MIFACE Investigation Report #10MI038

Subject: Heavy Equipment Operator Killed When Ejected From Cab

Summary

In the spring of 2010, a male heavy equipment operator in his 30's died when he was ejected from the driver's seat of a Daewoo loader equipped with a tree fork, then pinned under the driver's side rear tire. The decedent, who was an authorized operator of the loader, fueled the loader at the fueling station located at the top of a hill. After fueling, he proceeded down the steep hill's logging road to begin work at the bottom of the hill. It is unknown if, at the fueling station, he attached his seat belt. It appears that at one point during his descent, the decedent either lost control of the loader or attempted to apply the brakes, which were non-functional. The loader began to gather speed and began to "bunny hop" or "buck" after it struck a dirt berm. The loader's fork marks were found on the path of his descent. Witnesses observed the decedent "bouncing around" in the operator cab as the loader proceeded down the slope. When the decedent and the machine reached the bottom of the hill, the decedent was ejected either through the front windshield or the operator door. The loader struck an excavator parked at the base of the hill, rolled back, and came to rest. The decedent was pinned under the driver's side rear tire. Emergency response was called and the decedent was declared dead at the scene.

Figure 1. Overview of incident site

Factors in incident:

- Equipment not appropriately maintained
- Seat belt not worn

RECOMMENDATIONS

- Perform equipment inspections prior to the work shift, report any changes in equipment operation, and tag the equipment out of service if a safety issue is recognized, such as diminishing braking capacity.
- Employers should ensure individuals performing repair work on heavy equipment have the appropriate training to perform repair work.
- Equipment operators should wear seat belts when seat belts are provided.
- Develop, implement and enforce a safety program, including disciplinary procedures for non-compliance.

- Perform a jobsite analysis to identify worksite layout safety issues and train employees regarding the identified site-specific hazards.
- Manufacturers and equipment designers should consider designing backhoes with interlock systems that would prevent the machine from operating unless the seatbelt is fastened properly.

INTRODUCTION

In the spring of 2010, a male heavy equipment operator in his 30's died when he was ejected from the driver's seat of a Daewoo loader equipped with a tree fork, and then pinned under the driver's side rear tire. The MIFACE researcher was notified of this fatality by MIOSHA. The company owner agreed to participate in the MIFACE research program and the two parties met and discussed the circumstances of the fatality at Michigan State University. The MIFACE researcher reviewed the death certificate, the medical examiner report, the police department report, the MIOSHA case file, and newspaper clippings. Pictures used in this report are courtesy of the police department (Figures 1, 3) and the MIOSHA compliance officer case file (Figures 2 4, 5 and 6). The pictures have been modified to preserve confidentiality.

The tree trimming and removal company, which had been in business for twenty years, was subcontracted to clear the trees from the top and side of a 45-degree hill for a road project. The firm employed 12 individuals. The work crew had been at the site for approximately one month. The decedent was a full-time, hourly worker. His normal work shift was 10 hours. He arrived at work at approximately 8:00 a.m. and left at 6:00 p.m.

The firm's safety program included an employee training program. Employee training consisted of both classroom and on-the-job training. The firm had a safety procedures training checklist for new employees. The checklist encompassed the following topics: General Safety Policy training; job specific safety training; THINK SAFETY training (from Michigan Association of Timbermen); first aid station identification; accident reporting; Powered Industrial Truck; Personal Protective Equipment; Lockout/Tagout; Hearing Conservation; Right To Know training including Material Safety Data Sheets; Emergency Action Plan; Fire Prevention Plan; and Company specific training. The firm had a verbal disciplinary procedure. The owner indicated to the MIFACE researcher that he "had no major problems" with any of his employees. Employees received training when they hired in for the machines they were going to operate. No additional equipment training was provided.

The company owner and other employees interviewed by MIOSHA indicated that seat belt use had been discussed in safety meetings. The owner told the MIFACE researcher that the decedent had been recently reminded by the owner to use a seat belt due to a recent skidder rollover incident the decedent had been involved in.

Maintenance records were kept on company-owned equipment. The service log for the loader indicated new brake lines had been installed two months prior to the incident date. It was revealed at a later date during the MIOSHA investigation that the line had not been replaced – it had been repaired (brazed). Topping off oil, anti freeze, hydraulic, brake and transmission fluids was conducted one month prior to the incident date.

The firm required an employee to successfully complete an equipment performance test to demonstrate competency of equipment operation prior to assignment to the machine. The decedent had received a permit to drive a forklift. He had been trained on skidder operation and most often worked the skidder. He had received some training on the front end loader and was in the process of learning how to operate it, but had not yet completed a performance test. The owner and another employee were the primary front end loader operators.

The MIOSHA Construction Safety and Health Division issued the following Serious citations and Health and Safety Recommendation to the employer at the conclusion of its investigation.

SERIOUS: GENERAL RULES, PART 1 RULE 114(2)(c)

Inspections of the construction site, tools, materials, and equipment to assure that unsafe conditions which could create a hazard are eliminated were not conducted.

Employee was driving a Daewoo front end loader down a sloped access road when the brakes failed; he lost control and was ejected from the machine.

SERIOUS: MOBILE EQUIPMENT, PART 13

- RULE 1301 REF OSHA 1926.602(a)(4)

  Brakes. All earthmoving equipment mentioned in this 1926.602(a) shall have a service braking system capable of stopping and holding the equipment fully loaded, as specified in Society of Automotive Engineers SAE-J237, LoaderDozer-1971, J236, Graders -1971, and J319b, Scrapers-1971. Brake systems for self-propelled rubber-tired off-highway equipment manufactured after January 1, 1972 shall meet the applicable minimum performance criteria set forth in the following Society of Automotive Engineers Recommended Practices:

  Self-Propelled Scrapers……...SAE J319b-1971

  Self-Propelled Graders …….……..SAE J236-1971

  Trucks and Wagons ……SAE J166-1971

  Front End Loaders and Dozers …….……..SAE J237-1971

  Employee was driving a Daewoo front end loader down a sloped access road when the brakes failed; he lost control and was ejected from the machine.

- RULE 1301 REF OSHA 1926.602(b)(1)

  Tractors covered in paragraph (a) of this section shall have seat belts as required for the operators when seated in the normal seating arrangement for tractor operation, even though back-hoes, breakers, or other similar attachments are used on these machines for excavating or other work.

The employee not wearing a seat belt was driving a Daewoo front end loader down a sloped access road when he lost control and was ejected from the machine.

SAFETY AND HEALTH RECOMMENDATION

NOTICE: Potential Safety or Health Hazard. An inspection/investigation of your premises or worksite revealed the following conditions which may constitute a threat to the safety or health of your employees:

1. A complete inspection shall be performed on 7119 Daewoo Model MG 200-111 Serial Number 1034 and any repairs shall be fixed before the loader is put back in service or sold.

INVESTIGATION

There were four company employees on site, including the decedent. He was operating a 12- to 15-year-old seatbelt-equipped Daewoo MG200-111 front end loader. The owner indicated that he had operated the Daewoo loader two days earlier, and that it was working properly.

Figure 2. Daewoo loader at bottom of hill

When the job began, the company foreman held a safety meeting and discussed the scope of work, steepness of the hill, and "being careful" when working on the hill. Work had been completed on the top of the hill, and the decedent was going to start working at the bottom of the hill.

The decedent had been performing work at the bottom of the hill. To refuel the vehicle, he drove up the 45-degree hill via the logging road. After refueling, he proceeded down the hill. MIOSHA interviewed the decedent's coworkers. His coworkers at the top of the hill indicated they were not close enough to see if the decedent was wearing a seat belt. One coworker indicated he thought that the decedent used the hill only a couple of times that day. The decedent usually took the long way around because of the steepness of the hill. The coworker was not sure why he was using the hill.


Figure 3. Functional seat belt

The owner stated that he thought that as the decedent was descending the hill, he would have

applied the brakes. The brakes were non-functional, and the loader picked up speed.

The company owner indicated that if the loader continued its course down the hill, it would likely have entered an area where other subcontractor employees were taking a break. The company owner thought the decedent stayed in the loader (rather than jump from the loader) to turn its front wheels so it could be steered away from the workers. The front tires went over a lip/berm in the hill, and the loader began to "bunny hop" or "buck". The wood rake at the front of the loader struck the ground and threw the decedent forward toward the windshield. The loader bounced back down, causing the decedent to be thrown back into the machine.

Figure 4. View of hill from base of hill

The jolt of striking the railroad track at the base of the hill caused him to be thrown from the loader. It appears he held briefly onto the handrail, with his feet facing the front of the machine and his head near the rear tire. The loader struck an excavator parked at the base of the hill, rolled back, and came to rest. The decedent fell from the loader and was pinned under the driver's side rear tire. The front windshield came to rest behind and to the left of the loader.

Other workers who witnessed the incident ran to the loader and called for emergency response. They covered the decedent and awaited emergency response arrival. The decedent was declared dead at the scene.

Figure 5. View of hill from top of hill

Figure 6. View of hill from slope/side of hill. Arrows show path of loader.

The MIOSHA compliance officer walked the path of the loader and noted that there was no evidence of hydraulic fluid on the hill.

The loader was moved from its resting location after the incident because another subcontractor crew was beginning work in the area. The site's general contractor and one of his employees checked the loader's engine oil, coolant level, hydraulic oil and the overall condition of the machine to ensure it was safe to move. The engine oil and coolant levels were satisfactory however the hydraulic oil level was not in the sight glass. The two individuals looked for a filler cap on the hydraulic tank but instead, found a vent and a plate that was bolted down. One of the individuals started the loader without adding hydraulic oil hoping that there was enough oil in the tank for the loader to function. The loader made a noise like the hydraulic pump was lacking oil, so the machine was shut off. A mechanic who was onsite was directed to remove the bolted plate on top of the hydraulic tank and add oil. He did so. The loader was restarted and the noise, a "whine" persisted. The hydraulic oil level was now in the sight gauge.

When the operator moved the loader, he found that the brakes failed to hold and the brake pedal could be depressed to the floor. It was thought that the low hydraulic fluid was the result of the brake failure. The MIOSHA compliance officer placed a "Danger. Do Not Operate" tag on the loader's steering wheel (the loader had to be repaired before being put into service). MIOSHA examined the loader and noted that the left front brake line looked like it had been recently brazed. The compliance officer found old oil residue around this area. The loader was removed from the jobsite and moved to the employer's repair facility to make the full repair.

The firm was able to regain some of the brake function but determined the scope of the repair was beyond the scope of their ability. The loader was sent to an authorized facility to be serviced. The service facility indicated that the low fluid level was not a factor in the poor braking function. The repair facility found that the front and rear brake pressures were below the manufacturer's pressure specification of 853 psi (250 psi and 325 psi respectively) and that a dirty or faulty brake pilot valve and defective solenoids were likely responsible for the lack of brake function. Appropriate repairs were made to the valve and solenoids as well as replacing the parking brake pads and a parking brake pressure switch. The repairs restored the brakes to the manufacturer's specifications.

CAUSE OF DEATH

The cause of death as listed on the death certificate was severe compression trauma to head and left shoulder. Toxicological tests on the decedent's blood were negative for alcohol and positive for cannabinoids (marijuana). Although it cannot be determined if the deceased was under the influence of cannabis, many studies have concluded that cannabis use reduces coordination, impairs balance, perception, judgment, memory and learning.

RECOMMENDATIONS/DISCUSSION

- Perform equipment inspections prior to the work shift, report any changes in equipment operation, and tag the equipment out of service if a safety issue is recognized, such as diminishing braking capacity.

MIOSHA Construction Safety Standard, Mobile Equipment, Part 13 requires earthmoving equipment to have service brakes capable of stopping and holding the equipment fully loaded. It is unknown if the decedent had noted any problems with the brakes prior to his descent on the slope. Operators should inspect their motorized equipment prior to its initial use and during the work shift and report any defects, damage, and malfunctions.

- Employers should ensure individuals performing repair work on heavy equipment have the appropriate training to perform repair work.

It is unknown what type of training and experience level that the individuals performing the heavy equipment repair in the firm's shop had received. Heavy equipment repair does not require a certification or license in Michigan. Individuals performing heavy equipment repair should have training to diagnose problems, plan repairs including required labor and parts, and then complete the repair with consideration to safety, MIOSHA, and environmental factors. Heavy equipment repair coursework is available at many community colleges and other types of training centers. Mechanic certification by the Michigan Department of State, available at the Bureau of Automotive Regulation, is usually required when working on any equipment which operates on highways. To become certified, individuals must pass a written exam and pay required fees.

- Equipment operators should wear seat belts when seat belts are provided.

In this incident, the victim was not wearing a seat belt, though the loader was equipped with one. The employer also had a safety training program which specifically included seat belt training. Often, however, there is a need for retraining and visual reminders which help employees to remember to use such equipment on a regular basis. The use of a seat belt would have kept the victim restrained and may have prevented his death. Employers and managers should ensure that seatbelts are functional and in good condition and require workers to wear them whenever seat belt-equipped motorized vehicles are operated.

- Develop, implement and enforce a safety program, including disciplinary procedures for non-compliance.

The company had a written safety program and employees had received training regarding the requirement to wear seat belts. The decedent had been instructed, and after an incident a week earlier, reminded to wear his seat belt. No disciplinary action was taken by the employer to enforce the safety rule. A strict management enforcement program, including progressive disciplinary action, should be administered when violations occur.

- Perform a jobsite analysis to identify worksite layout safety issues and train employees regarding the identified site-specific hazards.

The only equipment re-fueling station was located at the top of the hill. There was not a re-fueling station present at the base of the hill. The steepness of hill was considered in the jobsite planning, and equipment operators were told to "be careful" when operating equipment on the slope. The access road may not have been adequate for travel as an access road for a rubber-tire front-end loader, as specified in MIOSHA Construction Safety Standard, Mobile Equipment, Part 13 (1906.602(a)(3)(i)), Material Handling Equipment. Although the decedent was trained on the skidder, which has the ability to travel on all types of terrain, he was not adequately trained on the front-end loader terrain limitations.

Regular safety inspections assist both the employer and employees in raising their awareness regarding hazards to which they are exposed. Even though a jobsite safety inspection does not guarantee the prevention of occupational injury, inspection is one of the keys to identifying activities where special caution would need to be exerted, such as maneuvering a large loader on a sloped hill. This incident may have been prevented if a more active and collaborative approach to safe work practices had been initiated in the field. As work progressed, an on-going safety discussion may have identified the need for another re-fueling station to be available for equipment at the base of the hill.

- Manufacturers and equipment designers should consider designing backhoes with interlock systems that would prevent the machine from operating unless the seatbelt is fastened properly.

The loader was not equipped with a mechanism for preventing operation if the seatbelt was not fastened, other than administrative controls. Interlock systems are not required by regulation however, they are currently in place in some commercial vehicles. Although interlocks can be bypassed, their use may help to reduce the risk that employees will fail to use the seatbelt through simple memory lapse or intentional disregard. Had the machine been equipped with an interlock mechanism, this fatality may have been prevented by preventing operation without seatbelt use by the operator.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (LARA) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Licensing and Regulatory Affairs, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

- MIOSHA Construction Safety Standard, Mobile Equipment, Part 13.
- California FACE Report 95CA010: *Equipment Operator Dies After the Backhoe He Was Operating Rolled Off an Embankment in California.* http://www.cdc.gov/niosh/face/stateface/ca/95ca010.html

- Alaska FACE Report 99AK027: *Heavy Equipment Operator Killed During Rollover of Front-end Loader*. http://www.cdc.gov/niosh/face/stateface/ak/99ak027.html
- Minnesota FACE Investigation MN9218: *Excavation Company Owner Dies after Bulldozer Slips Over the Side of A Flat Bed Trailer*. http://www.cdc.gov/niosh/face/stateface/mn/92mn018.html
- Module #1 of Instruction Guide 43, On-the-Job Training Modules for Surface Metal and Nonmetal Mines; *Front-end Loader Operation.* Mine Safety and Health Administration. http://www.msha.gov/safetypro_in_a_box/IG%2043%20OJT%20training%20modules%20surface%20MNM/Module%2001%20Front-end%20loader%20operation.pdf

Key Words: Front end loader, seatbelt use, brake malfunction, drugs, construction

8/2/2012