

FACE Report Number 2007-02

September 10, 2007

Revised on June 3, 2014

## ***Laborer Dies When Backed Over by a Tack Truck in Residential Roadway Construction Work Zone – North Carolina***

### **SUMMARY**

On October 20, 2006, a 28-year-old laborer (the victim) was killed when he was backed over by a tack<sup>a</sup> truck while working as a flagger on an asphalt resurfacing job in a residential roadway work zone. The victim was standing with his back to the reversing tack truck when a dump truck driver attempted to warn him by waving his arms. The tack truck struck the victim; the driver thought he had passed over a manhole cover and continued backing. Seeing the dump truck driver running and waving his arms in his mirror, the tack truck driver stopped. At the front of the tack truck both drivers found the victim lying face down on a manhole cover on the ground. A laborer ran and notified a flagger who then called 911.

Approximately 4 minutes later, Emergency Medical Services (EMS) and the police arrived on the scene. EMS determined that the victim was not breathing and pronounced him dead on the scene. A coroner arrived on the scene and at approximately 2:21 p.m., the victim was transported to the morgue.

NIOSH investigators concluded that, to help prevent similar occurrences, employers should:

- *Ensure that backing procedures are in place for mobile construction vehicles, a spotter is designated to direct backing, and drivers are in communication with workers on foot*
- *Provide workers with safety training for the duties they are assigned to perform, and develop/implement specific training on equipment blind areas for roadway construction workers*

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<sup>a</sup> A glue used to bond the old and new asphalt together.

### **Fatality Assessment and Control Evaluation (FACE) Program**

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatality Assessment and Control Evaluation (FACE) investigations when notified by participating states (Maryland, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia); by the Wage and Hour Division, Department of Labor; or when a request for technical assistance is received from NIOSH-funded state-level FACE programs in California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon and Washington. The goal of FACE is to prevent fatal work injuries by studying the work environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact. FACE investigators evaluate information from multiple sources that may include interviews of employers, workers and other investigators; examination and measurement of the fatality site, and related equipment; and review of records such as OSHA, police, medical examiner reports, and employer safety procedures and training records. The FACE program does not seek to determine fault or place blame on companies or individual workers. Findings are summarized in narrative reports that include recommendations for preventing similar events in the future. For further information visit the FACE website [www.cdc.gov/niosh/face](http://www.cdc.gov/niosh/face) or call toll free 1-800-232-4636.

- *Develop, implement and enforce procedures that minimize exposure of workers on foot to moving construction vehicles and equipment*
- *Consider installing after market devices (i.e., camera, radar, and sonar) on construction vehicles and equipment to help monitor the presence of workers on foot in blind areas*

Additionally,

- *Manufacturers of heavy construction equipment, such as tack trucks, should explore the possibility of incorporating new monitoring technology (e.g., tag-based warning systems that use radio frequency (RFID) or magnetic field generators on equipment to detect electronic tags worn by workers) to help monitor the presence of workers on foot in blind areas*

## INTRODUCTION

On October 20, 2006, a 28-year-old laborer (the victim) was killed when he was backed over by a tack truck while working as a flagger on a residential roadway work zone. On November 1, 2006, officials of the North Carolina Occupational Safety and Health Administration (NCOSHA) notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), of the incident. On February 6, 2007, a DSR safety and occupational health specialist conducted an investigation of the incident and reviewed the incident circumstances with the NCOSHA investigating safety compliance officer assigned to the case. Photographs of the incident site and witness statements taken by NCOSHA shortly after the incident were reviewed. The city police report, coroner's report and the death certificate were reviewed. On February 6, 2007, the employer's full-time safety director and co-workers were interviewed and the tack truck was viewed.

**Employer:** The victim's employer provides construction services from site preparation to final building completion and had been in business for approximately 57 years. The company employs 1,300 full-time workers in the state of North Carolina. This was the company's fifth workplace fatality within the last 10 years. Three of the fatalities occurred due to the backing of mobile construction vehicles and equipment in roadway work zones.

**Victim:** The 28-year-old male victim had been working full-time for the company as a laborer for approximately 2 months. The victim had previously worked for a moving company.

While working for the employer, the victim was primarily assigned to work on the maintenance crew. Maintenance crew duties consisted of replacing curbs, gutters, sidewalks, patching asphalt, raising and lowering water valves and manhole covers. When the paving crews were short handed, the victim was used on an as needed basis as a flagger. Flagging duties consisted of directing, stopping, and slowing public traffic entering and exiting roadway work zones. The victim had worked as a flagger on several occasions for the employer. The victim was wearing a Class II<sup>b</sup> orange vest and work boots.

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<sup>b</sup> A high visibility safety garment. The American National Standards Institute (ANSI) and the International Safety Equipment Association (ISEA) recommends a Class II garment for workers who require greater visibility under inclement weather conditions, when backgrounds are complex or when tasks divert attention from approaching vehicle traffic moving in excess of 25 miles per hour.

**Written Safety Program and Training:** The company had a written safety program. New employees attended a one-hour safety and health orientation and received a ninety-three page employee handbook which covered a multitude of safety topics such as, the company's safety policy, fall protection, electrical safety, worker clothing and personal protective equipment, such as vests and foot protection. The handbook was given to all new employees and the employer considered it the employee's responsibility to read and understand it. Specialty training (i.e., trenching, forklift, and flagging) was conducted on an as needed basis by the safety manager. Tool box talks were conducted by the supervisor on the job site, primarily to warn of potential worksite hazards. The employer required employees designated as flaggers to attend formal flagging training, which consisted of 4-hours of instruction using a handbook, video and a written test. The course for flagging included working around work zone hazards, flagging procedures, responsibilities and coordination in the roadway work zone. The victim, for unknown reasons, had not attended the required flagging course. According to the safety manager, the victim had received informal instruction on flagging by his foreman when he worked on a previous roadway work zone.

The driver of the tack truck maintained a current commercial driver's license (CDL) and had worked for the employer for 5 years. He operated a tack truck for 1.5 years. At the time of hire, drivers are provided a 4-hour driver training class which consists of classroom instruction and hands-on operation. The employer requires driver training be updated on a yearly basis. According to the safety manager, the driver of the tack truck received the required refresher training.

**Incident Scene:** The employer was contracted to resurface the asphalt on several residential city streets located in neighborhoods consisting of single family dwellings. The work on the day of the incident consisted of resurfacing several connecting parallel city streets. The only traffic in the work zone was from residents living within the immediate area. The employer's safety director estimated that there were approximately 1 or 2 cars an hour traveling through the roadway work zone on the day of the incident.

The street where the incident occurred was approximately 33 feet wide and 1,072 feet long (Photo 1). The employer's job process for the asphalt resurfacing required the application of a Cationic Rapid Set Asphalt Emulsion (CR-1) commonly referred to as tack which is used to bond the old and new asphalt together. As part of the work process, workers elevated manhole covers in the roadway areas that needed to be resurfaced. Road work signage was set up according to the specifications in the written work contract with the city. The day of the incident was the victim's second day at this location.

**Equipment:** The tack truck in this incident was a 1998, F-700 Series and had a gross vehicle weight rating (GVWR) of 50,000 pounds (Photo2). The truck was equipped with a 2,000 gallon tank, which had a spray assembly with 30 nozzles attached to distribute the tack solution. The truck had approximately 1,500 gallons of tack solution inside the tank at the time of the incident. Mounted on each door of the truck were large mirrors approximately 7 inches wide and 16 inches high. Additionally, a round spot (convex) mirror was mounted on the large mirror on the passenger side.

The truck was approximately 24 feet long and the rear tailgate was approximately 8 inches above the ground. The spray assembly was in the activated (down) position at the time of the incident, making the width at the rear of the truck approximately 10 feet wide. The employer required that the truck be inspected daily by using an equipment checklist that the driver completed and documented prior to each shift (e.g., brakes, horn, lights, wipers, reverse alarm and safety equipment). The documented checklist was completed by the driver on the morning of the incident. The investigating NIOSHA compliance officer determined that the truck was equipped with a working audible reverse alarm that could be heard from a distance of approximately 30 feet away.

**Weather:** It was sunny at the time of incident and the temperature was in the 80's.

## INVESTIGATION

On October 20, 2006, at approximately 7:00 a.m., a work crew consisting of an asphalt supervisor, 4 operators, 2 skilled operators, 4 skilled laborers, 3 laborers (including the victim), 5 flaggers, and 4 drivers were working on resurfacing activities in a residential roadway work zone. The workers assisted with prepping two streets, one where the incident occurred and another parallel street. Resurfacing activities were delayed due to the streets being wet from a previous rain. The asphalt supervisor told the victim that he would be flagging for the paving crew. While waiting for the streets to dry, the victim assisted with street cleaning activities and raising manhole covers. At approximately 11:00 a.m., the asphalt resurfacing was ready to start and the victim was designated to flag public traffic on "A" street. Approximately one hour later, the victim moved to flag public traffic at the intersection of "B" and "A" streets (Diagram).

At approximately 1:00 p.m., the asphalt supervisor left the jobsite to attend a meeting and, prior to leaving, assigned a flagger and an operator to oversee the resurfacing operations. The driver of the tack truck drove west on "B" street while applying tack to the roadway surface. Following the application, the driver parked the tack truck on "B" street and walked up (west) "B" street where he met up with the victim. A laborer came over from "A" street to converse. Several minutes later, the operator who was overseeing operations made a radio call to the laborer who was conversing with the victim. He instructed the laborer to tell the driver of the tack truck to spray an additional 2-foot-wide strip of tack on the entire length of "B" street. The laborer relayed the instructions to the tack truck driver. The tack driver warned the victim and the laborer to move out of the way because he was going to back the tack truck (west) down "B" street. The total distance of the reverse travel would have been approximately 1,072 feet. The laborer returned to "A" street where the rest of the paving crew were working.

A dump truck driver drove (east) down "B" street, then parked and got out to wait until he was needed. He saw the victim standing approximately 200 feet in front of him at the intersection with his back to the tack truck. The dump truck driver noticed the tack truck moving in reverse, heard the audible reverse alarm, and realized the victim was standing in the direct path of the tack truck. The dump truck driver began waving his arms in an effort to get the victim's attention.

After backing approximately 427 feet, the tack truck struck the victim. Thinking he had run over a manhole cover, the driver continued driving in reverse for approximately 25 feet. The city police report estimated that the tack truck was traveling in reverse at approximately 5 miles per hour at the time of impact.

While waving his arms, the dump truck driver ran towards the tack truck. Seeing the dump truck driver in his mirror, the driver of the tack truck stopped and got out of his truck. Together they found the victim lying in front of the truck facedown on the ground on a manhole cover. A laborer walking over from the other street ran back to "A" Street and informed a flagger of the incident. At approximately 1:46 p.m. the flagger called 911 on his mobile phone.

At approximately 1:50 p.m., Emergency Medical Services (EMS) and the city police arrived on the scene. After assessing the victim, EMS found that he was not breathing and pronounced him dead at 1:50 p.m. At approximately 2:00 p.m., the coroner was notified and the victim was transported to the county morgue at approximately 2:21 p.m.

### CAUSE OF DEATH

The coroner's report stated that the cause of death was blunt force injuries to the head and chest due to being run over by a motor vehicle.

### RECOMMENDATIONS / DISCUSSION

***Recommendation #1: Employers should ensure that backing procedures are in place for mobile construction vehicles, a spotter is designated to direct backing, and drivers are in communication with workers on foot.***

Discussion: Backing procedures for trucks and construction equipment should be developed and implemented for each roadway construction job. In this case, there were only two established backing protocols and no requirement for using designated backing spotters. The employer's employee handbook states that prior to backing on the work site, a driver is to get out of their vehicle and determine whether or not it is safe to back their vehicle. Additionally, the handbook advises a vehicle driver to always check their mirrors before backing. Backing protocols should include, but not be limited to, an assigned backing spotter, and policies that backing will not begin without an understandable signal from the spotter that it is safe to start backing.<sup>1</sup> In addition, all operators of construction vehicles and equipment must come to a complete stop if contact with a spotter is lost, and backing should not resume until contact is re-established. All equipment operators and truck drivers, upon entering the roadway work zone, should be aware of who the spotters are and the established backing protocol. To assist with making themselves visible to the operators, all workers on foot (e.g., spotters, flaggers) should be required to wear a high visibility safety garment.<sup>1</sup>

Employers must ensure adequate communication among all workers on the construction roadway work zone site. Communication of any changes to scheduled tasks is critical, especially between mobile vehicle and equipment operators and workers on foot. This can be accomplished by personal one-on-one communication, hand signaling, or with two-way radios. In this incident, none of the flaggers were provided with mobile radios, therefore they could not easily communicate with each other or with their co-workers. When communication was necessary, they had to leave their designated work area and find the required person.

***Recommendation #2: Provide workers with safety training for the duties they are assigned to perform, and develop/implement specific training on equipment blind areas for roadway construction workers.***

Discussion: OSHA regulations require employers to train workers to recognize and avoid unsafe conditions that may be present in their work environments, and to provide training on the regulations applicable to their work.<sup>2</sup> Training should be an essential part of a roadway construction company's safety program and should address, at a minimum, all known and anticipated hazards. To ensure the utility of the safety training, an employer might consider ways to ensure that the worker comprehends the important information (e.g., written testing, verbal questions, or role playing).

Roadway construction workers, flaggers, mobile vehicle and equipment operators should be made aware that blind areas exist around construction vehicles and they should receive specific training in the identification of these blind areas. A blind area (or blind spot) is the area around a vehicle or piece of construction equipment that is not visible to the operator, either by direct line-of-sight or indirectly by the use of internal and external mirrors. Training is important for both construction vehicle operators and workers on foot in proximity to mobile vehicles and equipment. As part of a research project evaluating different strategies to prevent worker injuries in construction work zones, NIOSH contracted with Caterpillar to provide blind area diagrams for 38 different vehicles or machines used in roadway construction.<sup>3,4</sup> These diagrams may be useful in worker training.

***Recommendation #3: Employers should develop, implement and enforce procedures that minimize exposure of workers on foot to moving construction vehicles and equipment.***

Discussion: According to a December 2004 article in the Bureau of Labor Statistics' Monthly Labor Review, of the 844 fatal workplace injuries on road construction sites identified by the Census of Fatal Occupational Injuries (CFOI) from 1995 to 2002, about 60 percent were the result of a worker being struck by a vehicle or some kind of mobile equipment. Two-hundred and seventy-four workers were struck by trucks (including 100 dump trucks), 172 were struck by automobiles or other vehicles, and 63 workers were struck by machinery.<sup>5</sup> It is critical that employers develop procedures to minimize exposure of workers on foot to moving vehicles and equipment in the tight confines of roadway construction work zones. Construction vehicle and equipment operators, and workers on foot, need to be made aware of the potential for exposure to construction vehicles and steps to minimize hazards for workers on foot.

Internal traffic control plans (ITCP) are a promising tool for protecting workers on foot from moving vehicles and equipment.<sup>6</sup> ITCPs are site-specific plans that coordinate the flow of construction vehicles, equipment, and workers on foot. ITCPs identify directions and pathways for moving vehicles and equipment, and should be developed by employers to minimize the backing of vehicles and equipment, to the extent possible. ITCPs may also include designated walkways for workers on foot that are clear of operating construction vehicles and equipment, and should be developed to minimize the backing distance of vehicles and equipment and to designate areas of a work zone that are prohibited for workers on foot. For small recurrent operations such as filling potholes, routine maintenance, and mowing work zones, a checklist could be used in place of a complete ITCP.<sup>1,6</sup> An ITCP used in combination with communication and a site specific backing protocol could reduce the

likelihood of workers on foot being struck by backing vehicles. Roadway construction supervisors need to continually evaluate and ensure that the work is in compliance with the prescribed procedures for the work.

Additional information and recommendations for protecting roadway construction workers can be obtained from the NIOSH document entitled “Building Safer Roadway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment,”<sup>1</sup> and the Roadway Work Zone Safety and Health Coalition Alliance document entitled “Internal Traffic Control Plans.”<sup>6</sup>

***Recommendation #4: Employers should consider installing after market devices (i.e., camera, radar, and sonar) on construction vehicles and equipment to help monitor the presence of workers on foot in blind areas.***

Discussion: Rear-view cameras and sensors based on radar, sonar, and infrared technology are available to help monitor equipment blind spots.<sup>7,8</sup> Although improvements may be needed to make this technology more durable in the rough physical environment of a construction site, this equipment shows promise as a tool for worker safety. A camera mounted on the rear of the equipment provides a view of the obstructed area on a video monitor in the cab. Sensor systems provide an alarm in the cab when a person or other obstacle is detected at the rear of the equipment. A combination of a camera and a sensor system may offer the best protection, especially in congested work areas.

***Recommendation #5: Manufacturers of heavy construction equipment, such as tack trucks, should explore the possibility of incorporating new monitoring technology (e.g., tag-based warning systems that use radio frequency (RFID) or magnetic field generators on equipment to detect electronic tags worn by workers) to help monitor the presence of workers on foot in blind areas.***

Discussion: In this incident, the police reported that the driver stated he did not see the victim behind the truck. Emerging technology, such as sensor-based systems, rear-view cameras, and tag-based warning systems that use radio frequency (RFID) or magnetic field generators on equipment to detect electronic tags worn by workers are becoming available for construction equipment, though testing and demonstration at construction projects are still needed.<sup>1,7,8</sup> Collisions between construction vehicles, equipment and workers have been attributed, in part, to limited visibility around the equipment. As new or existing monitoring technologies are proven to be effective on work sites, equipment manufacturers should offer these systems on new equipment.

#### **Additional Information.**

The NIOSH Safety and Health Topic Page on Highway Work Zones is available at:  
<http://www.cdc.gov/niosh/topics/highwayworkzones>

## REFERENCES

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## INVESTIGATOR INFORMATION

This investigation was conducted by Nancy T. Romano, Safety and Occupational Health Specialist, Fatality Investigations Team, Surveillance and Field Investigations Branch, Division of Safety Research.

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Photo 1. Photo of incident scene. Photograph courtesy of NCOSHA.



Photo 2. Photo of the Tack Truck. Photograph courtesy of NCOSHA.

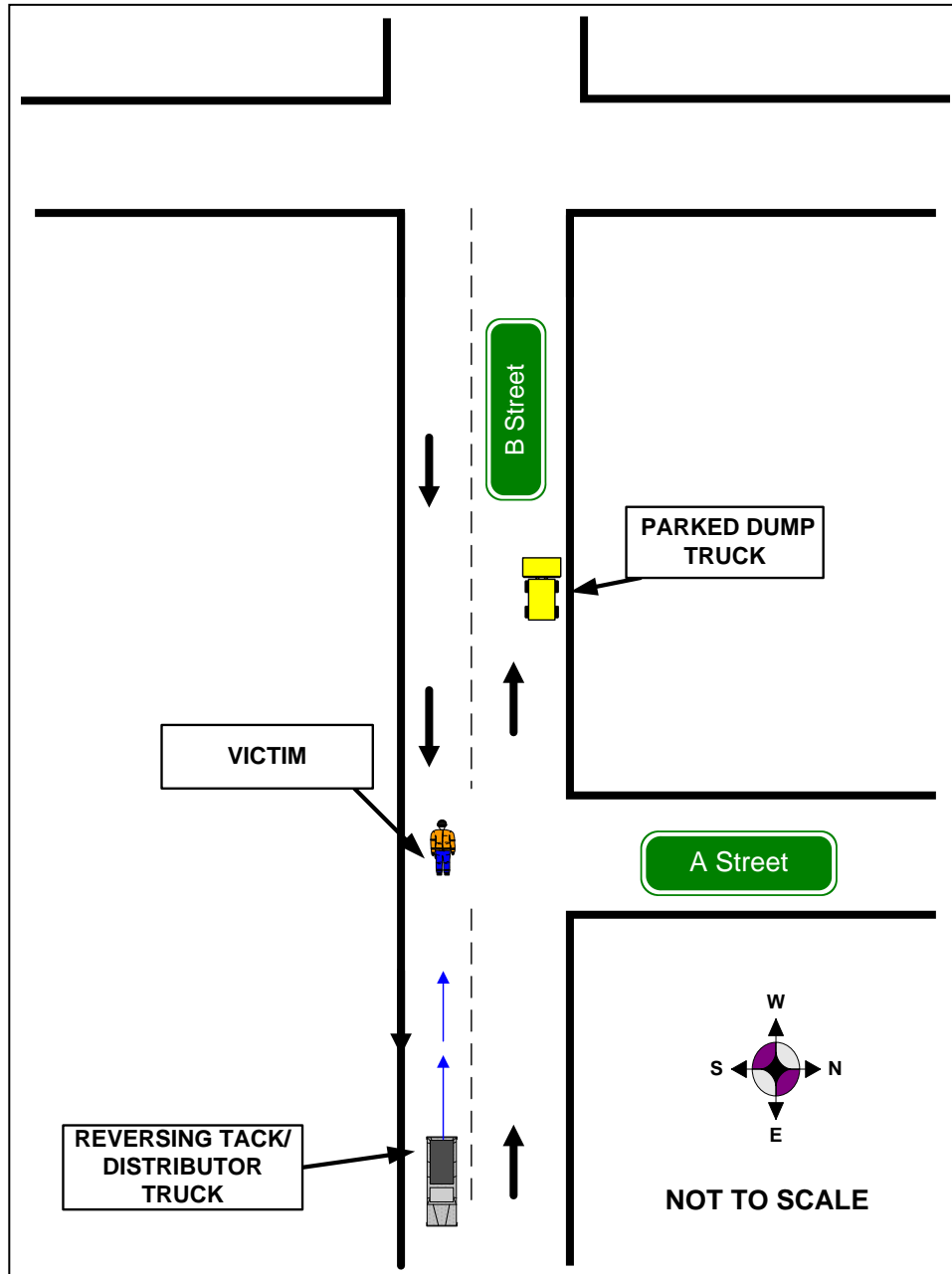


Diagram. Aerial view of incident scene