



INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

TRB Subject Code: 51-8 Work Zone Safety
Publication No.: FHWA/IN/JTRP-2002/34, SPR-2496

June 2003
Final Report

Construction Work Zone Safety

Introduction

The segment of road where construction activities takes place is commonly defined as a work zone. Work zones on interstates are most of the times unexpected by the traveling public, increasing the likelihood of accidents occurrences. The natural aging of the highway infrastructure has led to an increase in the number of work zones on interstates. As evidenced in recent years, the attention has been shifted to perform less new construction and instead conduct more rehabilitation and/or reconstruction of existing highway facilities. Therefore, the work is being performed with high exposure to traffic. Maintaining safety of both the traveling public and construction workers performing the work are difficult tasks faced by transportation officials.

Several statistics revealed alarming number of fatalities and accidents during periods of construction work on highways. The statistics have been increasing throughout years, unveiling even

more the need for measures to improve safety during periods of work. Several states including Indiana have had the misfortune of experiencing fatalities and accidents during construction work on interstates. During the period of April to May of 2001, a bridge rehabilitation project on I-65 in Lafayette was the site of several fatalities and accidents.

The need of maintaining safety of motorists and workers during periods of construction activities on interstates has prompted the Indiana Department of Transportation (INDOT) to initiate a study aiming to improve the safety in work zones on rural interstates. The two main objectives of the project consisted in 1) determining if active warning devices or improved signing have an impact in work zone safety and 2) to determining if it is appropriate to consider temporary roads and bridges during construction activity on interstates in an effort to maintain two lanes open at all times.

Findings

An extensive evaluation was conducted to investigate the features of several traffic management technologies currently available. The systems analyzed have been designed to inform the traveling public of the changing conditions during periods of construction work on interstates. These technologies have been proven effective as dissemination tools for informing motorists of the conditions that lie ahead. However, these systems have not been found to be associated with an improvement of safety on interstate work zones. The spacing between sensors and the limitation in communications influences the information that is being displayed to motorists. The benefits of these systems can sometimes be outweighed by

their costs, if such systems are not deployed appropriately.

The number of accidents and fatalities is expected to increase during periods of work zones. However, the increase in these numbers was not quantified in the past. Data from sixteen (16) interstate projects in the state of Indiana was analyzed in an effort to quantify the increment of these occurrences during periods of work. Data was analyzed for the period of construction and the same period one year prior to the construction period when there was no construction in the particular section of the highway. Based on the findings, the accident rate was found to increase by twenty seven and one

half percent (27.5%). The high consistency of the regression value (0.995) obtained, showed high confidence on the results obtained.

To inform drivers well in advance of the work zone of the construction activities taking place, a pilot project was initiated in the I-65/US-30 interchange reconstruction project near Merrillville, IN. The deployment of experimental signs consisted of fixed panel signs and Variable Message Signs (VMS) prior to entering the work zone. The panel signs used included a combination of signs presently used by INDOT. The VMS displayed the number of traffic citations issued to date in the work zone. The installation of the panel signs had a significant reduction in the average speeds only at the US-30 interchange. The results also indicated that displaying the number of tickets issued to date did not have a significant impact on the average speeds of motorists throughout the study area. Although a significant reduction in the average speed was observed at the US-30 interchange (heart of work zone), this speed reduction was associated with the installation of the fixed panel signs, rather than with the installation of the Variable Message Signs displaying the number of tickets.

An enforcement study was also conducted in the I-65/US-30 project to evaluate the effectiveness of Indiana State Police (ISP) patrols in advance

and though the work zone. Results of the evaluation showed a reduction in the speeds of vehicles traveling the work zone when enforcement was present. The study indicated that a significant speed reduction (greater than 5 mph) occurred on I-65 adjacent to the trooper. This significant speed reduction remained in effect 1.2 miles downstream of the trooper, but was not present 2.4 miles downstream of the trooper.

A travel time study was conducted with the use of a GPS device has been presented. This study showed the benefits of utilizing such systems to document and reference conditions throughout the life of the work zone. The benefits of using GPS systems include the possibility of linking a type of lane restriction to its impact on traffic flow and to use this knowledge in future construction seasons.

An economic model was developed to determine the feasibility of maintaining two lanes open at all times during work zones. This model was developed in terms of the costs of shoulder strengthening, temporary bridges, accidents and fatalities. This model provides INDOT with a preliminary tool for deciding if two lanes open should be maintained in a particular project. The model was validated by using one project located on I-65 near the Tippecanoe/White county border in the state of Indiana.

Implementation

Improving safety of both motorists and construction workers has led departments of transportation to implement several alternatives in an effort to minimize the occurrences of accidents and fatalities during periods of work on interstates. Changes in traveling conditions typically associated with work zones increase the likelihood of accident occurrences. It is therefore important to inform the traveling public well in advance of the work zone of the changing conditions that lie ahead.

The Indiana Department of Transportation has initiated this study in an effort to find mechanisms to improve the safety on rural interstate work zones in the state of Indiana. The most important findings of this evaluation:

- The benefits associated with deploying traffic management technologies were found to be outweighed by their costs.

- Accident rates on rural interstates can be expected to increase approximately thirty percent during periods of construction.
- Fixed panel signs result in isolated speed reduction in the work zone. This may be of some safety benefit to the construction workers in the immediate construction area.
- Neither the fixed signs nor the variable message signs advising motorists of the enforcing activity appeared to have an impact on upstream speeds. Since high speed rear end collisions are the most significant motorist safety problem, it is not clear these signs will reduce fatal accidents resulting from approaching

the workzone traffic queue at prevalent speeds.

- Enforcement activity was found to significantly reduce speeds (greater than 5 mph) at the location adjacent to the trooper. However, the effect of the trooper diminishes as the motorists increase their distance from the trooper.
- GPS systems provide the capability of linking a type of lane restriction to its

impact on traffic flow and use this knowledge in future construction seasons.

- The decision to maintain two operational lanes per direction in a particular project can be evaluated using the economic model provided in the report.

Contacts

For more information:

Prof. Darcy M. Bullock
Principal Investigator
School of Civil Engineering
Purdue University
West Lafayette IN 47907
Phone: (765) 494-2226
Fax: (765) 496-1105

Prof. Dulcy M. Abraham
Principal Investigator
School of Civil Engineering
Purdue University
West Lafayette IN 47907
Phone: (765) 494-2239
Fax: (765) 494-0644

Indiana Department of Transportation
Division of Research
1205 Montgomery Street
P.O. Box 2279
West Lafayette, IN 47906
Phone: (765) 463-1521
Fax: (765) 497-1665

Purdue University
Joint Transportation Research Program
School of Civil Engineering
West Lafayette, IN 47907-1284
Phone: (765) 494-9310
Fax: (765) 496-1105