MICHIGAN State FACE Program
Fatality Assessment & Control Evaluation

Michigan State University
Department of Medicine • Occupational and Environmental Medicine
909 Fee Road, 117 West Fee Hall • East Lansing, MI 48824 • 1-517-353-1846 • https://oem.msu.edu

REPORT#: 16MI090 **REPORT DATE:** 1/16/19

Ironworker Fell 25 Feet While Working From/Relocating a Ladder in a Shaft way

INCIDENT HIGHLIGHTS

DATE:
Fall, 2016

TIME:
8:15 a.m.

VICTIM:
Ironworker in his 50s

INDUSTRY/NAICS CODE:
Construction/23

EMPLOYER:
Design/Build Construction Co

SAFETY & TRAINING:
Fall Protection, Ladder Safety

SCENE:
Manufacturing Building Shaft way

LOCATION:
Michigan

EVENT TYPE:
Fall

SUMMARY

In fall 2016, a 50-year-old male iron worker fell 25 feet while working from and relocating an unsecured 24-foot fiberglass extension ladder positioned at the immediate edge of and across a 6-foot wide by 8-foot deep open shaft way. The decedent, while wearing his fall harness/retractable lifeline and tied off to an overhead attachment point ascended the ladder to reposition a chain fall. After repositioning the chain fall, the decedent descended the ladder to remove it. He unhooked his retractable lifeline from the harness. While he stood on the ladder's second and/or third rung, he lifted/bumped the fly section to unlock the rung hooks. The ladder feet slipped into the opening…. READ THE FULL REPORT> (p.3)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- The decedent unhooked his lifeline from his harness prior to standing on the ladder while attempting to lower the fly section.
- The base and top of the ladder were unsecured.
- The angle of the ladder across the shaftway was too shallow. LEARN MORE> (p.9)

RECOMMENDATIONS

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

- Workers should always use fall protection when working above a height per the appropriate regulatory requirement. In this incident, the decedent was performing a steel erection activity, and fall protection was required when working at a height above 15 feet…… LEARN MORE> (p.9)

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Michigan Fatality Assessment and Control Evaluation (FACE) Program

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SUMMARY

In fall 2016, a 50-year-old male iron worker fell 25 feet while working from and relocating an unsecured 24-foot fiberglass extension ladder positioned across a 6-foot wide by 8-foot deep open shaft way. The extension ladder feet were set at the immediate edge of elevator shaft way on the second floor of the building. Neither the top (fly) section nor the bottom (base) section of the extension ladder that was spanned across the shaft was secured. The decedent, while wearing his fall harness/retractable lifeline and tied off to an overhead attachment point, stepped over a mid-rail that had been left in position across the shaft way opening and ascended the ladder to reposition a chain fall. After repositioning the rigging, the decedent descended the ladder and unhooked his retractable lifeline from his harness and hooked it to the mid-rail on the second floor wall at the opening of the shaft way. To remove the extension ladder, the decedent (still wearing his harness) stepped over the mid-rail and ascended a few rungs on the ladder. While lifting/bumping the fly section to unlock the rung hooks and allow the ladder to compress in order to move it out of the opening, the ladder feet slipped inward at the base into the shaft way opening and the decedent and ladder fell 25 feet to the concrete first floor. After the incident, the MIOSHA compliance officer measured the ladder length; the ladder was extended to approximately 18 feet 4 inches.

INTRODUCTION

MIFACE personnel contacted the vice president of the firm who agreed to be interviewed by MIFACE personnel. MIFACE reviewed the MIOSHA compliance officer file, death certificate, and the medical examiner and police reports during the writing of this report. Pictures used in the report are courtesy of the responding police department, pictures taken by the MIOSHA compliance officer at the time of the MIOSHA compliance inspection, and the employer.

EMPLOYERS

The construction firm had been in business for 65 years performing construction management and steel erection and as a general contractor. The firm employed 86 individuals, ten of whom were iron workers. The employees were not represented by a union. On the jobsite were the superintendent in the job trailer, a foreman, the decedent, and an apprentice.

WRITTEN SAFETY PROGRAMS and TRAINING

The firm had a designated individual responsible for safety and health management and the implementation and enforcement of the firm's written accident prevention program (APP). The designated person started with the firm as a carpenter, progressed to project manager level, and received a construction management degree. The designated individual for safety reported to the president of the firm. Safety responsibilities on site were delegated to the superintendent on site; he was located in the job trailer at the time of the incident.

The APP, developed by a private consultant, addressed site-specific hazards and included a written hazard communication program. The firm had a joint health and safety committee which met quarterly. Employees participated in safety and health decision making and were encouraged to report hazards or concerns and participated in a site walk-around to identify and correct hazards.

Employees and supervisors received new employee orientation, were required to attend an OSHA 10-hour construction course, received training as required by relevant MIOSHA standards, and received on-the-job training. Retraining was offered as needed. Supervisors discussed safety and health topics on a weekly basis (toolbox talks) and the firm held

monthly safety meetings, led by senior staff. Training was periodically reviewed for effectiveness and training records were maintained.

Prior to starting new work activities, the firm performed a job hazard analysis. Safety issues were discussed during the design and planning phases of this project.

The employer did not have an effective system to enforce the APP safety and health requirements. The firm's APP section on ladders required ladder inspection and tagging for repair and removal from service, if needed.

WORKER INFORMATION

The decedent worked as an iron worker for 27 years. He was with the firm for 27 years, working full-time as an hourly worker. He had been working 9-hour days. On the day of the incident, he started work at 6:30 a.m.

On previous jobs, he had been a lead man, because of his experience and seniority. He was often involved in specialty-type items, such as what was required for this job (installation of the stationary lift equipment). On this job, he was not the lead person but was part of a 3-person crew consisting of the lead man, the decedent and an apprentice.

The decedent received ladder training the previous year.

The apprentice had worked for the company for approximately one year. The apprentice was working with the decedent on the 2nd floor and witnessed the incident.

INCIDENT SCENE

The incident occurred at a manufacturing plant undergoing renovation that specialized in over-the-counter healthcare products and supplied infant formulas for the store brand market. A shaft way/hoist way was built to contain a stationary product lifting system (like a dumbwaiter) to lift product components from the concrete first floor to the second floor. The shaft way was 6 feet wide by 8 feet deep. The second floor could be accessed by stairs and was 22 feet above the first floor. The opening to the shaft way on the second floor had, at one point, two pieces of wood wedged between the walls which acted as a guardrail.

See Drawing 1 on Page 12 for an overview of the incident scene.

Photo 1. Ladder used by decedent

The stationary product lifting system was to be installed in sections. Two sections of the system had been installed the day prior to the incident.

The 24-foot fiberglass extension ladder involved in the incident was missing the manufacturer-supplied rope or equivalent to raise or lower top section of ladder from the base section.

WEATHER

The death occurred indoors and weather was not a factor.

INVESTIGATION

The incident occurred at a global health care manufacturer that specialized in over-the-counter healthcare products and supplied infant formulas for the store-brand market. The firm was adding manufacturing capacity by building an addition to an existing plant.

At some point during the construction process, a make-shift wood barrier system using two pieces of wood was installed at the opening on the north side of the shaft way on the second floor. The two wood guardrail pieces were wedge-fit into the opening with cardboard protecting the wall areas; the guardrails did not overlap beyond the opening nor mechanically fastened to the wall. It is unknown when the top section of the wood barrier was removed leaving only the mid-rail, located approximately 21 inches above the floor (See Photo 2). A coworker indicated the top rail was removed for easier positioning of the ladder.

Photo 2. Lifeline attached to midrail at time of incident

On the day prior to the incident, the work crew prepared the work area and installed two sections of the stationary lift equipment. The crew installed the chain fall and fastened it to a steel beam located above the second floor ceiling in the center of the shaft way. The crew also installed the personal fall protection system to the same beam.

The ladder involved in the incident was extended to approximately 18 feet 4 inches and positioned across the open shaft way (North to South) to allow a worker to operate the chain fall to position the two sections of the product lifting equipment.

Day of Incident

The decedent and the apprentice were instructed to move the chain fall so it was in a better position to lift the third section of the product lift equipment. A new 18" by 18" hole had been cut further south on the ceiling; it was to this position he was to move the chain fall. The ladder was positioned across the shaft way, the safety feet on the floor, at the immediate edge of the open shaft way on the north side and the fly section against the south wall, approximately 16 feet above the 2nd floor. The ladder base and top were not secured. The decedent was wearing a hard hat and safety glasses.

Photo 3. Ladder marks on edge of second floor

The decedent stepped over the mid-rail and onto the ladder. The apprentice told the responding police that the decedent's harness was attached to the retractable lifeline while he worked from the ladder and moved the chain fall. It is unknown when the decedent attached the retractable lifeline, whether prior to or after stepping over the mid-rail.

After moving the chain fall, the ladder was to be removed so a scissor lift could be used within the shaft way. The decedent came down from the ladder and stopped on the bottom rung. The apprentice indicated the decedent removed the retractable lifeline from his harness and secured it to the mid-rail. The decedent, still wearing his harness, then attempted to retract the fly section of the ladder. It appeared that the decedent positioned himself on the 2nd and/or 3rd rung of the ladder base. The decedent was lifting/bumping the fly section to unlock the rung hooks and allow the ladder to compress in order to get it out of the opening. In the process of doing this, the ladder base slipped inward, into the opening and fell feet first, striking the lift equipment and rotating approximately 180^0 before landing on the first floor. The decedent fell 25 feet to the concrete first floor, landing in the northeast corner of the shaft way. The decedent's foreman was in the area prior to the incident and was just walking away when the incident occurred. He was with a factory rep for the company that supplied the equipment. The foreman had to leave the building to call 911 because of poor reception inside the building.

Photo 4. View of shaft way from second floor. Red circle locates the ladder feet marks on the edge of the shaft way

A painter from another firm was doing work at the first floor when the decedent fell. He heard the ladder falling and saw the decedent fall almost head first at the 1st floor level. He started first aid, including rescue breathing and chest compressions until the first responders from the manufacturing facility arrived and took over.

The apprentice ran to the job trailer and spoke to the superintendent and procured an AED.

Upon police department arrival, a firefighter from the manufacturing firm and the painter were doing chest compressions. An AED was hooked up to the decedent and no shock was advised. The ambulance arrived shortly thereafter and ACLS protocol was followed. At time of transport to a local hospital, the decedent had a pulse, but he was not breathing on his own. The decedent was then transported to another hospital for further treatment. He died several hours later.

The top guardrail was re-installed after the incident and was wedge-fit into shaft way opening with cardboard, protecting the wall areas from scratching. The ladder also appeared damaged from possibly striking the top of the installed lift equipment.

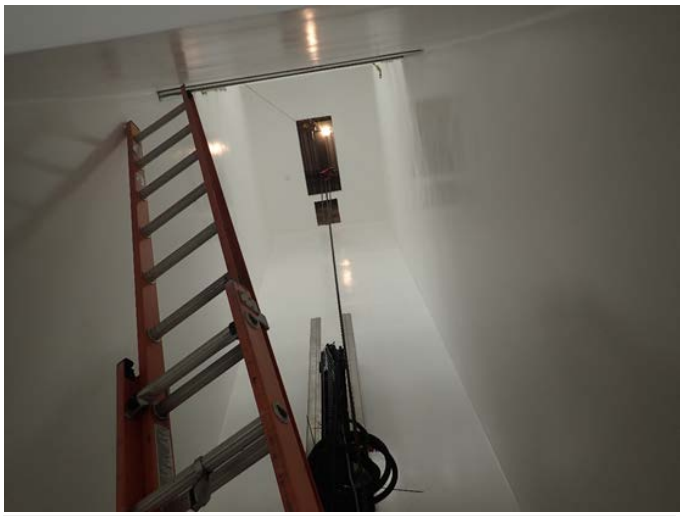

Photo 5. View of shaft way looking up from the ground floor.

The decedent's employer held a company meeting and discussed the incident. Several options to minimize the fall hazard were discussed during the installation of the equipment and the removal of the ladder. Each option had drawbacks for the firm. One option was utilizing a scaffold system, but a scaffold system created issues with the correct installation of the lift equipment. Another option was to cut a hole on the opposite side of the shaft to eliminate the fall hazard in moving the ladder, but creating another hole in the shaft wall and requiring subsequent repair.

MIOSHA CITATIONS

MIOSHA Construction Safety Division issued the following Serious citations and a Notice of a Potential Safety or Health Hazard to the employer at the conclusion of its investigation.

SERIOUS: FIXED AND PORTABLE LADDERS, CS PART 11

- RULE 408.41111(3): A manufactured portable plastic ladder shall be constructed and maintained as prescribed in the ANSI standard A14.5-1982 and supplement 1985, which is adopted by reference in this rule and may be inspected at the Lansing office of the Department of Licensing and Regulatory Affairs. This standard may be purchased at a cost as of the time of adoption of this rule of $42.00 from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado, 80112, telephone number 1-800-854-7179, website: www.global.ihs,com, or from the Michigan Department of Licensing and Regulatory Affairs, 7150 Harris Drive, Box 30643, Lansing, Michigan 48909.

  The fiberglass two-section extension ladder was not properly maintained; It was missing the manufacturer supplied rope or equivalent to raise or lower top section of ladder from the base section.

- RULE 408.41122(2): A ladder shall be placed on a substantial and stable base unless it is secured to prevent accidental displacement. The area around the top and bottom of the ladder shall be kept clear.

An extension ladder set at the edge of an elevator shaft was not secured, and the wooden mid-rail presented a tripping hazard while climbing on and off the ladder.

- RULE 408.41122(8): A ladder shall not be moved, shifted, or extended while occupied by an employee.

  The extension ladder was being moved by an employee who was standing on the lower ladder section.

- RULE 408.41124(1): A portable ladder shall be used at such a pitch that the horizontal projected distance from the top support to the base is not more than ¼ of the vertical distance between these points.

  A fiberglass extension ladder set across the elevator shaft opening with a horizontal projected distance of approximately 8 feet and a vertical distance approximately 16 feet. The pitch exceeded the allowable 1:4 ratio. Employees using the ladder were exposed to a 22-foot fall to interior of the elevator shaft.

SERIOUS: STEEL ERECTION, CS PART 26, RULE 408.42645(1): Except as provided by sub-rule (3) of this rule, each employee engaged in a steel erection activity who is on a walking/working surface with an unprotected side or edge more than 15 feet (4.6 m) above a lower level shall be protected from fall hazards by guardrail systems, safety net systems, personal fall arrest systems, positioning device systems, or fall restraint systems.

The top rail of the guardrail system was removed while employees were at the edge of the elevator shaft working with a chain fall and moving the ladder. Refer to rule 1926.502(b)(1), Part 45 Fall Protection standard.

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) Retractable steel cable lifeline attached above ceiling at *incident* plant may have been attached to hook of employees PFAS, either to end of nylon retractable hook or to D ring on employees back while nylon retractable was also still attached to D ring. See Part 45:
   - 1926.502(d)(6) Unless the snap hook is a locking type and designed for the following connections, snap hooks shall not be engaged:
   - 1926.502(d)(6)(i) directly to webbing, rope or wire rope;
   - 1926.502(d)(6)(ii) to each other
   - 1926.502(d)(6)(iii) to a dee-ring to which another snap hook or other connector is attached

2) Guardrails installed across 2nd level opening at *incident* plant were wedge fit into opening with cardboard on ends to protect wall surface. Not overlapped beyond opening or mechanically fastened. No way to determine slip and friction resistance would meet minimum outward and downward loading criteria required by the standard. See Part 45:

   - 1926.502(b)(3) Guardrail systems shall be capable of withstanding, without failure, a force of at least 200 pounds (890 N) applied within 2 inches (5.1cm) of the top edge, in any outward or downward direction at any point along the top edge.

- 1926.502(b)(5) Mid-rails, screens, mesh, intermediate vertical members, solid panels and equivalent structural members shall be capable of withstanding, without failure a force of at least 200 pounds (890 N) applied within 2 inches (5.1cm) of the top edge, in any outward or downward direction at any point along the top edge.

MIFACE revised the Notice by removing the name of the plant where the fatality occurred.

CAUSE OF DEATH

The death certificate listed the cause of death as craniocerebral trauma. An autopsy was not performed. Upon admission to the hospital, his blood was drawn and was found negative for alcohol, prescription and non-prescription drugs.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. The following unrecognized hazards were identified as key contributing factors in this incident:

- *The decedent unhooked his lifeline from his harness prior to standing on the ladder while attempting to lower the fly section.*
- *The base and top of the ladder were unsecured.*
- *The angle of the ladder across shaftway was too shallow.*
- *The ladder did not have rope to assist in lowering the fly section.*

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Workers should always use fall protection when working above a height per the appropriate regulatory requirement. In this incident, the decedent was performing a steel erection activity, and fall protection was required when working at a height above 15 feet.

Discussion: The scope of the steel erection standard includes construction, alteration and/or repair of materials and assemblies of conveying systems; therefore, the activity performed by the firm was determined to be steel erection and the 15-foot rule for fall protection applied. The decedent's coworker stated that the decedent had previously worn his fall protection when working on the ladder. It is unknown why the decedent removed the lifeline while working from the ladder to remove it while the ladder still spanned the shaft. When the ladder base moved into the open shaft way, the decedent was unprotected from the fatal fall. Workers should always wear fall protection as required by the applicable regulatory standard.

Recommendation #2: Ensure ladders are inspected, set up and used correctly. Remove ladders from service if found defective.

Discussion: The employer should ensure workers adhere to company safety policies. The firm had a ladder safety section in their written health and safety program and had trained workers about safe ladder use. Training included how to inspect a ladder, place a ladder at the appropriate angle, and remove a ladder from service if defective. The company representative indicated that there was uncertainty regarding whether a rope was *required* to be present on an extension ladder. Workers sometimes removed the rope from extension ladders because the rope was "in the way". When a ladder manufacturer includes a rope in the construction of the ladder, the rope is a "required" piece of the

ladder and should not be removed, or if removed when the ladder is disassembled, it should be re-installed when the ladder is reassembled.

The decedent was standing on the ladder while he attempted to release the fly section. Adjustment of an extension ladder *must* be made by the user when standing at the base of the ladder, not while standing on it, so that proper engagement of the rung locks can be observed.

The ladder had been placed at an angle less than 75^0, the optimal angle for ladder placement and use. The NIOSH Ladder Safety App can be downloaded on Apple iPhone/iPad and Google Android devices to provide user-friendly guides and interactive tools to prevent major causes of falls. The app is available in English and Spanish and can be found here.

The ladder was not tied, blocked, or otherwise secured to prevent displacement at either the top or at the base when it was positioned across the shaft way. The bouncing motion of the ladder as the decedent attempted to unlock the rung locks contributed to the ladder feet sliding from their position at the edge of the shaft way into the open shaft way. If the ladder feet had been appropriately secured, the ladder base would not have moved.

Recommendation #3: The employer should consider instituting daily pre-task planning while working on a construction project.

Discussion: Daily pre-task planning might have brought these hazardous ladder positions to the attention of management. Before any hazardous task is started a thorough review of how the task is to be done safely should be p*er*formed. Workers should agree on the safe method of preforming the task before it is started.

ADDITIONAL RESOURCES

NIOSH Mobile Ladder Safety Application. https://www.cdc.gov/niosh/topics/falls/mobileapp.html

elCOSH Focus Four Toolbox Talks, Module 1 – Falls, Talk #6 – Falls from ladders.

elCOSH. Preventing Falls from Ladders in Construction: A Guide to Training Site Supervisors.

CPWR You Tube Video. Don't FALL For It – Ladder Safety Package. Includes a You Tube Video, Four Ladder Safety Modules, and a pre- and post- survey. http://www.elcosh.org/video/1220/a000081/Don't%20Fall%20For%20It!.html

MIOSHA Ladder https://www.michigan.gov/lara/0,4601,7-154-11407_15333_46807-174620--,00.html

Extracting Stuck Equipment Safely: How to Avoid and Painful Incidents. Purdue University Extension. https://www.extension.purdue.edu/extmedia/PPP/PPP-98.pdf

DISCLAIMER

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REFERENCES

MIOSHA standards 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 Division, Part 11-Fixed and Portable Ladders.

ACKNOWLEDGEMEMENT

The Michigan FACE Program would like to acknowledge the vice president of the firm for providing assistance and information for this investigation.

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Drawing 1. Drawing of Scene.