



Massachusetts FACE • Occupational Fatality Report

Massachusetts Department of Public Health
Occupational Health Surveillance Program
Fatality Assessment and Control Evaluation Project



Laborer Dies After Being Backed Over by Dump Truck at a Nighttime Highway Work Zone Construction Site - Massachusetts

Investigation: # 08-MA-028-01

Release Date: February 25, 2011

SUMMARY

On June 3, 2008, a 31-year-old male construction laborer (the victim) was fatally injured when he was struck by a backing dump truck. The victim was on foot walking away from the dump truck, towards oncoming traffic, while painting a guideline for the operator of an asphalt milling machine to follow. The dump truck operator started to back the dump truck, striking the victim with the right rear double wheels. The dump truck operator realized that he had struck something, placed the truck in drive, moved the truck forward approximately 54 feet and exited the truck. When the dump truck operator walked to the rear of the truck he noticed the victim and started to yell for help. Calls were placed for emergency medical services (EMS). A state trooper assigned to the work zone was radioed by dispatch, scanned the immediate area for the victim, and then got into his police car and drove to the incident location. Within minutes EMS arrived and pronounced the victim deceased at the incident location and the Medical Examiner's Office was called. The Massachusetts FACE Program concluded that to prevent similar occurrences in the future, employers should:

- **Develop, implement, and enforce an internal traffic control plan (ITCP) specific to each construction site to help protect workers on foot;**
- **Ensure backing protocols are in place and that designated individuals are assigned as signalers to direct backing vehicles on construction sites;**
- **Ensure that communication exists among equipment operators and workers on foot;**
- **Ensure work zones are properly illuminated;**
- **Implement a buddy system for employees working on foot around mobile construction equipment;**
- **Develop and enforce policies that prohibit non-employee passengers from riding within the cabs of construction vehicles and heavy equipment while being operated within construction sites / work zones;**
- **Consider installing monitoring technology on construction vehicles and equipment to assist operators in detecting workers on foot within blind areas; and**

- **Ensure that all employees performing work on Massachusetts publically funded construction projects costing more than \$10,000 have completed the OSHA 10 hour training.**

INTRODUCTION

On June 3, 2008, the Massachusetts FACE Program was alerted by the local media that on the same day a male laborer was fatally injured when he was struck by a backing dump truck in a roadway construction site. An investigation was immediately initiated. On July 18, 2008, the Massachusetts FACE Program Director and an investigator traveled to the company headquarters and to the incident location. While at the company headquarters, the Massachusetts FACE project representatives met with the company's Safety Director and a Project Manager. The police report, death certificate, company information, and the Occupational Safety and Health Administration (OSHA) fatality and catastrophe report were reviewed during the course of the investigation. The incident location was photographed.

The employer's primary business is roadway and highway construction projects, stone quarrying, and manufacturing of hot mix asphalt, with locations in two states. The company has been in business for 60 years. The company has five main divisions: administration, materials (asphalt manufacturing and mining), contracting (milling asphalt roadways and laying asphalt), real estate (managing and maintenance of properties), and sales / marketing. The numbers of employees ranges from 160 – 204. The bulk of the company's work is seasonal resulting in a fluctuating employee count, with the largest number of employees from March through November. The victim's job title was ground laborer and had worked at the company for four years.

The company has a full time health and safety professional and a written health and safety program. The company provides health and safety training to all employees and also offers the training to its contracted trucking services, other companies, and customers. Training topics consist of, but are not limited to, the Occupational Safety and Health Administration (OSHA) 10 hour course, the Mine Safety and Health Administration 8 hour course, and courses on confined space, hazard communication, fall protection, flagging certification, and first aid. There is some documentation for all of the trainings and, when required, the training proficiency is tested. The company has a health and safety committee that includes representatives from all of the company's divisions and union labor representatives. The company reported that they distribute workplace/home safety information with employee paychecks as part of their way to highlight and enforce the company's safety culture. The majority of the company's employees in Massachusetts are part of collective bargaining units.

INVESTIGATION

The project involved in the incident was a federally funded nighttime roadway resurfacing project for a section of a major interstate. The company had won a state bid for this project,

which was not the company's first state funded project. The company has been paving for most of its 60 years in business and they had recently started performing the process of milling roadway surfaces instead of subcontracting this process out. This project was the company's first job performing the milling process themselves. The company reported that the process of milling is very similar to paving, in terms of work zone setup, management, and hazards.

The project started in March of 2008 and was scheduled to be completed in September 2009. The work was scheduled to take place at night from, 9:00 p.m. to 6:00 a.m., Sundays through Thursdays. The two major components of the project were to mill down the current asphalt roadway surface and then repave the milled section of roadway. The project location was a major interstate consisting of a six-lane asphalt highway with a left hand asphalt shoulder, a right hand breakdown lane and a large grass median. The asphalt shoulder is four feet wide with a right hand solid yellow line. The three travel lanes are each 12 feet wide, separated by white dashed lines (skip lines), and the breakdown lane is ten feet wide with a continuous white fog line bordering the right lane (Figure 1). The section of the interstate roadway to be repaved was 2.9 miles long and 50 feet wide, the width of all travel lanes, shoulder, and breakdown lane. This section of roadway where the incident occurred is level and straight, with a very slight curve. At the time of the incident it was dark with temperatures in the 50s and the roadway was dry.

The night of the incident was the first night of milling. The company had two work crews onsite: a safety crew and a milling crew. The safety crew consisted of one safety foreman and two laborers. The safety crew's main tasks were to set up and maintain the work zone. The milling crew consisted of one construction superintendent, one milling superintendent/supervisor, one milling foreman, three ground laborers (including the victim), and one operating engineer. The milling crew's main task was to conduct the actual asphalt milling operation. In addition, on the night of the incident there were three state police troopers assigned to the project and one state highway department engineer onsite.

At approximately 8:00 p.m., the company's safety crew and construction superintendent, along with state troopers, arrived at the project site. The crew started setting up the work zone, which was about one mile long and included shutting down the three northbound travel lanes. The 10-foot breakdown lane and two feet of the right-hand travel lane were designated as the single travel lane for motorists to pass by the work zone. This temporary travel lane was separated from the work zone by traffic barrels. A right-hand entrance ramp merged with the single designated travel lane adjacent to the work zone. The southbound travel lanes were not affected on the night of the incident (Figure 2). The work zone set up was completed by 8:30 p.m.

The section of roadway that was scheduled to be milled on the night of the incident was 2,400 linear feet of asphalt for each of the three travel lanes and breakdown lane. Between 8:30 p.m. and 9:00 p.m., the milling crew arrived on site with the equipment needed for the milling task. This included, but was not limited to, a cold planer (milling machine), water truck, sweeper, skid-steer loader and two light towers. Each light tower consisted of an extending boom and

four area lights. One of the light towers was positioned at the beginning of the milling operation (start line) and the other light tower was positioned at the end of the milling operation. No lights were set up between the two light towers, which had been reported as the company's normal lighting set up. During the milling process, when the milling machine was in between the two stationary light towers, the lights located on the milling machine were used to illuminate the work area.

The milling machine was recently purchased new by the company. Milling machines are designed to remove the top layers of worn or deteriorated asphalt, eliminating surface imperfections such as bumps and ruts. During the milling process, the removed asphalt is ground up and discharged via a conveyor that is located at the front of the machine. A dump truck is positioned at the end of the conveyor to collect the discharged asphalt. The dump truck is driven forward to move along with the milling machine so discharged asphalt from the milling machine's conveyor is continuously flowing into the dump truck. The operator's area, located on top of the milling machine, has a dual control console. This allows the operator to control the machine from either the left or right sides of the machine.

The cutting width of this milling machine was seven feet. One pass of the milling machine, from south to north along this 2,400-foot section, was estimated to take about forty minutes. When the equipment reached the end of the 2,400 foot section, it would then back in a southerly direction to the start line. The backing process takes about five minutes. Before the next pass of the milling machine begins, there is a 10-minute down time where the equipment is checked and other tasks such as filling the milling machine's water tank are performed.

There were 13 tri-axle dump trucks being used to collect the milled asphalt on the night of this incident. All of the dump trucks were owned and operated by multiple subcontractors hired by the company. The dump trucks entered the work zone and positioned themselves facing north in the approximate location of where the dump truck would be loaded with milled asphalt. Loaded dump trucks would then drive out of the work zone and to a dump site that was nine miles from the project location. After the load of milled asphalt was dumped, the truck would then return to the construction work zone and get back in line with the other dump trucks and wait their turn for their next load of milled asphalt.

The victim was a ground laborer and his main tasks were to observe the milling process and ensure that the dump trucks collecting the milled asphalt were in the correct position relative to the milling machine's conveyor. The victim was wearing blue jeans, a dark colored sweatshirt, work boots, a high visibility Class II green vest, and a red hardhat. Prior to the incident, three passes of the milling machine had been completed and the milling equipment had backed to the start line. During the ten minute down time some of the workers conduct required tasks, such as filling the milling machine's water tank, or are on break. During this particular downtime, it was reported that the company foreman had planned on painting a section of a guideline when the victim offered to perform this task. A guideline is used by the milling machine operator to ensure that during the milling process the milling machine is moving in a straight line. The task

was to connect the existing white skip lines, which are the dashed lines that separated the highway travel lanes, with white paint. It was reported by the employer that the non-painted sections between the white skip lines were each 40 feet long.

The task of painting the guideline was performed using a paint stick, a tool that consists of a pole with a location for a spray paint can, a handle with a trigger, and a wheel to roll the device along the painted path. Although the incident was not witnessed, it appears that the victim had walked to the northern boundary of the section to be milled, turned to face the on coming traffic and started walking in the southerly direction back towards the start line as he painted the guideline. The 14-wheel tri-axle dump truck that backed over the victim was next in line to be loaded with milled asphalt (Figure 3). It appears that the truck driver may have thought he needed to reposition his dump truck closer to the milling machine and started to back the truck in a southerly direction. At approximately 1:20 a.m., while backing, the dump truck's rear right dual wheels struck and ran over the victim. The dump truck driver realized that he ran something over and drove the truck forward approximately 54 feet, running over the victim a second time. The dump truck driver got out of the truck's cab, walked to the rear of the truck, found the victim, and started yelling for help.

Emergency medical services (EMS) were called and one of the state troopers assigned to the work zone immediately got into his police car and drove to the victim's location, approximately 450 feet north of the milling machine. Within minutes EMS arrived and pronounced the victim dead at the incident location and the Medical Examiner's Office was called.

The driver of the dump truck had a passenger (non employee) present inside the cab at the time of the incident. According to federal law (49 CFR Part 392.60) unless authorized in writing by the motor carrier under whose authority the commercial motor vehicle is being operated, no driver shall transport any person on any commercial motor vehicle other than a bus.¹ After the incident the dump truck was impounded by the Department of Transportation and a full inspection of the truck was conducted. The truck appeared to be in good working order with a functioning backup alarm and backup lights.

CAUSE OF DEATH

The medical examiner listed the cause of death for the victim as blunt force trauma to head and torso, including skull and spine fractures and injuries to internal organs.

RECOMMENDATIONS/DISCUSION

Recommendation #1: Employers should develop, implement, and enforce an internal traffic control plan (ITCP) specific to each construction site to help protect workers on foot.

Discussion: In work environments where mobile equipment are being operated, workers on foot are exposed to potential struck-by hazards, particularly being backed over.^{2a} An internal traffic control plan (ITCP) is a tool that a project manager can use to coordinate the flow of construction vehicles, equipment, and workers on foot moving in close proximity to each other on a construction site.³ An ITCP should be developed for all medium, large, and multi-contractor jobs, such as this repaving job. For small recurrent operations, such as filling potholes, a checklist can be used in place of a complete ITCP.³ The ITCP should be included as part of the company's comprehensive healthy and safety program.

To reduce the hazard associated with backing construction vehicles and equipment, an ITCP can be developed to minimize the backing distances of all vehicles and equipment on a work site with the goal of eliminating backing vehicles and equipment altogether. This can be accomplished by taking into consideration the tasks to be performed by the vehicles and equipment and how the vehicles and equipment can safely navigate through the construction site to complete these tasks while backing as little as possible. The ITCP should also address workers on foot by creating walking zones for these workers that are clear of backing construction vehicles and equipment.³ This can be accomplished by taking into consideration the tasks to be performed by the workers on foot, and how these workers can safely navigate through the construction site to complete these tasks. Some areas within a construction work zone might have to be defined as areas that are prohibited for workers on foot. Providing employees training on the ITCP and sharing the plan with all workers on the site, including contracted and sub-contracted truck drivers, is essential for the ITCP to be effective.

Recommendation #2: Employers should ensure backing protocols are in place and that designated individuals are assigned as signalers to direct backing vehicles on construction sites.

Discussion: In this case, if backing protocols had been established and there was a person assigned as a backing signaler, the dump truck would not have been able to start backing until the signaler was sure it was safe to start. Backing protocols should be developed and implemented for each highway/street construction project. The employer should provide employees training on the backing protocols. These protocols should include, but not be limited to, an assigned backing signaler⁴ and policies that backing will not begin without an understandable signal from the signaler that it is safe to start backing. The established protocols should also state that operators of construction vehicles and equipment must come to a complete stop if contact with the signaler is lost and they must not resume backing until contact is re-established. All equipment operators and truck drivers, upon entering the construction site, should be notified of who the signalers are and about the backing protocols, which at this same time the backing protocols should be reviewed.

Backing protocols could also include Blind Area Diagrams for construction vehicles and equipment. NIOSH has information available on blind areas around construction vehicles and equipment primarily for safety personnel and instructors to be used as training aides in

developing awareness about hazardous areas around construction vehicles and equipment due to limited visibility. Blind Area Diagrams and test procedures (information on how to develop your own diagrams) are available on the NIOSH Web site at www.cdc.gov/niosh/topics/highwayworkzones/BAD/imagelookup.html.^{2b}

In addition, signalers could be equipped with hardhat lights for nighttime work and air horns that would only be used when a hazard exists from backing vehicles. Hardhat lights could help vehicle operators keep track of the worker on foot and air horns might get the attention of backing vehicle operators, the operators of other equipment, or workers on foot, reducing the hazard of backing vehicles. Of course these measures are only aides to help maintain constant communication/sight between backing drivers and their signalers.

Recommendation #3: Employers should ensure that communication exists among equipment operators and workers on foot.

Discussion: Communication among workers on a construction site regarding current work plans and any potential changes to scheduled tasks is critical especially between equipment operators and workers on foot. This can be accomplished by personal one-on-one communication or with two-way radios. Communication used in combination with an internal traffic control plan (ITCP) and a site specific backing protocol (as discussed in recommendations 1 and 2) could further reduce the chance of workers on foot being struck by backing vehicles.

In this case, the dump trucks enter the worksite at the northern end of the work zone and then back to the approximate location of where they would be next in line to collect the milled asphalt. If the there had been communication between the dump truck operator and the victim that the dump truck was going to back and that the victim was going to paint a guide line, the hazard of the dump truck backing over the victim could have been recognized and eliminated.

Recommendation #4: Employers should ensure work zones are properly illuminated.

Discussion: During nighttime roadway work, employers should routinely monitor the work area's lighting and ensure that appropriate lighting levels are maintained over the course of a project. Inadequate lighting of work zones raises concerns about the ability of workers on foot, equipment operators and truck drivers to operate safely within the work zone.⁵ The Occupational Safety and Health Administration (OSHA) regulations require a minimum illumination of construction areas.⁶ The OSHA required minimum illumination standard for general construction areas is five foot-candles. However, the National Cooperative Highway Research Program recommends a minimum illumination of 10 foot-candles for paving operations. Detailed information on work zone lighting can be also obtained from the National Cooperative Highway Research Program's *Illumination Guidelines for Nighttime Highway Work*.⁶

In this case, although two portable light towers were provided and in use at the time of the incident, no lighting was provided at the location where the victim was struck by the backing truck. Of the two light towers, one was located at the start line and the other light tower was located at the northern end of the work zone. Both light towers remained stationary during the milling process and did not provide light at the actually milling operation. The light at the milling operation was generated primarily by the lights that were on the milling machine. Analysis by the state police reconstruction team found that the illumination levels in the location where the victim was struck to be less than one foot-candle.

Recommendation #5: Employers should implement a buddy system for employees working on foot around mobile construction equipment.

Discussion: When workers are focused on a task, it may be difficult for the workers to recognize or react to moving equipment. In this incident, the victim was painting guide lines during a nighttime roadway construction project and was alone on foot around mobile construction equipment and trucks. In addition, the victim had his back to the parked dump truck most likely so he could face and concentrate on the motor vehicles going past him only a few feet away at 65 mph while painting the guide line. A buddy system, where coworkers are assigned to spot one another, especially during tasks that will bring workers on foot in close proximity to mobile vehicles, would allow workers to focus on their tasks while another coworker watches for the movement of equipment and other hazardous situations.

Recommendation 6#: Employers should develop and enforce policies that prohibit non-employee passengers from riding within the cabs of construction vehicles and heavy equipment while being operated within construction sites / work zones.

Discussion: Although in this case the operator of the dump truck had a passenger in the cab with him, it was not clear if he was distracted at the time of the incident. Operating, including backing, motor vehicles or heavy equipment within a construction site / work zone requires the complete attention of the operator. Employers should ensure that operators of motor vehicles and heavy equipment are dedicating their complete attention to the task at hand. To help ensure this, a written policy prohibiting non-employees passengers from riding within cabs at construction sites should be developed and enforced.

Recommendation 7#: Employers should consider installing monitoring technology on construction vehicles and equipment to assist operators in detecting workers on foot within blind areas.

Discussion: Aftermarket monitoring technology, such as sensor based systems, rear-view cameras, and radio frequency identification (RFID) tags and tag readers, are available to assist in monitoring vehicle blind spots. These systems could give operators a better view and sense of what is located in blind spots, especially when backing.

Combining the use of monitoring systems, such as a rear-view camera and a sensor system, which provides an alarm in the cab when a person or object is detected at the rear of the vehicle, along with some administrative controls, such as an ITCP, backing procedures, and a buddy system, will help minimize the possibility of a worker on foot being backed over.

Recommendation 8#: Employers should ensure that all employees performing work on Massachusetts publically funded construction projects costing more than \$10,000 have completed the OSHA 10 hour training.

Discussion: In Massachusetts, all workers on publically funded construction projects costing more than \$10,000 are required (Chapter 306 of the Acts of 2004) to have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration.⁷ In this case, the operator of the dump truck did not have the required OSHA 10 training.

In addition to employers ensuring that their employees have successfully completed the OSHA 10 training, general contractors should keep track of subcontracted workers on the work site at all times and ensure that these workers have been provided and completed the OSHA 10 training.

REFERENCES

1. Code of Federal Regulations, 49 CFR 392.60 Driving of Commercial Motor Vehicles, Unauthorized persons not to be transported, Government Printing Office.
- 2a. NIOSH 2009. Workplace Safety and Health Topics: Highway Work Zone Safety. [cited on 2010 November 9]. Available from: URL: <http://www.cdc.gov/niosh/topics/highwayworkzones/>.
- 2b. NIOSH 2009. Workplace Safety and Health Topics: Highway Work Zone Safety: Construction Equipment Visibility. [cited on 2010 November 9]. Available from: URL: <http://www.cdc.gov/niosh/topics/highwayworkzones/BAD/imagelookup.html>.
3. NIOSH 2001. *Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment*, Department of Health and Human Services, Center for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-128.
4. Code of Federal Regulations, 29 CFR 1926.601 (b)(4) Safety and Health Regulations for Construction, Motor vehicles, Government Printing Office.

5. NCHRP [2003]. Illumination Guidelines for Nighttime Highway Work. National Cooperative Highway Research Program (NCHRP), Report 498. Available at:
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_498.pdf
6. Code of Federal Regulations (2005). 29 CFR 1926.56 (a). Illumination. Washington, DC: U.S. Printing Office, Office of the Federal Register.
7. Massachusetts General Laws. Chapter 306 of the Acts of 2004. An Act Relative to the Health and Safety on Public Construction Projects.
www.mass.gov/legis/laws/seslaw04/sl040306.htm

Figure 1 – Roadway where incident occurred.



Figure 2 – Diagram of the work zone.

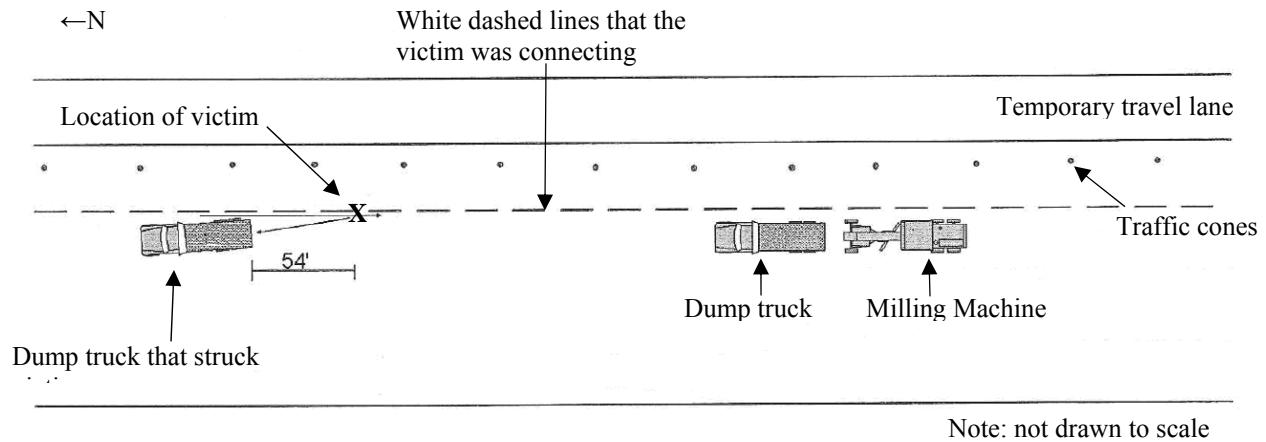


Figure 3 – Truck involved in the incident.

