NIOSH
FACE
Fatality Assessment and Control Evaluation Program
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Cement Truck Driver Dies after being Backed Over by a Skid-Steer Loader – South Carolina

SUMMARY

On March 29, 2008, a 45-year-old male cement truck driver (the victim) was fatally injured when he was backed over by a skid-steer loader. Before 9:00 AM in the morning, the victim stepped out of a worksite trailer onto a gravel path to greet a contract worker who had just arrived on-site, and was struck by the skid-steer loader that was traveling in reverse. The company dispatcher was operating the skid-steer loader, cleaning the gravel pathway used to test concrete patches. The contract worker saw the victim step into the path of the skid-steer loader and shouted a warning and waved his arms to both the victim and the machine operator. The operator did not hear the warning and the victim did not react. The rear of the skid-steer loader struck the victim on the right-hand side of his body and rolled over his torso. The operator was not aware he had struck someone. Emergency Medical Services (EMS) were immediately called and arrived on scene at approximately 9:02 AM. The victim was in cardiac arrest and was transported to the local hospital for further care. The victim died en route to the hospital and was pronounced dead-on-arrival at 9:23 AM.

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

- ***install permanent barriers separating commonly used walkways from that of areas where heavy equipment is being operated***
- ***develop, implement, and enforce a policy that workers-on-foot maintain a safe clearance from mobile equipment, use designated pathways, and use personal protective equipment such as high visibility clothing***
- ***develop and implement a comprehensive training program for operators of heavy mobile equipment, including training on appropriate backing procedures***

Fatality Assessment and Control Evaluation (FACE) Program

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In 1982, NIOSH initiated the Fatality Assessment and Control Evaluation (FACE) Program. FACE examines the circumstances of targeted causes of traumatic occupational fatalities so that safety professionals, researchers, employers, trainers, and workers can learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent occupational deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under the FACE program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the program website at www.cdc.gov/niosh/face/ or call toll free at 1-800-CDC-INFO (1-800-232-4643).

- ***consider installing backup alarms and electronic sensors to warn heavy equipment operators of workers-on-foot in the immediate work area***

INTRODUCTION

On March 29, 2008, a 45-year-old cement truck driver (the victim) was fatally injured after being backed over by a skid-steer loader while working at a concrete and precast company. On May 12, 2008, the South Carolina Department of Labor / Office of Occupational Safety and Health (SCOSHA) notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), of the incident. On June 16, 2008, a DSR epidemiologist and a senior safety and occupational health specialist conducted an investigation of the incident. Photographs of the incident site and equipment were taken and the company's general manager was interviewed. The employer asked that the investigation occur after work hours and that no employees be interviewed. The city police report and county coroner's report were reviewed. The incident was also reviewed with the SCOSHA investigator.

EMPLOYER

The victim's employer sold and produced ready-mixed concrete and a line of concrete products. The company had been in business for over 15 years. The company employs 24 workers in two separate locations. Approximately 15 employees work at the site of the workplace fatality: 10 concrete truck drivers, 2 dispatchers, 2 mechanics, and a maintenance person. The company employs 9 others at another local site: 7 office personnel and 2 salesmen. On the day of the incident, six employees were working at the site. This was the company's first workplace fatality.

VICTIM

The victim was a 45-year-old white male. The victim had worked full-time for the company as a concrete truck driver for 2 years and 3 months. The general manager reported that the victim had a disability on the right side of his body which limited his mobility. The victim's primary job duty was to drive a concrete truck. He had a valid driver's license and a commercial driver's license (CDL). His duties also included working as a mechanic, operating heavy equipment such as a skid steer loader, and performing other duties, as assigned.

EQUIPMENT

The skid steer loader involved in this incident was purchased used approximately 6-8 years prior to the incident, and was used regularly. Safety equipment such as extended mirrors or backup alarms were not required because the machine had a large rear plexi-glass window (Photo 1). The compliance officer asked the employer to operate the machine and the employer reported the machine to be in good operating condition. Since the time of the workplace fatality, the skid-steer loader has been equipped with an audible backup alarm.

An online search using 'Google' indicated that the skid-steer manufacturer produced this model between 1994 and 1999. The loader is diesel-powered and has a hydrostatic drive type. Standard

10.00 x 16.6 tires are used and the lift bucket has a capacity ranging from 1,700 pounds to 2,500 pounds.

EMPLOYEE SAFETY PROGRAM AND TRAINING

The company had a written safety program. New employees reviewed a computer-based, Windows PowerPoint presentation, approximately one-hour in length. This covered a multitude of safety topics such as, confined spaces, lock-out/tag-out procedures, Hazmat procedures, and hazard communication. Specialty training was conducted on an as-needed basis by the general manager.

Three employees regularly operated the skid-steer loader, one of which was the victim. Those operating the skid-steer loader received informal hands-on-training from more experienced operators. There was no formalized training for the skid-steer loader operators. SCOSHA investigators cited the company for no formalized training program for skid-steer loader operators.

INCIDENT SCENE

The incident site was a commercial construction site where ready-mixed concrete and other concrete products were prepared and tested. Located on site was a worksite trailer where basic office work and radio dispatching occurred. There was a set of wooden stairs leading out of the worksite trailer onto an unpaved sidewalk which directed foot traffic away from the front of the trailer. Located directly in front of the worksite trailer was a 20 feet wide by 20 feet long section of gravel which was used to test patches of concrete prior to use (Diagram 1).

The fatality occurred just outside of the worksite trailer, on the gravel section used to test concrete, as the victim stepped into the path of the skid-steer loader as it was traveling in reverse (Diagram 1). The day of the incident, it was overcast and rainy.

INVESTIGATION

The general manager of the company, who was not present the day of the incident, was interviewed by NIOSH investigators. The general manager indicated that the employees were all good friends and the workplace fatality had disrupted the work environment. He asked the NIOSH investigators to avoid visiting the worksite during normal work hours. The general manager gave investigators his account of the incident, as described to him by the operator of the skid-steer loader.

On Saturday, March 29, 2008, six employees of the company started work at approximately 6:00 AM. These employees were working overtime on Saturday morning. Rain started to fall in the early morning and forced the employees to cut their work day short shortly after 8:00 AM. That morning, a contract worker was expected to arrive on site to perform maintenance on the tires of the large cement trucks. Since the victim was a driver of these trucks, he was frequently the contact person for the contract worker. The victim had entered the worksite trailer to avoid the rain and wait for the contract worker.

The employee working as the dispatcher often helped in the clearing of the section of the yard used for concrete testing. During lulls in the workday, the dispatcher would operate the skid-steer loader and clean the approximately 20 feet wide by 20 feet long gravel section used to test concrete. The dispatcher, working as a skid-steer loader operator, would level the remaining gravel by lowering the arms of the skid-steer loader and tilting the bucket forward until the bucket rested on the gravel. He then would back the skid-steer loader and bucket over the gravel, a process known as back-dragging. According to the general manager, the dispatcher was an experienced operator of the skid-steer loader and regularly performed this work activity. Shortly after 8:00 AM, the dispatcher went outside of the worksite trailer to perform this work activity. He had been performing this work for about one hour when the fatality occurred. The general manager noted that the operator of the skid-steer loader was aware that the victim was inside of the worksite trailer, awaiting the arrival of the contract worker.

Before 9:00 AM, the contract worker arrived on-site and pulled his truck along the right-hand side of the worksite trailer. The victim descended the worksite trailer stairs to greet him. The victim did not descend the stairs and approach the contract worker from the sidewalk located on the right-hand side of the trailer, but rather, stepped into the section of gravel located in front of the worksite trailer and into the path of the skid-steer loader. The general manager noted that the victim 'was probably' aware that the skid-steer loader was being operated. The general manager had no idea why the victim walked onto the gravel section instead of using the paved sidewalk, but noted that he may have been tired from the weeks' work.

The contract worker waved his arms and shouted at the victim to warn of the skid-steer loader that was backing up on the gravel section. The operator did not hear the warning and the victim did not react, possibly thinking that the contract worker was greeting him. The general manager stated that the operator of the machine had looked out of the glass window before he started backing the machine up and did not see the victim in the vicinity. The machine struck the victim on the right-hand side of his body, knocking him to the ground (Photograph 1). The operator then backed over the victim running over his torso. The general manager said that the operator had not realized that he had struck the victim and continued to back drag until he heard the cries of the contract worker who told him he had struck the victim. The general manager noted that it was possible that the victim's limited mobility prevented him from avoiding the skid-steer loader since he was struck on the side of his body that was disabled. The operator and contract worker dialed 911 and began cardiopulmonary resuscitation (CPR).

Emergency medical services arrived within minutes of the phone call. The police report indicated that they were dispatched at 8:58 AM and arrived on the scene at 9:02 AM. Upon arrival at the scene, the police witnessed the medical personnel treating the victim who was in cardiac arrest. Shortly after, the victim was transported by an ambulance for further medical treatment and died en route to the hospital. He was pronounced dead-on-arrival at 9:23 am. There was no indication of alcohol or drugs having played a role in the incident. Drug tests conducted on the victim's blood were negative.

SCOSHA investigated the incident on the next business day. The police investigation determined there was no evidence of foul play. The concrete company was cited for workers not wearing

reflective orange vests and lack of a formal training program in the operation of moving construction equipment.

CAUSE OF DEATH

The county coroner's report stated that the cause of death was blunt force trauma to the chest.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should install permanent barriers separating commonly used walkways from that of areas where heavy equipment is being operated.

Discussion: Concrete barriers have greatly improved safety in construction and highway work zones.[1] These barriers reduce a worker's risk of being struck by backing vehicles while on-foot in a work zone site. In fixed worksites such as in this incident, permanent barriers are feasible and offer consistent protection for workers; however, another option is portable barriers. These barriers are often made of a heavy-duty polyethylene and are water-filled.[1] They are most commonly orange and white in color and provide high visibility to workers-on-foot. These portable barriers provide some of the same benefits of concrete barriers, but have the added benefit of being lightweight and easy to set-up and tear-down.[1]

Recommendation #2: Employers should develop, implement, and enforce a policy that workers-on-foot maintain a safe clearance from mobile equipment, use designated pathways, and use personal protective equipment such as high visibility clothing.

Discussion: Working in and around heavy mobile vehicles can be hazardous as it puts workers at risk for being struck by and run over by vehicles and/or equipment.[2] Employers should develop standard operating procedures for workers while on-foot near moving vehicles and /or equipment. Safe equipment operation around workers-on-foot should include isolating workers-on-foot from equipment, training both workers-on-foot and equipment operators to use communication methods such as two-way radios, and scheduling work tasks to keep workers away from areas where heavy equipment is being used.

Additionally, the American National Standards Institute has developed guidelines for the selection of high visibility garments.[3] When a policy on the use of such high visibility clothing is enforced and high visibility vests are provided and worn by employees, it is more likely that operators of heavy mobile vehicles will recognize workers-on-foot.

Recommendation #3: Employers should develop and implement a comprehensive training program for operators of heavy mobile equipment, including training on appropriate backing procedures.

Discussion**:** Backing procedures for heavy mobile vehicles should be developed and implemented. In this case, there were no established backing protocols or specific training for operators of the skid-steer loader. Backing protocols should include, when possible, 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.[2]

OSHA regulations require employers to train their workers to recognize and avoid unsafe conditions in their work environments [29 CFR 1926.21 (b)(2)].[4] Training should be provided to employees in a manner best suited for that particular work environment. In this case, employees received their safety training via PowerPoint presentation. Providing training to employees on safety around heavy mobile equipment could easily be added to the company's current safety training program.

Recommendation #4: Employers should consider installing backup alarms and electronic sensors to warn heavy equipment operators of workers-on-foot in the immediate work area

Discussion: The company installed an audible back-up alarm on the skid steer loader following this incident. Employers should consider installing after market electronic signaling devices or sensors on heavy mobile equipment, such as skid-steer loaders, to help monitor the presence of workers-on-foot within blind areas. Current research is investigating navigation and warning aids for mobile equipment in the mining and construction industry, and such collision warning systems could be used on heavy mobile equipment.[5,6,7] Although such machines are frequently equipped with a large plexi-glass window, this requires diligence on the part of the operator to use proper backing procedures. In this case, the operator reported using the plexi-glass window and did not see the victim.

Additionally, when using the machine to back drag, the operator's visual attention must be divided between monitoring the bucket at the machine's front and ensuring that the travel way behind the machine is clear. A more passive safety intervention, such as electronic sensors to warn operators of workers-on-foot, in combination with the rear window, would further decrease the risk of occupational deaths caused by back-overs.

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INVESTIGATOR INFORMATION

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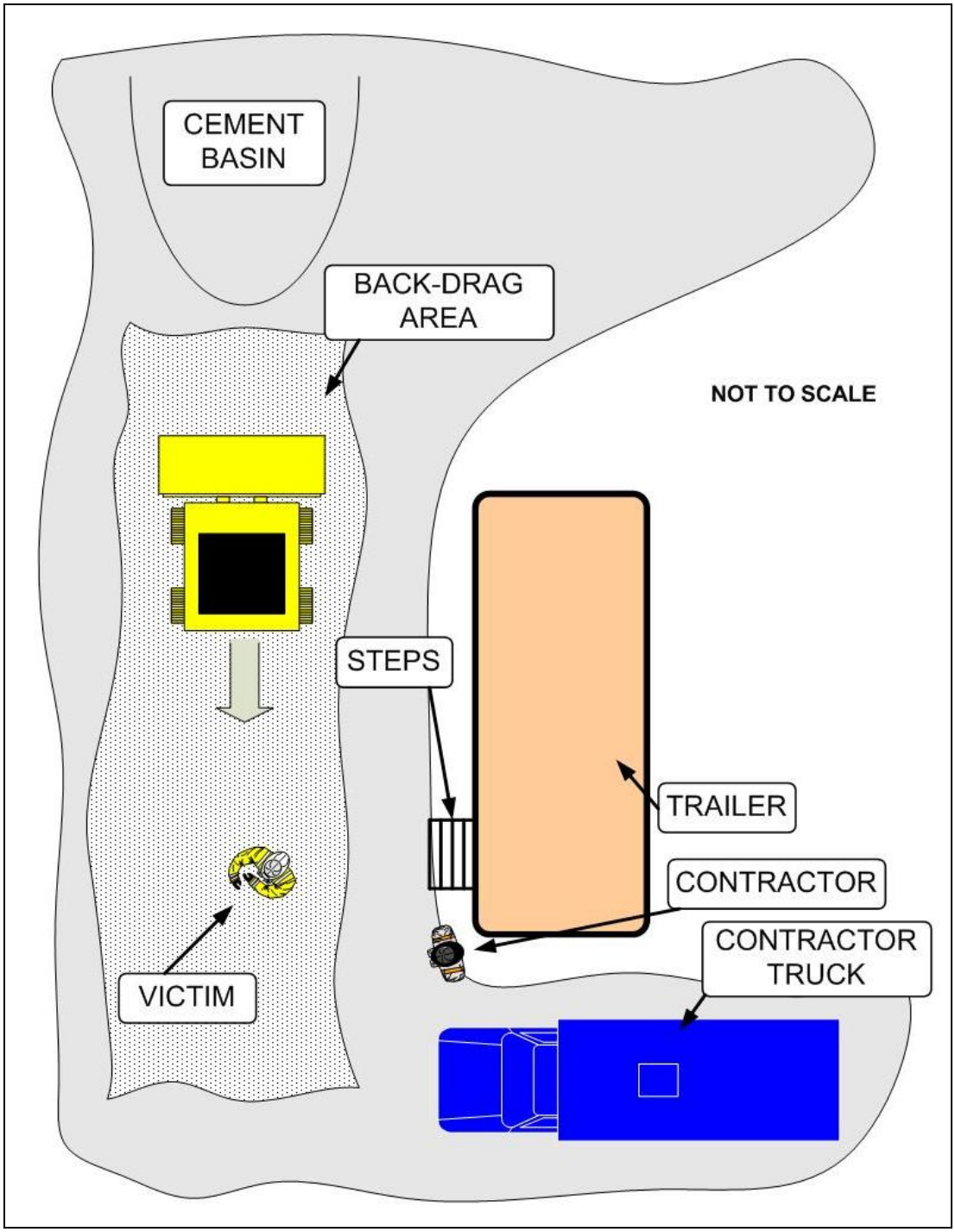

Diagram 1. Overhead View of Incident Site

Photograph 1. This photograph illustrates the rear of the skid steer loader