

# Avoiding Equipment Related Injuries in Work Zones

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## Abstract

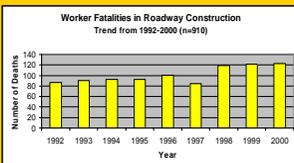
NIOSH developed a project to evaluate interventions to protect workers from being struck by construction vehicles and equipment operating inside the work space of roadway construction projects. The selected interventions were promising, but their efficacy for preventing fatalities and injuries associated with construction vehicles and equipment was unproven. The project involved the demonstration and evaluation of two injury prevention strategies—a work practice modification known as internal traffic control plans (ITCP), and commercially available proximity warning systems (PWS).



*In the U.S. highway construction industry an average of 22 fatalities occur each year from collisions between construction equipment and a worker. Half of all the backing fatalities involve a dump truck.*

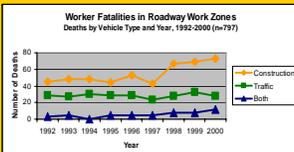
## Background

Between 1992 and 2000, the Census of Fatal Occupational Injuries (CFOI) reported 910 occupational fatalities in roadway work zones. The majority of these fatalities (828) involved vehicles and/or equipment. In 550 of these fatalities (66%), a worker-on-foot (WOF) was struck by either a construction vehicle (258), a traffic vehicle (250) or both (42). In 130 of the 258 WOF fatalities involving construction vehicles and equipment, the piece of equipment was backing; most were dump trucks.

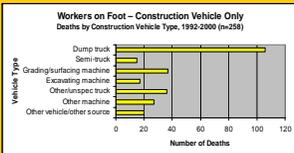


## General Methods

In order to evaluate the effectiveness of injury prevention measures NIOSH researchers needed to adapt the prevention measures to road construction, characterize the injury hazard, develop methods to measure worker risk, implement the prevention measure at asphalt paving sites, and compare worker risk from sites with and without the prevention measure.



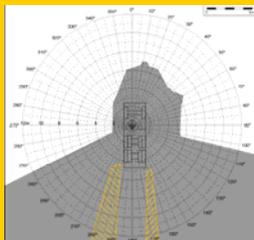
Data collection activities for control, PWS, and ITCP occurred over 7 days each, during daytime paving activities, on sites separated from active traffic, at 7 companies. There were three methods of data collection employed: direct observation, video observation, and GPS. The data collected during field evaluations is currently being evaluated, consequently results presented are preliminary.



This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data (excluding New York City). The views expressed here do not necessarily reflect the views of the BLS.

## Characterizing the Injury Hazard

The hazard of being struck by equipment on a construction site has several risk factors. They include equipment visibility or blind area, operating speeds, turning radius, travel direction, and worker proximity. The amount of time a WOF spent within an equipment operator's blind area was used as the metric for measuring workers' exposure to being struck by that equipment. Based upon the blind area diagrams and risk factors, researchers developed a tool to measure risk and tallied when WOF entered specified areas around a piece of construction equipment.



*The blind area diagram above shows the area around a dump truck, the area in grey the ground cannot be seen by the operator. A website that contains blind area diagrams for 38 pieces of construction equipment can be found at: <http://www.cdc.gov/niosh/topics/highway/workzones/BAD/default.html>*



*NIOSH had to characterize the risk of being struck by a piece of equipment. The tool above was used to measure this risk. The diagram depicts a truck in grey; the areas around the truck in green show low risk; red shows high risk.*

## Proximity Warning Systems

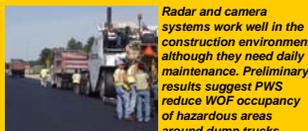
NIOSH evaluated three types of proximity warning systems on dump trucks: sonar, radar, and camera. PWS are used to alert the driver that there is a person or object in the detection area of the system. Sonar and radar systems are active systems in that they have a sensor that detects when a person or object enters the detection area. The camera system is passive requiring the driver to watch the monitor to know someone or something has entered the blind area of the truck.



*NIOSH mounted sonar, radar or camera proximity warning systems on dump trucks. PWS are intended to reduce worker occupancy in hazardous areas around dump trucks. More information on PWS technologies can be found at: <http://www.cdc.gov/niosh/mining/pubs/pdfs/2007-146.pdf>*

## PWS Discussion

The sonar works in flush mount applications, although it is not designed to be mounted on dump trucks. In our tests, the system consistently detected the overhanging truck bed. The radar works when mounted on dump trucks, although daily maintenance must occur to prevent asphalt build-up on the system. The camera also works well in the construction environment, however daily maintenance must occur to readjust the camera and clean the camera lens from asphalt residue and dust.



*Radar and camera systems work well in the construction environment although they need daily maintenance. Preliminary results suggest PWS reduce WOF occupancy of hazardous areas around dump trucks.*

## Internal Traffic Control Plans

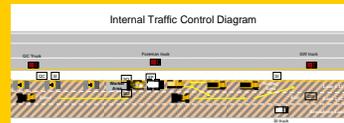
ITCPs are site-specific work practices designed to reduce WOF exposure to being struck by construction vehicles and equipment. These plans regulate the movement of workers and construction vehicles and equipment within the work space. ITCPs are intended to reduce the amount of equipment backing, designate vehicle travel lanes, reduce the amount of equipment on site, and develop "worker free zones".



*ITCPs control the movement of vehicles and equipment inside the work zone. Well constructed ITCPs are intended to limit exposure of WOF to vehicles and equipment.*

## ITCP Discussion

ITCPs were implemented for this project by training the company foreman, safety representative, trucking boss, and head state inspector. Effective implementation required proper training and commitment of everyone on site including the company, other contractors, state personnel, and other workers on site. ITCPs are developed before paving begins and are modified as situations change throughout the paving process.



*Above is an example of an ITCP diagram created during company training. The project foreman develops the ITCP based upon the projected construction activities. Preliminary results suggest an effective ITCP must be conveyed to everyone on site.*

## Results

NIOSH is in the process of analyzing data collected during field activities. Preliminary results suggest that PWS and ITCPs may reduce worker occupancy of hazardous areas around dump trucks.

## Useful Resources

NIOSH Protecting Workers in Construction - Preventing Injuries Related to Motor Vehicles and Equipment  
<http://www.cdc.gov/niosh/programs/const/insights/insightscostruction.pdf>

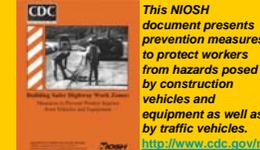


*As part of the Roadway Work Zone Safety and Health Alliance, NIOSH helped create an ITCP development booklet for contractors. More information can be found at: [http://www.workzonesafty.org/files/documents/fraining\\_hwa\\_wr\\_arrantitcp.pdf](http://www.workzonesafty.org/files/documents/fraining_hwa_wr_arrantitcp.pdf)*

Highway Work Zones Topic Page  
<http://www.cdc.gov/niosh/topics/highwayworkzones/>

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*This NIOSH document presents prevention measures to protect workers from hazards posed by construction vehicles and equipment as well as by traffic vehicles. <http://www.cdc.gov/niosh/2001128.html>*

\*The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.\*