Investigation Of Highway Workzone Crashes- Summary Report

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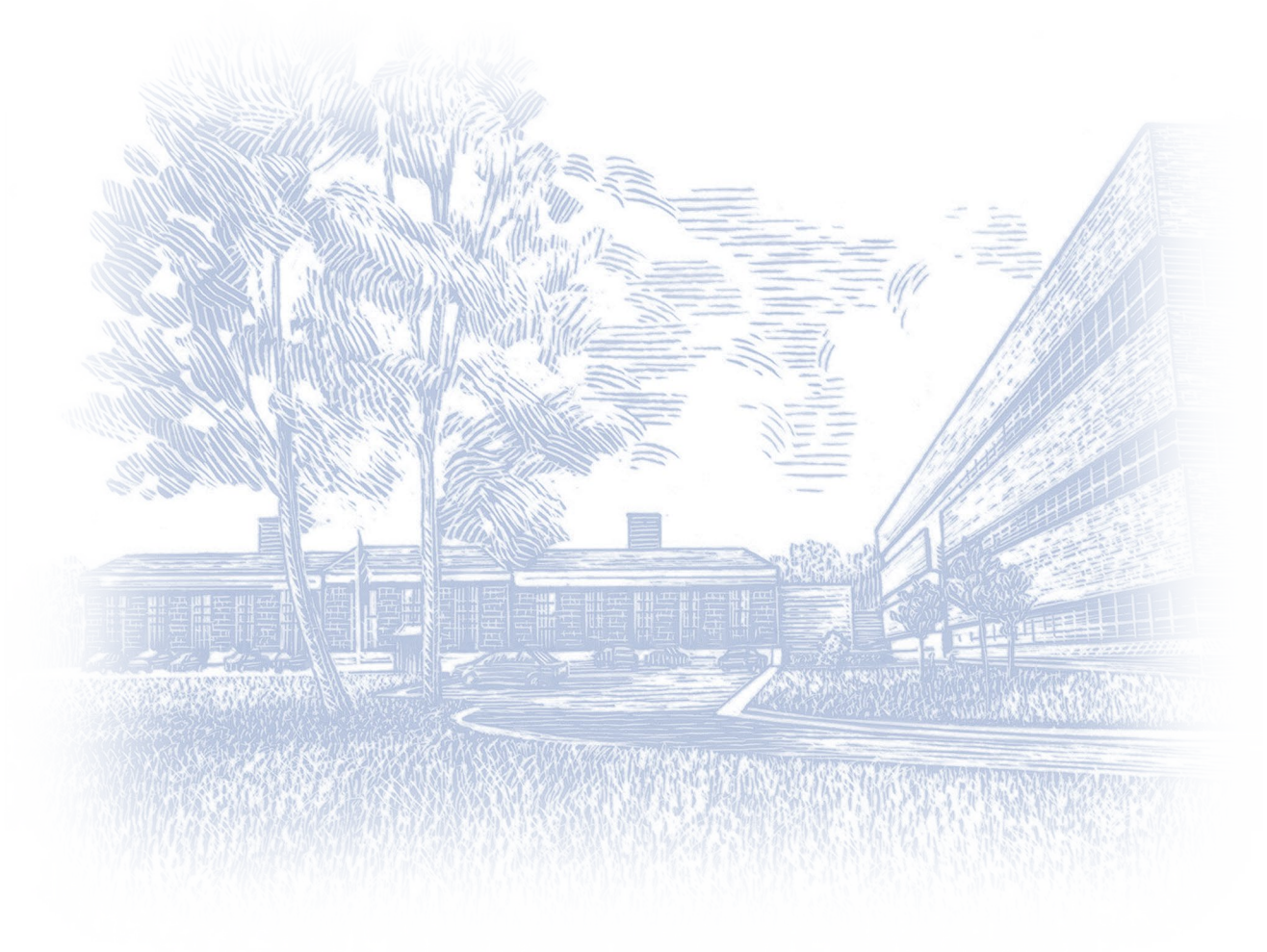

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Foreword

Work zone safety continues to be a high–priority issue for traffic engineering professionals and highway agencies. Based on the Fatal Accident Reporting System (FARS), work zone fatalities climbed to an all–time high in 1994 when 833 people were killed (figure 1).

This figure represents an approximately 29–percent increase over 1992 when work zone deaths reached a 10–year low.

The emphasis on work zone safety and on improving the identification of work zone problems has been increased by recent legislation. The Intermodal Surface Transportation Efficiency Act (ISTEA) specifically required the Secretary of Transportation to develop and implement a work zone safety program that will improve work zone safety at construction sites and to develop uniform accident reporting for fatalities, injuries, and certain specified accident types, which include work zone accidents. Recommendations in a 1992 report by the National Transportation Safety Board (NTSB) included the following: (1) the reporting of work zone fatalities should be revised to distinguish between persons driving highway maintenance vehicles within work zones and other drivers who crash in work zones while traversing the work zone site; (2) in conjunction with the Federal Highway Administration (FHWA), all State accident report forms should be reviewed and the data elements that comprehensively document work zone accidents should be identified, and States should be encouraged to incorporate these data elements into their accident report forms.

In 1994, the FHWA issued a notice and request for comments on a National Highway Work Zone Safety Program. The program consists of four components: standardization, compliance, evaluation, and innovation. Under the evaluation component, the notice indicated that the FHWA, in cooperation with the National Highway Traffic Safety Administration (NHTSA), will develop guidelines for the collection and reporting of data on deaths and injuries occurring in highway work zones and that the FHWA will assist State highway agencies in evaluating their programs for collecting and analyzing work zone accident and incident data. A recent national conference on work zone safety also called for efforts to make data collection in work zones easier and more detailed. As is evident from the above, there is a critical need for improved data related to work zone safety. These data–related issues must be examined and addressed in order to better understand the nature of work zone crashes. Unfortunately, except for fatal accident statistics in work zones, no national data bases currently exist that can provide details for all (non–fatal) work zone crashes. Indeed, many State crash data bases do not show whether a crash site involved a work zone. The study objectives of this investigation were to: attempt to more clearly quantify the magnitude of highway work zone crashes using the Highway Safety Information System (HSIS); investigate characteristics of highway work zone crashes; investigate how work zone crashes are reported on police accident report forms and how reporting procedures affect the crash numbers that have been reported; identify critical voids in the knowledge of the relative safety of work zones; and examine possible ways to address currently unfulfilled information needs related to work zone safety.

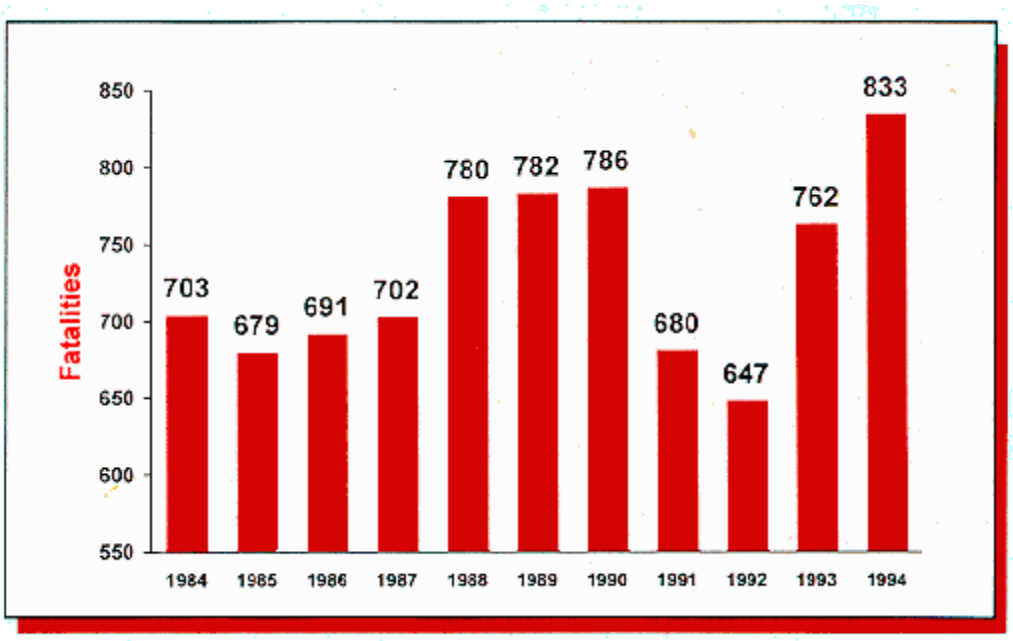

Figure 1. Fatalities in work zones in the United States.

State Data Bases Used

The HSIS was used in a preliminary investigation of the work zone safety problem. Considerable inconsistencies were found in the reporting and coding of work zone accidents among five HSIS States for which data were available during the course of this study. Only two States now use an explicit variable (i.e., a data element on the form that requires officers to indicate work zone) for a work zone accident. In other States, work zone accidents must be identified using other variables, such as Special Tag, Road Deficiency, or Road Defect. Based on the reliability and specificity of existing variables related to work zone accidents, subsequent analyses were performed using data from three States: State A, State B, and State C.

Analysis Methods

The magnitude and characteristics of work zone accidents were examined using accident data files from 1991 and 1992 for the three HSIS States. The variables and codes used for identifying work zone accidents for the three States are shown in table 1. The magnitude of work zone–related accidents is expressed as a percentage of all reported accidents. The characteristics of work zone crashes were examined by comparing accident distributions between work zone–related crashes and non–work zone crashes for various accident–related variables, including accident severity, type of accident, roadway type, type of work zone, lighting condition, roadway surface, weather, intersection relationship, and fixed object, among others. Finally, in an attempt to identify unresolved issues, a thorough literature review regarding past and recent studies on various aspects of work zone safety was also conducted.

Table 1. Identification of work zone accidents from HSIS.

State	Variable	Related Code
A	Road construction *(Explicit variable)*	Construction Maintenance area Utility work area
B	***After 1991***	
	Road work *(Explicit variable)*	Marked construction zone Marked maintenance zone Marked utility work zone Unmarked construction zone Unmarked maintenance area Unmarked utility work zone
C	***Before 1991***	
	Fixed object	Construction barricades/equipment *(24 codes)*
	Traffic control	Officer, flagman *(21 codes)*
	Cause	Road construction *(20 codes)*
	Road deficiency	Repair work, barricaded Repair work, not barricaded *(9 codes)*

Results

Magnitude of the Work Zone Accident Problem. Table 2 presents the analysis results for the magnitude of work zone accidents. As indicated, work zone accidents represent approximately 2 percent of the total police–reported accidents for States A and C, and 3 percent for State B. These percentages compare favorably with results from earlier studies reviewed. It is believed, however, that the number of actual work zone accidents is probably greater than the reported number for three primary reasons: First, many minor accidents occurring at a work zone site may not result in a police accident report. Second, work zone crashes that occur near work activity (e.g., a rear–end collision at the end of a work zone queue) may not be reported as work zone accidents. Third, as d scussed below, the accident reporting/coding process may not pick up work zone accidents if the report form does not have explicit data elements for the work zone condition.

Table 2. Magnitude of work zone accidents from HSIS (1991–1992).

State	Work Zone Accidents	Total Accidents	Work Zone/Total (%)
A	1,541	68,702	2.24
B	5,132	171,140	3.00
C	5,386	280,714	1.92

Characteristics of Work Zone Accidents. In terms of accident severlty, data from States B and C revealed that work zone accidents are slightly less severe than non–work zone accidents. Based on χ^2 tests of proportion distributions, it was determined that the differences in injury severity between work zone accidents and non–work zone accidents were statistically significant at the 0.05 significance level. Data from State A revealed just the opposite, but the differences were not statistically significant and, therefore, may have been due to chance.

With respect to accident types, data from all three States indicate that the percentage of work zone accidents involving a rear–end collision was significantly higher than that of non–work zone accidents. This may suggest that speed differential among vehicles traveling through work zones may be a primary contributor to work zone accidents. It was also found from all three States' distributions that the percentage of sideswipe collisions in work zones is higher than the percentage of sideswipe collisions in non–work zones. Many work zones typically include shoulder/lane closures, which increase the chance of lane–change maneuvers. This may account for the difference in the percentage of sideswipe accidents.

Work Zone Accident Reporting Practices. Because of the initial problems of completeness and accuracy found in the data of the HSIS States, the issue of work zone accident reporting was examined by conducting an investigation of work zone accident reporting practices for all 50 States and the District of Columbia. This was done using the 1992 State Accident Reporr Form Catalog published by NHTSA. Figure 2 presents a graphic chart that gives percentage distributions for different types of data elements appearing on the State accident report forms. It was found that 35 States (68 percent of all investigated States) have some type of data element indicating construction/work zone on their police accident report forms. Of these 35 States, 14 (27 percent of all States) have an explicit data element on the form (i.e., a data "box" dedicated to only work zone information), while the remainder (41 percent of all States) identify work zone accidents from other data elements. In addition, eight States (16 percent of all States) provide some classification of work zone type. This investigation also revealed that 22 percent of all States allow for identification that a construction vehicle was involved in a work zone accident. Forty–one percent of all States allow for identification that a construction worker was involved in a work zone accident.

The effect of having an explicit data element to identify work zone crashes was examined through an analysis of State B accident files comparing explicit and non–explicit work zone reporting/coding procedures. State B had changed from a non–explicit to an explicit element in 1990. A comparison of the 1988–1989 data with the 1991–1992 data showed that:

- 871 work zone accidents (0.55 percent of all reported accidents) occurred in 1988 and 1989, based on identifying work zone crashes from non–explicit variables.
- 5,132 work zone accidents (3.00 percent of all reported accidents) occurred in 1991 and 1992 that were identified by means of an explicit variable for work zones.

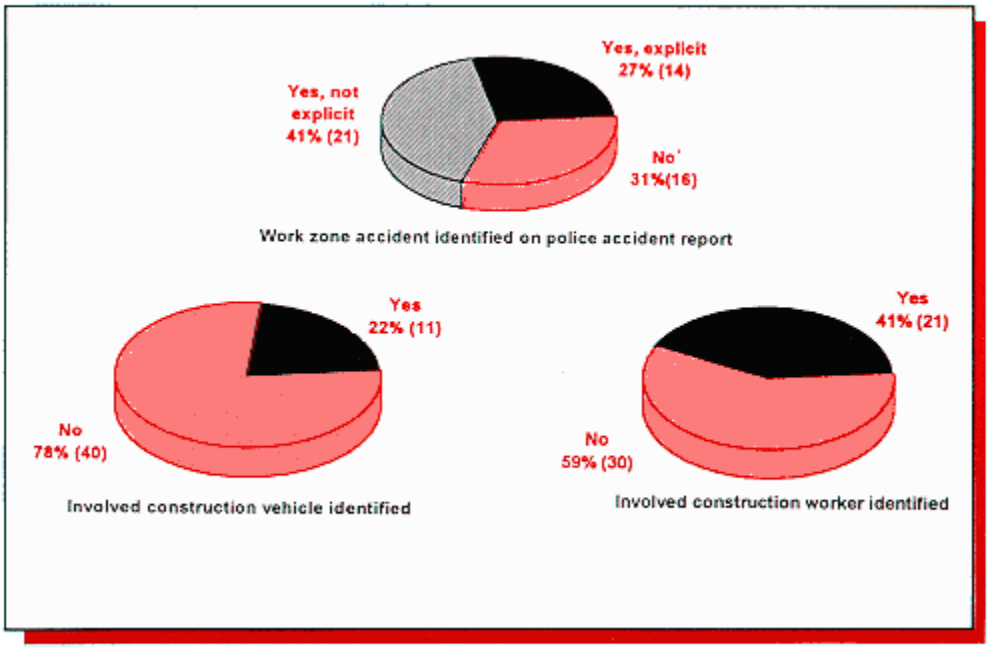

Figure 2. Distribution of State accident reporting practices related to work zones.

As can be seen, the proportion of work zone accidents drawn from non–explicit (1988–1989) accident files was considerably lower than that of 1991–1992 accident data that applied an explicit work zone variable in the accident reporting procedure. It is unlikely that this level of increase can be explained by an increase in work zone activity and traffic exposure.

However, the use of an explicit variable on the form will not solve the entire accident data problem. An unpublished study conducted by the Michigan Department of Transportation (DOT) in 1986 investigated the reliability of their construction zone code in the Michigan accident files.(2) The investigation found that about 85 percent of police–coded work zone accidents (with an explicit variable) occurred in work zones. However, based on limited investigation of four selected work zones, as many as 77 percent of crashes that did occur within the four zones were not coded as work zone accidents. One likely explanation for this is that a police officer may interpret the work zone accident variable to only apply when construction activity was present or had an influence on the accident. These results support the need for better work zone definitions and suggest that even an "explicit" data element may not ensure that all work zone crashes are identified.

Study Implications

The issue of how police officers interpret the data elements on the form related to work zones raises a larger question: what criteria should be used to define work zone accidents? Should the criteria include only those accidents that occur within the specific limits of work area during the time that work is being performed? Or should it include all accidents that occur within the work zone while the signs are present and not necessarily while work is ongoing at the time of the accident? Should the definition also include accidents that occur upstream of the first construction zone warning sign but are attributable to queuing that has been created by the work area? An explicit data element regarding work zones on police accident report forms and clear definitions of work zone–related data elements are necessary if estimates of the magnitude of the work zone accident problem are to be improved. Questions still remain regarding the safety of work zones. It is believed that major obstacles to answering these questions are: (1) the lack of quality data related to the characteristics and conditions existing at the time of the accident, and (2) the lack of reliable work zone inventories. Past studies about work zone safety were mostly based on very

limited data. Very few studies attempted to explicitly consider exposure to work zone activities or to develop work zone accident rates that account for differences in exposure. A key need is to determine an appropriate exposure measure to calculate the work zone crash rate.

Study Recommendations

Based on the results of this study, the following recommendations were developed: (1) uniform definitions of "work zone type" and "work zone crash" should be developed and implemented; (an example of data elements for collecting work–zone accident information is shown in figure 3), (2) methods for determining exposure in work zones should be developed; (3) issues related to work zone crashes should be considered during the development of new accident reporting technologies and "smart" data collecting/reporting software; and (4) a "special study" of work zone safety should be conducted in cooperation with selected States to develop a more detailed understanding of the relationships between work zone designs and crashes.

Did the crash occur in or near a construction, maintenance, or utility work area?
____ Yes ____No If yes, please continue

1. Work activity at time of the crash? ____ Ongoing ____ Not apparent

2. Was the work area marked with warning signs, cones, etc.? ____ Yes ____ No

If yes, where did the crash occur?
____ Before work area (after the first warning sign and before lane shift/closure)
____ In work area approach taper (where lane closed or shifted)
____ Adjacent to actual work area

3. Type of work area?
____ Lane closure (reduction in number of lanes)
____ Lane shift/crossover (no reduction in number of lanes)
____ Work on shoulder or median
____ Intermittent/moving work (e.g., pothole patching, lane marking)

Other (specify):

4. Did the work area have an influence on or contribute to the crash? ____ Yes ____ No

Figure 3. Example of data elements for work zone accident in an accident report form.

References

1. American Traffic Safety Services Association, Inc. (ATSSA). "Work Zone Fatalities Climb to All–Time High," *Signal*, Fredericksburg, VA, September 1995.

2. M.P. Fenner, E.E. McAdams, and D.J. Mercer, *Assessment of Michigan State Trunkline Construction Zone Accident Data*, Report No. TSD 563–86, Michigan Department of Transportation, June 1986.