to be observed at any site, a minimum number of sites must also be selected to ensure that the sample is large enough to detect a significant difference in speeds between the test and control groups in this case. To determine the variability attributable to differences between study locations, the distribution of means for each speed study is examined.

Table 2 provides the standard deviation of the speed observations, both within and between sites, at each of the three locations (prior to the work zone, within the work zone, and near the end of the work zone). Separate summary data is provided for I-10, the 2-lane segments on I-95, and the 3-lane segments on I-95. The "within site" values represent the average of the standard deviations of the speed studies experienced at each site within the particular study group. These values quantify the variability due to the individual vehicles within each sample. The "between sites" values represent the standard deviations of the mean speeds between the individual speed studies in each group. These values quantify the variability due to differences between study locations.

To determine the "minimum detectable difference", appropriate confidence levels and statistical power must be selected and assumptions about the characteristics of the speed distribution must be made. The standard research convention is to assume a confidence level of 95 percent and a power of 80 percent. Since no prior knowledge existed as to the effectiveness of the Motorist Awareness System, a two-tailed statistical test was utilized. Given this information, the detectable difference was calculated using a sample size equation for a two sample test of means.

TABLE 2 Standard Deviation of Speed Observations

Study Location	**Location with Respect to Work Zone**	**Within Site Standard Deviation**	**Between Sites Standard Deviation**
I-10	Prior	5.04	0.71
	Within	5.10	2.38
	End	5.48	2.43
I-95 2-Lane	Prior	4.82	2.25
	Within	4.50	6.51
	End	4.47	5.07
I-95 3-Lane	Prior	4.50	0.71
	Within	5.10	5.40
	End	4.59	2.72

Based upon the number of vehicles observed (Table 1) and the standard deviation of the speed data within each group (Table 2), the "minimum detectable differences" at each location was calculated. Similarly, based upon the number of speed studies conducted (Table 1) and the standard deviation of the mean speeds between studies, "the minimum detectable difference" between sites was also determined. These values refer to the size of the difference in speeds that can be detected between the test and control groups with 95 percent confidence and 80 percent power. These results are presented in Table 3. As expected, the between site variability is substantially larger than the within site variability. In addition, variability was generally found to be lower prior to the work zone than at the two locations within the work zone area.

TABLE 3 Detectable Differences in Mean Speeds

Group	Detectable Difference Within Sites (mph)			Detectable Difference Between Sites (mph)		
	Prior	Within	End	Prior	Within	End
I-10	0.99 mph	1.01 mph	1.08 mph	1 mph	2 mph	2 mph
I-95 2 Lane	1.32 mph	1.22 mph	1.21 mph	2 mph	5 mph	4 mph
I-95 3 Lane	1.21 mph	1.39 mph	1.26 mph	1 mph	3 mph	3 mph

The evaluation sites along I-10 included three distinct scenarios: (1) Traditional Maintenance of Traffic without enforcement, (2) Motorist Awareness System without enforcement, and (3) Motorist Awareness System with enforcement. By examining these scenarios, a determination could be made as to the effectiveness of the MAS system and the additional impacts of police enforcement. Summary statistics for the speed studies conducted along I-10 are provided in Table 4. These statistics include the total number of studies at each location (prior to the work zone, within the work zone, near the end of the work zone) and under each MOT Scenario (either traditional MOT, MAS, or MAS with enforcement), as well as mean speeds, 85th percentile speeds, speed variance (average of the studies conducted under each scenario), and the proportion of vehicles traveling over the speed limit.

TABLE 4 Descriptive Statistics for I-10 Segments

Summary Statistics	Time Period and Location of Speed Data Collection by Traffic Control Scenario								
	Prior to Work Zone			Within Work Zone			End of Work Zone		
	MOT	MAS	MAS + POLICE	MOT	MAS	MAS + POLICE	MOT	MAS	MAS + POLICE
Number Speed of Studies	3	4	9	9	7	10	9	11	6
Mean Speed (mph)	70.06	70.38	69.54	58.31	56.82	54.73	60.86	60.83	56.87
Speed Variance (average)	29.21	23.99	28.77	29.30	20.33	28.24	31.00	26.54	36.22
85th Percentile Speed (mph)	74.60	74.50	73.89	62.56	60.40	59.08	65.33	65.00	61.73
Percentage of Motorists Driving over Speed Limit	48.0%	49.7%	44.9%	33.3%	19.6%	13.2%	55.3%	53.7%	27.8%

For all of the work zones on I-95, police enforcement was present for both the traditional Maintenance of Traffic and the Motorist Awareness System. This means the evaluation actually results in a comparison between Traditional MOT and MAS in the presence of police enforcement. The speed data collected along I-95 were divided based upon the number of lane reductions (from two lanes to one lane or from three lanes to two lanes) and Maintenance of Traffic Plan (Traditional or Motorist Awareness System). Summary statistics for the speed studies conducted along I-95 are shown in Table 5 and Table 6 for the two-lane and three-lane scenarios, respectively.

For all of the speed studies conducted as a part of this study, the observers collected speed data using a radar gun and the speed of each individual vehicle was recorded. While conducting these speed studies, data collectors were positioned covertly within the work zone so that there presence would go undetected by approaching motorists. Observers recorded the date and time of day for each observational period, the direction of travel, and other information that could affect the behavior of vehicles entering the work zone, such as a speeding driver being stopped by law enforcement.

TABLE 5 Descriptive Statistics for 2-Lane (each direction) Segments on I-95

Summary Statistics	Time Period and Location of Speed Data					
	Prior to Work Zone		Within Work Zone		End of Work Zone	
	MOT w/Police	MAS w/Police	MOT w/Police	MAS w/Police	MOT w/Police	MAS w/Police
Number of Speed of Studies	16	16	7	15	8	15
Mean Speed (mph)	70.55	73.44	50.1	46.1	54.4	53.41
Speed Variance (average)	20.53	20.12	27.14	16.63	29.12	20.18
85th Percentile Speed (mph)	74.5	77.03	54.43	49.32	58.97	57.13
Percentage of Motorists Driving over Speed Limit	48.95%	73.93%	0.25%	1.02%	20.46%	3.99%

TABLE 6 Descriptive Statistics for 3-Lane (each direction) Segments on I-95

Various Speed Statistics	Time Period and Location of Speed Data					
	Prior to Work Zone		Within Work Zone		End of Work Zone	
	MOT w/Police	MAS w/Police	MOT w/Police	MAS w/Police	MOT w/Police	MAS w/Police
Number of Speed of Studies	5	6	6	6	6	6
Mean Speed (mph)	74.33	69.86	56.09	51.63	57.15	53.71
Speed Variance (average)	16.22	25.99	23.43	29.16	18.51	22.46
85th Percentile Speed (mph)	77.2	73.77	60.3	55.83	60.17	57.67
Percentage of Motorists Driving over Speed Limit	83.95%	44.56%	1.59%	8.18%	0.63%	10.18%

STATISTICAL ANALYSIS

Following the completion of the speed studies and a review of the data for outlying data points, a statistical evaluation was conducted on both the I-10 and I-95 data sets as outlined in the following section to determine the effects of the MAS, as well as the effects of enforcement.

Tests for Speed Variance

Large disparities in speed variance have been shown to be strongly associated with increased crash potential at a given roadway location (*10*). Speed variance is a particular problem in work zones as drivers are generally confronted with additional distractions which potentially heighten their crash risks further. The differences in the speed variances resulting from the maintenance of traffic plans were compared using the F-test (*11*) to determine whether the MAS had an impact on speed variance in comparison to the standard MOT plan. Separate comparisons were conducted at the locations prior to, within, and near the end of the work zones.

For the I-10 sites, the variance of the speed data within the work zone for the Motorist Awareness System group was consistently less than that of the Motorist Awareness System with

Police and the Traditional MOT groups. This result held prior to, within, and at the end of the work zones. At the locations prior to and within the work zones, the speed variance for the sites where the MAS was implemented with Police was not significantly different than the sites where the traditional MOT plan was implemented. At the end of the work zones, there was greater variability in the MAS with Police group, presumably due to the fact that these speed study locations were downstream from the police enforcement locations.

For the I-95 test sites where two lanes were reduced to one lane in each direction, there was no significant difference in the variances prior to the work zone between the MOT and MAS groups, both of which had enforcement vehicles present at the beginning of the lane closure. Within the work zones and at the end of the work zones, the MAS significantly reduced the speed variance across locations.

For the I-95 sites where three lanes were reduced to two lanes in each direction, the opposite was true as variance was greater in the presence of the MAS in comparison to traditional MOT. This may have been a function of the volume and interaction of traffic at these three lane sites in comparison to the two lane sites.

Tests for Differences in the Mean and 85th Percentile Speeds

In order to test the effectiveness of the Motorist Awareness System (MAS) in reducing vehicular speeds, Analysis of Variance (ANOVA) and t-tests were utilized to determine if differences in the mean and 85th percentile speeds existed between the traditional Maintenance of Traffic (MOT) and MAS (*10*).

The I-10 evaluation consisted of comparisons among three distinctly different scenarios: (1) Traditional Maintenance of Traffic versus Motorist Awareness System without enforcement, (2) Traditional Maintenance of Traffic versus Motorist Awareness System with enforcement, and (3) Motorist Awareness System without enforcement versus Motorist Awareness System with enforcement. To compare these scenarios, an Analysis of Variance (ANOVA) was first conducted to determine whether significant differences existed between any of the three groups. Where significant differences were detected, the Tukey Honest Significant Difference (HSD) procedure was utilized to conduct pair wise comparisons to determine if significant differences existed between each of the groups.

The analysis revealed that motorist speed prior to the work zone was quite consistent, regardless of the MOT plan or the presence of enforcement. This finding was as expected since these studies were conducted at locations prior to any notice of the upcoming work activity. However, once vehicles entered the work zone, the Motorist Awareness System was found to lower speeds the average speed by 1.49 mph and the 85th percentile speed by 2.16 mph in comparison to the traditional MOT plan. These results were consistent for each of the speed studies conducted along I-10. Combining the MAS with increased enforcement was found to reduce the average and 85th percentile speeds by 3.58 mph and 3.48 mph, respectively, in comparison to the traditional MOT.

For the I-95 locations where three-to-two lane drops occurred, average speeds at the end of the work zone were found to be significantly lower for the segments where the MAS was utilized as shown in Table 6. For the two-to-one lane drop scenario, speeds at the end of the work zone were not significantly different between the two groups. Under both scenarios, the use of MAS decreased average speeds in the work zone as compared to traditional MOT. For the I-95 segments, the Motorist Awareness System (MAS) reduced speeds within the work zone by 4 to 5 miles per hour. The speed reduction in the two-lane case within the work zone is of special interest because the speed prior to the work zone was found to be nearly 3 miles per hour higher under the MAS condition. Consequently, the 4 mile per hour reduction experienced within the work zone is likely a conservative estimate of the true effect of the MAS.

The 85th percentile speeds were also examined at each location and under each scenario. As with the mean speeds, the 85th percentile speeds decreased within the work zone when the Motorists Awareness System was utilized for both the three-lane and two-lane scenarios. The evaluation of both the mean and 85th percentile speeds consistently showed the MAS to outperform the traditional MOT when each was combined with targeted speed enforcement.

Z-Test for Differences in Proportions of Speed Limit Violation

The Z-test was used to compare the proportion of vehicles traveling over the posted speed limit in the "test" conditions with those speeding in the "control" conditions (*10*). Three proportions were compared for each scenario: (1) vehicles traveling over the speed limit, (2) vehicles traveling more than 5 mph above the speed limit, and (3) vehicles traveling more than 10 mph above the speed limit. Table 7 present the percentage of drivers exceeding the speed limit for each traffic control scenario on I-10. All differences in proportions were statistically significant at a 95 percent confidence level except for the comparison between the percentage of drivers exceeding the speed limit by 10 mph under Traditional MOT and MAS with Police.

TABLE 7 Percentage of Drivers Exceeding the Speed Limit on I-10

		Percentage of Speeding Vehicles		
Scenario	**Location**	**Traditional MOT**	**MAS w/o Police**	**MAS w/Police**
Above Speed Limit	Prior	47.9%	49.7%	44.9%
	Within	33.3%	19.6%	13.2%
	End	55.3%	53.7%	27.8%
5 mph Above	Prior	15.5%	14.9%	11.7%
	Within	9.7%	2.5%	1.4%
	End	19.2%	18.3%	7.3%
10 mph Above	Prior	1.3%	1.3%	1.5%
	Within	1.7%	0.1%	0.2%
	End	2.9%	3.1%	0.7%

These results reveal that the Motorist Awareness System significantly reduced the proportion of speeding drivers within the work zone. This is an important finding as speeding within work zones increases the potential for severe injuries and fatalities resulting from collisions with roadside equipment or other vehicles. For each of the scenarios (over the limit, 5 miles over, and 10 miles over), the MAS, whether combined with law enforcement or not, was found to consistently decrease the proportion of speeding drivers within the work zones. For example, the proportion of drivers traveling over the speed limit was reduced from 33.3 percent to 19.6 percent under the MAS at the work zone locations on I-10. Combining MAS with enforcement further decreased this percentage to 13.2 percent.

CONCLUSIONS

This study evaluated a field experiment conducted in Florida along I-10 in Baker County and I-95 in Flagler County where a Motorists Awareness System (MAS) was compared to the traditional maintenance of traffic plan (MOT). The MAS has many similarities to the traditional MOT plan, as well as several addition elements, which include a portable changeable message sign (PCMS), a portable regulatory sign (PRS), a radar speed display unit (RSDU), and a speed law enforcement official (SLEO) who patrols the active work area. Regardless of whether the targeted speed enforcement was utilized, the results show the MAS to consistently outperform the traditional MOT. Further, combining the MAS with speed enforcement appears to provide additional benefits as evidenced by the speed studies conducted along I-95 which compared this alternative to traditional MOT combined with enforcement.

The MAS provided reductions in mean speeds, 85th percentile speeds, speed variance, and the proportion of speeding vehicles. These reductions were most pronounced within the work zone area, though impacts were also evident upstream of the work zone and as drivers exited the work area. Specific improvements realized by the MAS are summarized here:

- Both the mean and 85th percentile speeds were consistently lower at the locations within the work zones where the MAS was utilized in comparison to the standard MOT. The implementation of the MAS along I-10 reduced average speeds by 1.5 to 2.2 miles per hour in comparison to standard MOT. Combining MAS with enforcement resulted in additional reduction in mean speeds by 3 to 4 miles per hour in comparison to standard MOT.
- The combination of the MAS with enforcement was also shown to decrease speeds in comparison to the standard MOT with enforcement along I-95. In general, speeds within the work zone were reduced by an average of 4 to 5 miles per hour.
- The speed variance within the work zone was decreased when MAS was utilized in comparison to standard MOT along I-10. The same result was found along the 2-lane (per direction) segments of I-95, though the converse was true along the 3-lane segments, which may have been due to larger traffic volumes and more interaction between vehicles at these locations.
- The proportions of drivers speeding within and near the end of the work zones were also substantially reduced when the MAS was utilized in comparison to the standard MOT under all scenarios. Further, combining MAS with enforcement produced more pronounced reductions both within and near the end of the work zone.

Overall, the Motorist Awareness System (MAS) was found to be effective at reducing vehicular speeds through construction work zones. Based on these findings, the use of MAS at construction work zones provides a practical countermeasure to reduce vehicular speeds through the work zone, thereby improving safety for both the motorist and the construction worker.

DISCLAIMER

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Florida Department of Transportation.

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