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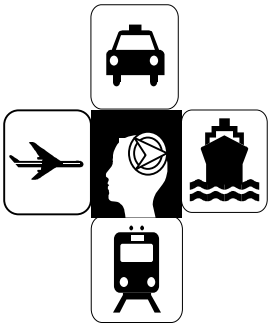

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Project 2003-27: Identification of Traffic Control Devices for Mobile and Short Duration Work Operations

FHWA-NJ-2006-006 July 2006

SUMMARY

This report documents and summarizes the study "Identification of Traffic Control Devices for Mobile and Short Duration Work Operations," for the New Jersey Department of Transportation. The study was conducted in three tasks: 1. Literature Search, 2. Evaluation Criteria and Analysis, and 3. Identify Guidelines to Eliminate Driver Inattentiveness, and Design Alternative Strategies and Techniques for Traffic Control. The study was conducted by two groups: the Region 2, University Transportation Research Center, City College of New York and the Institute for Transportation Research and Education, North Carolina State University. Working papers were completed for each of those tasks.

The objective of this research project is to study mobile and short duration work zone safety with particular attention to the identification of work zone safety devices, information systems for the reduction of safety and congestion, and implementation of innovative techniques to reduce delays and crashes due to work zones. The specific objectives are to:

- Identify state-of-the art work zone safety technologies to improve worker safety in mobile work zone and short term maintenance operations,
- Identify information systems for work zone traffic control to reduce delays and crashes,
- Identify "best practices" for the use of law enforcement to improve work zone safety,
- Identify key issues to be considered from public outreach and information systems.

The identified work zone safety items will provide improvements for maximum protection of the motoring public, protection of exposed workers in the work zone and of workers in the set up of the work zone, and will meet the current standards established by internal policies of the NJDOT.

Research Approach

The research approach includes a literature search to identify the potential technologies and information systems for mobile and short duration work operations. Potential technologies and information systems were identified from the Transportation Research Board and National Cooperative Highway Research Program reports, international sources, Strategic Highway Research Program reports, other State DOT correspondence, and manufacturers and vendors. The identified technologies and information systems were researched to obtain users and technical information on their effectiveness.

For this study, mobile and short duration work zones are defined as work operations that move along the pavement or shoulder intermittently or continuously, with frequent stops or one fixed area where the work operations require a short time to complete. In all of these situations, extensive protection systems would not be practicable for the completion of the work or traffic disruption.

The Manual on Uniform Traffic Control Devices provides uniform standards for safety protection of workers and traffic control during work operations. The manual suggests signs, light boards, arrow panels, and truck mounted attenuators in a caravan of vehicles to provide state-of-the art protection for exposed works, warn and alert motorists, and provide traffic control around the work area.

Work Zone Safety Technologies

TRB, NCHRP and State DOT Sources

This literature search focused on safety technologies for mobile and short duration work zone safety technologies from Transportation Research Board and National Cooperative Research Program publications, FHWA, State DOT and other agency publications which include web sites of most national safety organizations. The search identified nine devices which are used by State agencies or have the potential for use in mobile and short duration work zones. The devices are:

- Fluorescent/Bright Signs
- Reflectorized/Bright Suits and Vests
- Drone Radar and Speed Indicator/Displays
- Remotely Operated Autoflagger
- Truck Mounted Attenuators and Message Boards
- CB Wizard Alert System
- Rumble Strips
- Intrusion Alarm
- Lane Merger System

The TRB and NCHRP literature indicates that State DOTs use the MUTCD and caravan approach to mobile and short duration work zone safety situations. Texas DOT noted operational problems that included the improper use of arrowboards, the lack of uniform procedures for freeway entry and exit, large spacing between caravan vehicles, and unnecessary lane blockage by the caravan. The recommended solutions to the

problems are improved communications, effective advance signing, controlled caravan length, caravan positioning procedures observed during certain operation:, and modifications to procedures observed in others. Missouri DOT tested three traffic control devices: white lane drop arrows, orange rumble strips, and the CB wizard alert system-were tested for their effectiveness in improving merging and reducing speed and speed variance at an interstate highway work zone. All three devices appear to be effective for improving safety in work zones.

The States DOTS of Kansas, Nebraska, Iowa, and Missouri conducted a pooled-fund study of innovative devices designed to improve the safety and efficiency with which highway maintenance is conducted. In the state of Kansas, a total of nine devices were evaluated, including lighted raised pavement markers, CB-radio warning systems, and radar-triggered speed displays. All of the products showed potential for improving work zone safety and operations.

An NCHRP study focused on human response to warning lights which varied by the type of light both in closed field and operational tests. It was found during research that no one light is maximally effective in both transmitting information and gaining attention. Therefore several of the lighting recommendations combine the two types of light in order to ensure optimum information transmission and conspicuity. Some of the devices like shadow vehicles were found to be very effective in producing desired results but involved substantial costs as well.

The Caltrans Worker Safety program includes construction and maintenance worker safety orientation and instruction, the use of protective vehicles – shadow vehicles, barrier vehicles and advance warning vehicles for all work zones and a District Driver Training Program to eliminate employee preventable vehicle accidents.

The New York Sate Department of Transportation(5, 7) has initiated Highway Work Zone Safety Awareness bulletins, partnered with the New York State Police and identified specific features for improved mobile and short duration work zones. The agency identified six intrusion countermeasures: increased police enforcement, reduced channelization spacing, enhanced flagger stations, rumble strips, reduced speed limits, dynamic message signs, and drone radar.

Strategic Highway Research Program

The Strategic Highway Research Program (SHRP) was initiated to improve the safety of workers, improve efficiency of work operations and improve traffic control. The primary emphasize of SHRP was work zone safety concepts and research of applicable devices.

Of the ten initial devices researched, tested, and developed by SHRP, the Flashing Stop/Slow Paddles is the only device with a potential for short duration and mobile work zone traffic control, and therefore worker safety. The NJDOT has approved this device for use by maintenance forces. However, the device is clumsy, heavy and requires frequent battery changes. An initial evaluation indicates that the device is somewhat

effective for traffic control and worker safety.

Recently, SHRP researched five devices that have the potential for increased work efficiency, and improved worker safety by eliminating direct worker exposure to traffic and mitigating errand vehicles. The five devices which are discussed the report are:

- Cone Shooter
- Automated Pavement Crack Sealers
- Automated Debris Removal Vehicle
- Balsi Beam
- Robotic Highway Safety Markers.

All of the above five devices appear to have some practical application. However, the Balsi Beam has the greatest potential for protecting exposed workers in short duration work operations. The beam provides a positive protection from errand vehicles and is crash worthy as tested by NCHRP criteria. Unlike portable concrete median barrier which is time consuming and labor/equipment intensive to set up, and requires a 42 inch clear zone between the barrier and the worker, the Balsi Beam can be set up in less than 10 minutes and requires no clear zone between the beam and workers. The California Department of Transportation is presently implementing the barrier for specialized concrete construction and bridge repair operations on high speed interstate highways. The beam can be used in maintenance operations wherever workers are exposed to traffic in a limited area for several hours. No workers have been killed or injured while working behind the beam.

California Balsi Beam and Presentation

The researchers met with California Department of Transportation engineers to observe the operation of the Balsi Beam and talk to Caltrans maintenance workers. The Caltrans is implementing the second generation prototype beam with a bridge and concrete repair crew on Route I-80 between Marysville and Reno, NV.

Caltrans uses the beam for medina barrier repairs, bridge deck patching and repairs, slab replacement and joint repairs, installation of bridge sealers and guiderail and parapet repairs. The beam is used in conjunction with other safety equipment - - TMAs, trucks, signs and safety set up . The bridge maintenance crew and foreman were very enthusiastic about using the beam. The crew is able to use air compressors, bobcats and other equipment in the work area of the beam. Suggestions have been made to incorporate some of the equipment on the beam-tractor to make the beam a multi-functional piece of equipment.

Essentially, Caltrans, Division of Equipment, designed the beam with some assistance from TTI and funding from the FHWA. Caltrans fabricates and builds their own trucks and large equipment for maintenance, so they have extensive equipment design and fabricating experience. Caltrans and the FHWA would like to implement the beam in the east coast DOTs. At this time, Caltrans does not have the resources to demonstrate the beam throughout the country, and would like other State DOTs to be involved in implementation. The researchers believe this is an opportunity for NJDOT to

improve worker safety, be a showcase and assist the FHWA for the implementation of the beam in the eastern states.

The researchers presented the information on the Balsi Beam and a PowerPoint presentation to Region South and Region North Maintenance workers and engineers. Both regions were interested in the potential for the beam to protect workers. However, Region North has the best application for the beam on bridge and concrete repair projects along Route I-80 in Northern New Jersey.

Law Enforcement
In the report, “The Use of Uniformed Police Officers”, the FHWA recommends the presence of uniformed police officers on Federal-aid highway work zones. It further recommends the use of automated enforcement and intrusions alarms as well as uniformed police officers to improve traffic safety at highway work zones. Our literatures search indicates that most State DOT s have programs and policy regarding the use of uniformed police officers at highway work zones.

Motorist Information, Education and Outreach Systems
Motorist Information, Education and Outreach Systems are important tools for State DOTs. Most DOTs and the FHWA have specific programs to inform the public and train workers.

Review of Work Operations
The researchers conducted five field observations of mobile and short duration work operations to analysis and compare current maintenance work zone operations with the MUTCD and other agencies, as well as interviews with work zone safety personnel. The safety for mobile operations of pothole patching, sweeping, spraying and mobile patching was in accordance with MUTCD requirements. Workers requested improved devices such as strobe lights and improved reflective materials for signs to get driver’s attention.

Conclusions
The objective of the research project was to study mobile and short duration work zone safety. The objective was achieved successfully by suggesting existing and new measures, techniques and devices to better catch the driver’s attention, improve traffic control within work zones, and recommendations to reduce delays and crashes due to work zones.

Devices and technologies were identified from information from TRB, NCHRP and other State DOT resources sources. These devices and technologies are being used or tested by State DOTs, and have the potential to improve the safety of exposed workers and the motoring public. The Safe Lites company produces “Bright Zone Signs and Beacon Wear Safety Vests” with a patented “GlowSkin” technology. This technology will improve worker visibility and safety in short duration work operations.

Five new SHRP products for the improved safety of workers and the motoring public

were identified for potential implementation by the NJDOT. These devices and vehicles remove or enclose exposed workers in the work area by placing them in vehicles or behind fixed barriers. The Balsi Beam as developed and implemented by the California Department of Transportation and the FHWA, has the potential to improve safety of workers in short duration work operation in New Jersey.

The FHWA recommends the presence of uniform police officers in highway work zones. Many State DOTs have programs to train and coordinate police efforts for highway work zones. Motorist Information, Education and Outreach Systems are important tools for State DOTs. Most DOTs and the FHWA have specific programs to inform the public and train workers.

Based on the literature search and field inspections of mobile and short duration work zones, interviews with NJDOT personnel and the literature search of the cause of work zone accidents, the following conclusions and recommendations are presented:
Most NJDOT work zone crashes are caused by careless driving, speeding and motorist inattention cause accidents, which are similar causes to crashes in work zones from the literature and other agencies. The most significant cause is motorist inattention to the work zone system and traffic conditions.
NJDOT mobile and short duration work zones meet the safety standards for design and application specifications for traffic control during highway maintenance by Manual on Uniform Traffic Control Devices (MUTCD).
Safety devices should be selected to reduce traffic speed through work zones, improve motorists' recognition of work zone hazards, and improve motorists' attention to signs and the work zone.
Any new safety devices for mobile and short duration work zones should be implemented in conjunction with worker safety training, and public safety and education programs.

Recommendations
The NJDOT should fabricate and implement the Balsi Beam with the assistance of Caltrans and the FHWA on selected short duration work zones.

The NJDOT should implement "Bright Zone Signs" to improve work safety and visibility in work zones.

The researchers propose to develop a work plan to prepare a licensing agreement with Caltrans, prepare plans and specifications for bidding, investigate bidding and fabrication schemes such as fabrication at a facility in California, inspection and engineering expertise during fabrication, delivery of the beam, operation training and implementation studies with NJDOT engineers.

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A final report is available online at http://www.state.nj.us/transportation/refdata/research/

If you would like a copy of the full report, please FAX the NJDOT, Burea of Research, Technology Transfer Group at (609) 530-3722 or send an e-mail to Research.Bureau @dot.state.nj.us and ask for:
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