

FACE 88-06: Plumber Falls to His Death Through a Roof opening

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On October 30, 1987, a 24-year-old plumber died when he fell 22 feet through a skylight opening to a concrete floor.

CONTACTS/ACTIVITIES

State Occupational Safety and Health Administration (OSHA) officials notified DSR concerning this fatality and requested technical assistance. On December 10, 1987, a DSR research team conducted a site visit, met with employer representatives and co-workers, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was employed as a plumber by a construction company which employs 50 workers. The employer has a written safety program and the victim had received both written and verbal safety instruction. The victim had worked for the company for approximately 6 months at the time of the incident.

SYNOPSIS OF EVENTS

On the day of the incident, the victim was working as a member of a crew installing various plumbing fixtures/fittings on the 36,000-square-foot roof of a new building. The victim had been working on this project for several days. The incident occurred near the end of the work day, after the victim had been on the job for 7 1/2 hours.

Numerous 4-foot-square openings, framed by 2- by 6-inch material, were present in the roof. These openings were to be used for installing "fire dome"--type skylights. No guards were present around these skylight openings, nor was any fall protection provided underneath the openings.

At the time of the incident, the victim and a co-worker were discussing the relocation of a fixture on the roof. The victim was walking away from his co-worker while looking back over his shoulder to talk. He stepped into one of the skylight openings and fell approximately 22 feet to the concrete floor below, striking his head, neck, and shoulders.

Emergency medical service (EMS) personnel were called to the scene and arrived approximately 15 minutes after the fall occurred. Medical care was provided both at the scene of the incident and while the victim was being transported to a nearby hospital. The victim was pronounced dead at the hospital approximately 1 hour and 20 minutes after the incident.

CAUSE OF DEATH

The medical examiner ruled that death was due to multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide a level of guarding and/or fall protection around all roof openings that is equivalent to requirements specified by OSHA 29 CFR 1926.500 (b)(4).

Discussion: A guardrail, as required by OSHA 29 CFR 1926.500(b)(4), could have prevented the fall. In instances where the use of a standard guardrail is not practical for the type of work, an alternative form of fall protection, such as safety nets, catch platforms, etc., should be used. Construction which utilizes large numbers of skylight openings is becoming more commonplace. Consequently, numerous openings can be present on roofs during construction activities. As this type of building design increases, the potential for falls continues to grow. Guarding and/or fall protection must be utilized during the construction process, otherwise an increase in this type of incident is to be expected.

Recommendation #2: Employers should periodically monitor worksites to evaluate field compliance with company safety rules and procedures.

Discussion: While the company had a written safety program, field compliance was inadequate to protect the victim from the worksite hazards. A safety program, no matter how detailed or comprehensive, cannot be effective unless it is implemented at the worksite.

Recommendation #3: Employers should perform job hazard analyses to identify the hazards to be encountered by their employees and to develop hazard control measures for the jobsite.

Discussion: A job hazard analysis is one method of identifying the hazards associated with performing a job. Failure to adequately identify and control these hazards results in unnecessary employee exposure to harmful and potentially fatal energy sources.

Recommendation #4: Employers should utilize the job hazard analysis as a tool for training employees on the hazards associated with specific jobs and on the measures the employer intends to use to control these hazards.

Discussion: General training on company safety procedures should be supplemented by training on hazards known to exist during a specific job. Such training can make employees aware of the hazards to which they are exposed. At the same time, employees can be shown the measures which are to be taken for their protection. The job hazard analysis, through its breakdown of a job into specific steps, the hazards associated with each step, and the measures planned to control the hazards, provides an ideal means to relay this information to employees.

FACE 88-07: Roofer Falls to His Death from a Roof in Maryland

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On November 16, 1987, a 41-year-old male roofer died when he fell from roof framing to a concrete floor 22 feet below.

CONTACTS/ACTIVITIES

Officials of the Occupational Safety and Health Program for the State of Maryland notified DSR of this fatality and requested technical assistance. On December 11, 1987, a DSR research team met with employer representatives to review this incident. Prior to a field investigation, DSR personnel discussed this incident with personnel from the Maryland Occupational Safety and Health Administration.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was employed by a roofing company which presently employs 45 persons and has been under the same management since it began operation 4 years ago. The victim had worked for the employer for 2 years prior to the incident and had approximately 20 years experience as a roofer. The employer has a written safety program and employees receive both written and verbal safety instruction. In addition, safety programs on videotape are presented to employees on days when weather or other conditions preclude exterior work.

SYNOPSIS OF EVENTS

On the day of the incident, the victim was working with a co-worker to install roof decking panels on a new building. Four other workers were installing the overlying roofing material on another area of the roof.

The decking panels being installed by the victim were composed of wood fiber and portland cement. Each panel was 32 inches wide by 8 feet long by 2 inches thick and weighed 80 pounds. A tongue-and-groove system on the 32-inch ends permitted the interlocking of adjacent panels. Framing material consisted of 4-inch " I " beams on 5-foot centers, with 1 7/8-inch-wide inverted "T"-shaped purlins, 32 inches apart, forming the support for the decking panels.

At the time of the incident, the victim was standing with one foot on a panel which had already been installed and his other foot on one of the 1 7/8-inch purlins. He was pushing on one end of an 8-foot panel to force the tongue to engage the groove on the adjacent panel. His co-worker was at the far end of the panel guiding it into the groove. According to the co-worker's statement to Maryland OSHA, the panel suddenly dropped into place, and this action may have caused the victim to lose his balance. The co-worker looked up and saw the victim fall through a gap in the framing. The victim fell approximately 22 feet to a concrete floor

and experienced multiple injuries to the head and chest. A supervisor standing on the floor below saw the worker falling. No fall-arresting devices such as safety belts, lanyards, or safety nets were present.

Emergency medical service (EMS) personnel were immediately called and were on the scene in approximately 2 minutes. The victim was treated at the scene and enroute to the hospital. The victim was pronounced dead at the hospital 1 hour and 6 minutes after the incident occurred.

CAUSE OF DEATH

The medical examiner's report stated that death resulted from multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation: Whenever any work is performed where the potential for a fall from elevation exists, employers should ensure that fall-protection equipment is provided and utilized by their employees.

Discussion: The use of a safety belt/lanyard combination, as required by 29 CFR 1926.104(d), is sometimes not practical during construction operations. However, alternative forms of worker protection, such as the safety nets specified in 29 CFR 1926.105 should be considered. Safety nets can be equally effective in preventing injury or death when a worker falls. The use of safety nets below the workers may have prevented the fatality described above.

FACE 88-08: Construction Laborer Falls to His Death from a Roof in Ohio

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On December 7, 1987, a 26-year-old construction laborer in Ohio died when he fell 27 feet from the roof of a building under construction.

CONTACTS/ACTIVITIES

Officials of the Industrial Commission of Ohio (ICO) notified DSR of this fatality and requested technical assistance. On January 5, 1988, a DSR research team met with the employer to conduct an evaluation of this incident. DSR investigators discussed this incident with ICO personnel, and then conducted a field evaluation.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 2 months as a construction laborer by a small construction company specializing in the erection of prefabricated metal buildings. The company has been in existence for 6 years and has been involved in the erection of prefabricated metal buildings for the past 2 years. At the time of the incident, 26 employees worked for the company. Employees receive both classroom and on-the-job training for tasks which they are assigned. Written safety rules are given to employees who must sign a receipt acknowledging that they have received and read a copy of company safety policies. Although the victim had only been employed for 2 months, he had received training in proper work procedures, including specific instruction on how to avoid falls.

SYNOPSIS OF EVENTS

On the day of the incident, the victim was working as a member of an eight-man crew assigned to install roofing on a large (150 feet by 180 feet) prefabricated building. The pitch of the roof on the building is 1/2 foot per 12 feet. At the peak of the roof, a flat area 1 foot wide provides a walkway the length of the structure. Roofing materials were located in bundles on the roof near the area where they were to be installed. Normally this material is packaged in the order in which it is to be installed.

The crew began stretching a roll of heavy, reinforced insulation over the "Z" purlins which form the main supports for the roof. Next, 24-inch-wide, tongue-and-groove metal roofing panels were placed above the insulation and secured with a special crimping machine to form a solid one-piece surface for the roof. Workmen standing on the walkway at the peak of the roof, and on existing secured panels, installed the next roll of insulation and secured the metal roofing above this insulation prior to proceeding further out onto the roof. No fall protection equipment of any type was present, nor was any required by the company's standard operating procedures for this type of job.

At the time of the incident, the victim was standing on the walkway at the peak of the roof beyond the area where roofing tasks were being performed. A single panel of metal roofing 24 inches wide by 25 feet long had been laid across the "Z" purlins in this area. This panel was not secured and would not ordinarily have been placed in this area. For some unknown reason, the victim stepped from the walkway onto this unsecured panel. The panel twisted and gave way, and the victim fell 27 feet through a gap in the metal bracing to the concrete floor.

Emergency medical service (EMS) personnel were called to the scene and arrived approximately 10 minutes after the incident occurred. Casualty care was provided at the scene and while the victim was being transported to a nearby hospital. The victim was pronounced dead at the hospital approximately 26 hours after the incident occurred.

CAUSE OF DEATH

The cause of death was listed by the medical examiner as multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Whenever any work is performed from an elevation where the potential for a serious or fatal fall exists, employers should ensure that fall-protection equipment is provided and utilized by their employees.

Discussion: The use of a "traditional" safety belt/lanyard combination, as required by 29 CFR 1926.104(d), is sometimes not practical during construction operations. However, alternative forms of worker protection, such as the safety nets specified in 29 CFR 1926.105, should be considered. Safety nets can be equally effective in preventing injury or death when a worker falls. The use of safety nets below the workers may have prevented the fatality described above.

Recommendation #2: Unused or unsecured construction materials should be stored only in designated areas.

Discussion: For some reason, possibly because of its length, a roofing panel had been laid across the "Z" purlins at a location away from the work area. The victim may have thought that the panel was secured, and therefore safe to walk upon. If the unsecured panel had been placed in a designated storage area, this fall may not have occurred.

FACE 88-09: Ironworker Falls to His Death from a Steel Truss in Ohio

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On December 16, 1987, a 56-year-old male ironworker died and a male co-worker was seriously injured when they fell 47 feet from a steel truss to a concrete floor below.

CONTACTS/ACTIVITIES

Officials of the Industrial Commission of Ohio (ICO) notified DSR of this fatality and requested technical assistance. On January 5, 1988, a DSR research team met with the employer to conduct an evaluation of this incident. Prior to conducting a field evaluation, DSR investigators discussed this incident with ICO personnel, and then conducted a field evaluation.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim and a co-worker were employed as ironworkers by a small industrial contracting firm which currently has 70 employees. The company has been in business for 41 years and has a formal safety program. Workers complete an apprenticeship program with the union as well as classroom and on-the-job training with the employer. Reviews of jobsite conditions and hazards are performed prior to the commencement of each day's work. In addition, any employee found to be in violation of company safety policies is subject to disciplinary action, including dismissal.

SYNOPSIS OF EVENTS

On the day of the incident, the victim, an ironworker with 38 years of experience, and two co-workers were replacing steel roof support material in a building that was 59 years old.

The men were working from a 1-foot-wide steel truss as they burned out smaller cross braces and replaced these with new "wind trusses" measuring 19 feet by 11 inches. The truss they were standing on was steel, and the roofing material above them had been removed prior to the start of this work. Company policy calls for the use of safety belts, lanyards, and lifelines during all such work operations.

Prior to the start of the job, horizontal guy lines were installed for tying off lanyards. The workers were wearing safety belts and lanyards which were not secured to the guy lines at the time of the incident. At a pause in the work, one co-worker turned away momentarily. When he looked back around both of his co-workers were gone, having fallen 47 feet from the truss to a dirt-covered concrete floor.

Emergency medical service (EMS) personnel were summoned to the scene by the plant nurse and arrived approximately 7 minutes after the incident. The victim was dead at the scene. The co-worker was treated at the scene and transported to a nearby hospital where he was admitted with multiple traumatic injuries.

CAUSE OF DEATH

The cause of death was given by the coroner as multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employees should be constantly reminded of the importance of using their safety equipment.

Discussion: The company was aware of the need for fall protection systems since they had experienced a similar incident 4 years earlier. That incident led to the development of a company policy requiring the use of fall protection systems at elevated work areas. The company attempted to follow the policy at this worksite by installing a lifeline and providing employees with safety belts and lanyards. The victim, an ironworker of 38 years experience, was wearing a safety belt, yet he failed to secure his lanyard. It is recognized that the nature of the work being performed by ironworkers often requires them to detach their lanyards from a lifeline in order to reposition themselves. For this reason, the feasibility of using safety nets or catch platforms as additional fall protection should be considered. Additionally, efforts to keep employees aware of the dangers posed by failure to use personal protective equipment must be continual.

FACE 88-12: Company President Falls to His Death from Roof

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On February 23, 1988, the 29-year-old male president of a roofing company exited a manlift, and fell approximately 52 feet from the edge of a roof to a concrete entryway at ground level.

CONTACTS/ACTIVITIES

State Occupational Safety and Health Administration (OSHA) officials notified DSR concerning this fatality and requested technical assistance. On March 29, 1988, a DSR research team conducted a site visit, met with an employer representative, discussed the incident with the OSHA Compliance Officer, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was the president of a roofing company that employed four workers. The company, which had been in existence since August 1987, had no written safety policy or program.

SYNOPSIS OF EVENTS

A renovation project was underway at a local high school when the sub-contractor responsible for the roofing operations went out of business. The general contractor then arranged for a new sub-contractor, the victim's company, to complete the remaining roofing operations.

To provide access to the roof (which was 51 feet, 10 inches above ground level), the general contractor mounted a platform on a 60-foot, articulating hydraulic lift. Guardrails around the perimeter of the platform provided fall protection while workers were being lifted and lowered. When the platform was raised in place, access to the roof was provided by a gate on the side of the platform. Hydraulic lift controls were on the platform side opposite the gate. The lift boom was sufficiently long to extend the platform over the edge of the roof, so that workers could easily step down onto the roof (or up onto the platform from the roof). Workers for both sub-contractors complained to the general contractor about the jerking motion of the lift.

At the time of the incident, the new sub-contractor had finished installing the roofing materials and was ready to install the ridge cap at the top of the roof. The victim and two co-workers rode the lift to the edge of the roof. One co-worker opened the gate and stepped onto the roof. As he began to follow, the victim instructed the remaining co-worker, who was operating the lift, to lower the platform. As the co-worker activated the lift controls, the platform jerked and the victim fell from the roof. It is not known whether the platform struck the victim or if the victim was still grasping the gate when the platform jerked. Emergency

medical service (EMS) personnel were summoned by school officials. The victim was transported to a nearby hospital where he was pronounced dead.

CAUSE OF DEATH

The Medical Examiner listed multiple traumatic injuries as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should not use equipment if mechanical problems are reported. The equipment should be removed from service, thoroughly inspected, and repaired if necessary.

Discussion: The victim's employees as well as the employees of other sub-contractors had complained to the general contractor about the jerking motion of the lift. Although the equipment had not been repaired, the victim chose to use it in order to complete the job. If the equipment had been repaired, this incident may not have occurred.

Recommendation #2: The employer should prepare a hazard analysis of each activity making up a roofing job.

Discussion: A proper hazard analysis involves three distinct steps: (1) outlining each step of a task or activity, (2) identifying all potential hazards associated with each step, and (3) developing measures for controlling each hazard. If a hazard analysis had been performed, the employer may have identified the dangers associated with personnel not being clear of moving machinery and subsequently taken measures to prevent this incident. In this case, however, the victim reportedly had a habit of pushing the platform from the roof as it began moving away. He may have been doing this when the platform suddenly jerked, causing him to lose his balance and fall. Individual behaviors are often difficult to anticipate and, therefore, difficult to control.

Recommendation #3: The general contractor should designate only qualified personnel to operate mechanical materials handling equipment.

Discussion: The general contractor allowed several sub-contractor employees to operate the equipment as needed. It is not clear if the general contractor assessed the qualifications of these individuals as operators. However, the general contractor may have been more responsive about repairing the equipment had a qualified operator complained of the problems.

FACE 88-15: Ironworker Falls to His Death from a Steel Column

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On March 28, 1988, a 35-year-old male ironworker died when he fell 60 feet from a steel column to a concrete pad.

CONTACTS/ACTIVITIES

State Occupational Safety and Health Administration officials notified DSR concerning this fatality and requested technical assistance. On April 6, 1988, NIOSH met with company representatives and witnesses, photographed the incident site, and contacted emergency services personnel in the city where the fatality occurred.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this incident, a multi-state construction company involved in steel erection work, had been in business since 1968. An earlier employee of this company was killed in a fall in 1980. The company currently employs 160 persons in various construction operations. Approximately 16 men were employed by the company at the site where this fatality occurred. Company policy requires that workers use a safety belt and lanyard at all times when working off the ground or when not on a properly protected floor. The victim in this incident was a professional ironworker with more than 10 years experience. Although the victim had been working for only 2 months at this construction site, he had previously worked for the same employer on numerous other construction jobs.

SYNOPSIS OF EVENTS

The victim was a 35-year-old ironworker who worked as a "connector." A connector performs the initial bolt-up of structural steel to hold the various beams and columns in place until they can be plumbed and permanently bolted. On the day of the incident, the victim was a member of a construction crew setting a tier of exterior steel columns for a large multi-story building. The crew was in the process of setting a large 30-inch by 24-inch by 30-foot steel column. The column was 30 inches wide on the flange side, and the flanges were 6 inches thick. This column was to extend between the fifth and seventh floors of the building. Because of its size, two tower cranes were used to position the column. Once the column had been secured in position, it was necessary to disconnect the cables which were used to hoist and position the column. One cable was secured to the column at the lower end, while the other was attached to the upper end of the column approximately 90 feet above the ground.

In order to disconnect the upper cable assembly, the victim climbed the 30-inch-wide face of the column, holding on to the flanges. Since the flanges were 6 inches thick, the victim could not grip the flange as he

could on a smaller column; rather, he had to pull himself against the column using body compression for his support. Witnesses state that as the victim neared the top of the column he reached above himself with his right hand to grab a lug located at the top of the column. He needed to hold this lug while he disconnected the hoist cable assembly from the column. The victim was unable to reach this lug, and as he reached back to grasp the flange, he began sliding down the column. As he approached the bottom of the column his right hand was observed to be out of contact with the flange. The victim's right leg struck the bottom collar of the column and the victim fell sixty feet from the column to a concrete pad below.

Fire department paramedics were called to the scene and arrived approximately 5 minutes after the fall. The victim was reported to be unconscious and in shock, with multiple internal injuries. The victim was transported to a local medical center where he died approximately 2 hours after the fall.

No fall prevention or fall arresting equipment was used by the victim at the time of the incident.

CAUSE OF DEATH

The medical examiner's report lists the cause of death as multiple blunt force injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fall protection should always be provided when the potential for a serious or fatal fall from elevation exists.

Discussion: While traditional forms of fall protection, such as the safety belt/lanyard combination, may not be practical or applicable to all situations, an equally effective alternative should be utilized to eliminate the possibility of a fatal or serious fall. Some alternative methods which could have been used in this situation to protect the worker include: (1) safety nets rigged below the work area, or (2) a controlled descent device (retractor reel) secured to the crane rigging above the column. A cable from such a device running to a safety belt on the employee could have prevented this fall.

Recommendation #2: Safety considerations should be addressed during the planning phases of all construction projects. Potential safety problems, such as handling the oversize steel column, should be addressed in a pre-construction meeting between the contractor, architectural engineer, and the property owner.

Discussion: Often construction contracts contain generic requirements for the implementation of safety and health standards by referencing "compliance with all applicable local, state, and federal laws." Such broad-based requirements fail to address specific safety concerns which may be inherent to a project. If discussion of specific safety problems had been addressed prior to the start of the construction, provisions could have been made for the use of alternative safety measures while handling the oversize column, and the fatal fall could have been prevented.

Recommendation #3: Management should ensure that written safety policies and procedures exist and that they are enforced at the worksite.

Discussion: While company policy in this case required the use of a safety belt and lanyard at "all times when off the ground or off a properly protected floor," this policy was not enforced at the worksite. In this

case the employee had a safety belt and lanyard at the worksite; however, when the use of this equipment was impractical, the employee was permitted to work without fall protection of any type. A fatal fall was the result. When existing procedures or equipment are not sufficient for the job at hand, supervisors must take responsibility for implementing an alternative which provides at least the same level of protection as required by normal procedures. If some alternative form of fall protection had been utilized, this fatality would not have occurred.

FACE 88-18: Sheetmetal Helper Falls to His Death Through a Skylight Opening in South Carolina

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On January 6, 1988, an 18-year-old male sheetmetal helper in South Carolina died when he fell 33 feet through a skylight opening to a concrete floor.

CONTACTS/ACTIVITIES

Officials of the Occupational Safety and Health Program for the State of South Carolina notified DSR of this fatality and requested technical assistance. On April 19, 1988, a DSR research team collected incident data, photographed the site, and discussed the incident with the OSHA compliance officer and an employer representative.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 3 months as a sheetmetal helper by a small roofing/sheetmetal company. The company has been in existence for 14 years and employs 14 workers. Employees receive on-the-job training for assigned tasks and the supervisor reviews safety procedures to be followed before the start of each day's work. However, the employer does not have a written safety program.

SYNOPSIS OF EVENTS

On January 6, 1988, the victim was working as a member of a five-man crew assigned to replace corrugated metal roof sheeting (3 feet by 25 feet) and to install sections of chain-link fence material on top of approximately 24 white fiberglass panels (3 feet by 8 feet) used as skylights.

The fencing material was being installed to guard against the fall hazard presented by the fiberglass skylights. In October 1987, a company employee had fallen to his death through a skylight in this building. In the same month, another company employee fractured his hip and legs when he fell through a skylight of another building.

The pitch of the roof of the building is 1/2 foot per 12 feet. There were numerous vent stacks protruding through the roof. The victim was assigned the task of replacing sheet metal around the vent stacks to prevent water leakage. The other crew members were replacing the metal roof sheeting and installing the chain link fencing over the existing fiberglass panels (skylights). No fall protection guards of any type were present around these skylights at the time of the incident.

At 9:30 a.m. the supervisor ordered the crew to stop working until he called the office for further instructions. While awaiting further instructions, the crew left the work area and to warm themselves

walked toward a vent stack which was emitting heat. The victim stepped on the unguarded fiberglass panel and fell 33 feet through the opening to a concrete floor, landing on the back of his head and neck. Emergency first aid was provided by the contractor's dispensary personnel until an ambulance arrived approximately 15 minutes later. The victim was transported to a nearby hospital where he died 2 hours later.

CAUSE OF DEATH

The cause of death was listed by the coroner as multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Guarding and/or fall protection such as that required by OSHA 29 CFR 1926.500(b)(4) or an equivalent form of fall protection should be provided in the area of all roof openings.

Discussion: A guardrail or adequate cover as required by OSHA 29 CFR 1926.500(b)(4) could have prevented this fall. Also, in instances where the use of a standard type of guardrail or cover is not practical for the work being done (such as the task of installing permanent protective covers), alternative forms of fall protection which provide an equivalent level of protection, such as safety nets, catch platforms, etc., should be used. Construction and/or maintenance work which involves skylights is becoming commonplace throughout the nation. As the need for this type of construction/maintenance work increases, the potential for falls also increases. Unless fall protection methods and equipment are used, increased exposure might well lead to an increase in the number of injurious and fatal falls through skylights.

Recommendation #2: Worker safety should be considered and addressed in the planning phase of construction projects.

Discussion: Safety concerns should be discussed and incorporated into all construction projects during planning. These safety concerns should ensure worker safety throughout the entire life of the project. In this instance, poor planning and lack of concern for safety was demonstrated by allowing employees to work on the roof of a building without providing adequate guarding and/or fall protection.

FACE 88-38: Construction Foreman Falls to his Death from a Roof

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On August 11, 1988, a 53-year-old male construction foreman died when he fell from the roof of a building under construction to a dirt floor 30 feet below.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On September 7, 1988, a research safety specialist met with a company representative, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a general construction company specializing in roofing/sheetmetal erection. The company has been in operation for 13 years and employs 15 workers, including 4 job foremen. The company uses written general safety rules and procedures, but no written task-specific safety rules or procedures exist. The victim had been employed by the company for 8 years.

SYNOPSIS OF EVENTS

The construction company was sub-contracted to complete the roofing/sheetmetal work on a building 850 feet long by 180 feet wide by 30 feet high. At the time of the incident the walls of the building had been completed and approximately one-fourth of the roofing panels had been installed.

The roofing panel supports consist of 5-inch-wide bar joists (i.e., light steel joists of open web construction with a single zigzagged bar welded to upper and lower chords at the points of contact). These are positioned on 5-foot centers running the width of the building. Fiberglass insulation is placed on the bar joists and metal roofing panels cover this insulation.

The crew, consisting of 5 workers and the victim, had all been working on separate tasks prior to the incident. At approximately 11:30 a.m. the victim and a co-worker went to the roof to begin applying fiberglass insulation over the bar joists. The co-worker obtained a roll of fiberglass insulation 5 feet wide by 77 feet long. The co-worker rolled the insulation toward the victim, who was standing on the edge of the recently installed roofing panels. As the co-worker came within 10 feet of the victim, the victim stepped from the edge of the roofing panels out onto the 5-inch bar joist, lost his balance and fell to the ground.

The co-worker ran to the contractor's office (approximately 900 feet away) and summoned help. The emergency medical service arrived in 12 minutes and provided basic life support. The victim was transported to the hospital where he was later pronounced dead in the emergency room.

CAUSE OF DEATH

The cause of death was listed by the coroner as multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Whenever work is performed at an elevation where the potential for a serious or fatal fall exists, employers should ensure that fall-protection equipment is provided and used by employees.

Discussion: The use of a traditional safety belt/lanyard combination, as required by 29 CFR 1926.104(d), is sometimes not practical during construction operations. However, alternative forms of fall protection, such as safety nets as specified in 29 CFR 1926.105, should be used. The use of safety nets may have prevented this death.

Recommendation #2: Worker safety should be considered and addressed in the planning phase of construction projects.

Discussion: Safety concerns should be discussed and incorporated into all construction projects during planning and throughout the entire project. In this instance, poor planning of safety procedures was demonstrated by allowing employees to work on the roof of a building without providing adequate fall protection.

Recommendation #3: The employer should review the current safety program and incorporate written safety rules and procedures for specific tasks.

Discussion: A comprehensive safety program should address all aspects of safety, especially those related to specific tasks. These rules and procedures should include, but not be limited to, the recognition and elimination of fall hazards.

FACE 88-39: Lineman Dies from Fall from Utility Pole

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On July 26, 1988, a 33-year-old male lineman died after falling 23 feet from a utility pole.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On September 6, 1988, a research safety specialist met with company officials and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this case was a large municipal power company with 2500 employees. The company has written safety policies and procedures but there is no designated safety officer. The responsibility for safety compliance rests with area managers. The victim had been employed by the company for 9 years; however, he had only 1 year's experience performing the work task during which he was killed. He was considered a "trainee" and was only allowed to perform his job when accompanied by a supervisor.

SYNOPSIS OF EVENTS

The victim was an automatic switchman involved in maintenance and troubleshooting work. On the day of the incident the victim and his supervisor were engaged in routine maintenance on an electrical distribution system. This work involved performing "load tests" on transformers to determine if the overload conditions had damaged the transformers. A period of extended high temperatures in the weeks preceding this incident had resulted in high demands for electrical power for residential air conditioning units. These periods of high demand had caused numerous "surges" resulting in the temporary overloading of pole-mounted transformers. Company policy calls for inspection of all units which show a "red light" indicating that they have experienced an overload. The victim had checked three similar units from a bucket truck the week prior to the incident.

At the time of the incident the transformer on the pole where the fall occurred was in a "red light" condition. Because of the location of this pole it was impossible to gain access to the transformer by a bucket truck. The victim, wearing leather gloves, a standard lineman's tool belt and safety strap, ascended the pole. The transformer was located 26 feet above the ground, 3 feet above a cable television line. The victim could not climb to the transformer with the safety strap around the pole because of this television line. Accordingly, he climbed up the pole with his safety strap over his left shoulder (a standard practice for him) with the intention of securing the strap around the pole after he was above the cable.

When the victim's feet were just below the cable, he grasped a neutral guy wire with his left hand while reaching around the pole with his right hand to remove his safety strap from his left shoulder and secure it around the pole. In the process of reaching around the pole the victim's right hand contacted an energized 120-volt secondary line on the transformer. The supervisor, standing on the ground below, observed the victim in contact with the energized line. As the victim struggled to pull away from this line he fell backwards, striking the ground head first. The supervisor, who was trained in cardiopulmonary resuscitation (CPR), immediately summoned help on his two-way radio and began CPR on the victim. Emergency medical personnel responded in approximately 5 minutes. Neither the supervisor nor the responding emergency medical personnel were able to detect any vital signs following the incident. The victim was transferred to a local medical center where he was pronounced dead on arrival.

CAUSE OF DEATH

The coroner's office listed the cause of death as a broken neck.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Personal protective equipment must be utilized whenever the potential for a serious or fatal fall exists.

Discussion: The belt and safety strap worn by the victim would have been adequate to prevent a fall if used, but these were not utilized due to the difficulty in passing the television cable. A second strap, to provide protection until the climber had the primary strap in place above the lower cable, could have prevented this fall.

Recommendation #2: Insulated personal protective equipment should be utilized whenever work is performed near energized power lines.

Discussion: In this incident the victim was only wearing leather (noninsulated) gloves when he contacted the energized line. If insulated gloves and sleeves had been worn, the victim would not have received the electrical shock which contributed to the fatal fall.

Recommendation #3: Employers should establish and enforce safe work practices for all employees.

Discussion: The procedure of not using the safety strap during the climb, as in this incident, exposes the employee to the potential for a serious or fatal fall. Since this is a common type of situation encountered by linemen, the employer should develop and implement a modified work practice which would abate this hazard.

Recommendation #4: The work environment should be modified to prevent hazards.

Discussion: In this incident, the cable television lines introduced a hazard to the lineman. Had the lines not been on the same pole, the lineman would not have been exposed to this hazard. Alternatively, the power pole should have been placed so that it could have been accessed by a bucket truck--this would have decreased the probability of a fall.

FACE 88-42: Female Cement Finisher Dies in 165-Foot Fall at Construction Site

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On August 25, 1988, a 29-year-old female cement finisher died when she fell 165 feet from a high-rise office complex under construction.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On September 7, 1988, a research safety specialist met with company officials and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a multi-state, multi-divisional corporation that employs 14,000 workers in its construction division. The employer has a written safety policy and a comprehensive written safety program that provides new employee orientation and periodic training for all employees. Daily tailgate meetings are held by crews at the worksite. The victim had been employed for only 4 days; however, she had previous experience in high-rise construction.

SYNOPSIS OF EVENTS

Construction work on the office complex, begun in December 1987, had progressed to the 17th level by August 1988. An electric hoist was used to reach every floor of the complex. A 6-foot-high by 6-foot-wide chain link gate was present across the entrance of the hoist at every floor. The U-shaped latch on each gate was padlocked to prevent unintentional opening and the hoist operator had the only key. The 6-foot-high chain link fence extended 10 feet from the gate in both directions on each floor. Two lengths of 1/2-inch wire rope, at heights of 24 inches and 42 inches from floor level, provided fall protection for the remaining perimeter of each floor.

On the day of the incident the victim and a co-worker were taken by hoist to the 12th floor with orders to patch any holes or rub out any rough spots on the 12th and 13th floors. By lunch time the victim and her co-worker had started work on the 13th floor. The victim and co-worker decided to return to the ground floor to eat lunch and pushed the call button for the hoist. The hoist operator stated during interviews that he had not previously stopped the hoist on floor 13 that day.

The victim then placed her hands in her pants pockets and leaned back against the gate. The gate opened and the victim fell backward 165 feet to the ground. What caused the gate to open could not be determined. It is possible that the clamp attaching the U-shaped latch to the body of the gate may have been loose. This would have allowed the latch to turn and the gate to open. This could not be determined due to the extensive

damage done to the gate. (The hoist, which was above the 13th floor when the victim pushed the call button, had severely damaged the gate as it descended.) However, all witnesses stated that the padlock was locked in place on the U-shaped latch.

The emergency medical service was summoned and arrived within 10 minutes. The paramedics determined that the victim was dead and summoned the county coroner, who pronounced the victim dead at the scene.

CAUSE OF DEATH

The coroner ruled multiple trauma as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should stress the necessity of safe work habits to all employees.

Discussion: During new employee orientation, tailgate safety meetings, and periodic safety training, employers should stress the need to follow safe working habits. Although the victim had been employed for only 4 days, she did have prior high-rise construction experience. To lean against an outer perimeter barrier is a poor safety practice and, in this instance, resulted in her death.

Recommendation #2: The employer should routinely inspect all protective devices to ensure they operate properly. Although the gate was padlocked, it was a mechanical device and a malfunction was possible.

Discussion: Since the incident, the employer has performed random stress tests on the padlocked gates. None of the tested gates opened when pulled to the outside with 250 pounds of pressure. The employer has also welded the latch clamps to the body of all the gates and the gate hinges to their vertical poles to prevent any movement.

Periodically, the hoist operator could stop at each floor to inspect the gates, clamps, and padlocks to ensure that every component of this critical fall protection system remains intact. Just prior to the end of each shift might be an advantageous time to conduct such a floor-by-floor inspection. Had the hoist stopped at floor 13 prior to the fatal incident, the discrepancy which caused the gate latch to fail might have been discovered.

Since the incident, the employer has installed safety bars on all gates that will prevent the doors from opening to the outside. One additional measure the employer might take would be to install signs in clear view on each gate warning workers to stand back until the gate is opened by the hoist operator.

FACE 88-43: Carpenter Dies in 14-Foot Fall from Roof

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On August 17, 1988, a 38-year-old male carpenter died as the result of head injuries sustained in a 14-foot fall from a garage roof.

CONTACTS/ACTIVITIES

State officials notified DSR of the fatality and requested technical assistance. On September 8, 1988, a research safety specialist met with the company owner, photographed the incident site and discussed the incident with the Occupational Safety and Health Administration (OSHA) compliance officer and county coroner.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was one of five carpenters employed by a general contractor who had been in operation for 11 months. The employer had no written safety policy or safety program and did not provide safety training to employees.

SYNOPSIS OF EVENTS

The company had been sub-contracted to frame and finish the exterior of single dwellings in a new housing development. The victim, four co-workers and the owner had been working for 2 weeks on the dwelling involved in the incident. On the day of the incident, the victim and a co-worker were applying the 4-foot-wide by 8-foot-long pieces of sheeting to the roof of the garage portion of the dwelling. The roof had a 10:12 slope (i.e., it rose 10 inches for each foot in length). Short pieces of 2-inch-thick boards (i.e., toe boards) were nailed to the top surface of the sheeting to provide footholds for the workers. The front of the structure was open with no exterior siding in place. The cement floor of the garage had been finished.

When the victim and his co-worker finished applying the sheeting, the victim prepared to cut a 6-inch overhang off the front of the garage roof. The victim lowered a rope to the ground where a second co-worker attached a 7 1/4-inch circular saw. The victim pulled the saw up to the roof, then called to the second co-worker to throw him an extension cord. The victim caught the extension cord, but as he began to unwind and lower it back to the ground to be plugged in, he lost his balance. The victim fell off the roof but was able to grasp the toe board at the edge of the roof. The first co-worker tried to pull the victim back onto the roof but was unable to do so (because their hands and arms were slippery from perspiration).

The victim fell feet first through the open front of the dwelling, but as he fell, his feet struck a rafter. This caused his body to turn 180 degrees and he hit the concrete garage floor head first.

The emergency medical service, summoned by co-workers, arrived within 10 minutes and transported the victim to the local hospital. The victim was later transferred to a second hospital where surgery was performed. At 11: 30 a.m., August 18, 1988, the victim was pronounced brain dead by the attending physician. He died 4 hours later.

CAUSE OF DEATH

The medical examiner listed multiple cerebral contusions as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should strive to provide their workers with the safest possible work environment.

Discussion: Employers involved in roofing operations should provide employees with fall protection devices and ensure the use of these devices. This would provide the safest possible work environment for employees. The use of fall protection devices in this incident would have greatly reduced the possibility of a fatal fall.

Current OSHA regulations pertaining to fall protection during roofing operations do not address falls of under 16 feet. However, the United States Department of the Interior, Bureau of Reclamation's Construction Safety Standards contain Articles that do address these falls. These standards are developed with the cooperation of The Associated General Contractors of America, Inc. , and others. Although not usually required, these should be followed to ensure employee safety.

Article 13.221.1 of these standards requires that employees engaged in roofing activities where the roof edge to ground distance is greater than 6 feet shall be protected by one or a combination of the following types of fall protection:

- a. Lifelines, safety belts, and landyards
- b. Standard guardrails
- c. Safety nets
- d. Catch platform.

This requirement applies to all employees working within 10 feet of the roof perimeter or on a roof with a slope of 1:3 (a rise of 1 inch for every 3 inches in length). Although the roof involved in the incident had a slope that was more than twice the slope limit in the above-mentioned regulation, no type of fall protection was utilized.

FACE 89-02: Ironworker Dies Following a 35-Foot Fall at Construction Site

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On October 8, 1988, a 29-year-old male ironworker (a steel beam connector) died as a result of injuries that occurred when he fell 35 feet at a construction site on September 29, 1988.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On November 4, 1988, a DSR field team met with the Occupational Safety and Health Administration compliance officer, a city building inspector, and company officials. The incident site was visited and photographed.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a steel construction firm employing 40 individuals in steel erection operations. Of these, 14 are steel beam connectors. The company has been in business for the past 50 years. The company has written safety policies and procedures; however, it relies upon the employees' labor union to provide safety training for the employees.

SYNOPSIS OF EVENTS

The victim was a member of a six-man crew erecting the structural steel framework for an addition to an existing building. The victim, a connector, performed the initial "bolt-up" of the structural steel members. After the connector completes work on a component, other members of the crew perform the final bolting operation, "trueing" the involved steel components, inserting all remaining bolts in the column, and tightening these bolts to the required torque.

At the time of the incident a vertical steel column had been installed and the crew was placing a horizontal beam to connect this column to an adjacent one. The adjacent column had already been "trued" and final bolt-up of this column completed. As the crew attempted to place the horizontal beam in position they found that the former vertical column was out of alignment. In order to proceed, the bolts securing this vertical column had to be loosened and the column moved slightly so there was clearance for the horizontal beam.

To do this the victim sealed the column and, while holding onto the column with one hand, attempted to loosen the connecting bolts with the other. As he applied pressure to the wrench it slipped, causing him to lose his balance and fall from the column. The victim fell 34 feet 6 inches to the concrete floor below, striking his head. Personnel on the scene immediately after the incident reported seeing a small pool of blood on the floor around the victim's head. Emergency medical service paramedics were immediately called to

the scene and arrived approximately 5 minutes after the fall. The victim was transported to a local medical center where he died 10 days later.

The victim was not using any fall protection equipment at the time of the incident. According to company officials at the scene, this was "standard procedure" for connectors.

CAUSE OF DEATH

The medical examiner's ruling as to cause of death was pending at the time of this report.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fall protection should always be provided when the potential for a serious or fatal fall from elevation exists.

Discussion: The standard procedure which permitted the victim to work without fall protection failed to provide safety for the worker. While belts and lanyards were present at the worksite, they were not used in connecting operations. Although in some situations traditional forms of fall protection such as the belt/lanyard combination may not be practical, some alternative form of fall protection should always be used to prevent a serious fall. Some alternative methods for these situations include (1) safety nets rigged below the work area as required by 29 CFR 1926.106, or (2) a controlled descent device (retractor reel) secured to an overhead crane and to the worker's safety belt. If either of these systems had been employed this fatality could have been prevented.

Recommendation #2: Management should develop written safety policies and procedures addressing the hazards to which employees are exposed, and should enforce these safe work practices at the worksite.

Discussion: In this company the acceptance of a potentially serious or fatal fall, as indicated by the standard procedure of working without fall protection during connecting operations, demonstrates a lack of commitment to employee safety. Companies should emphasize safety of their workers by developing, implementing, and enforcing safe work procedures to prevent incidents such as this.

FACE 89-03: Painter Dies in 96-Foot Fall from Highway Bridge

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On October 29, 1988, a 43-year-old male painter died when he fell from a bridge he was painting to the rocky ground 96 feet beneath the bridge.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. A research safety specialist discussed this incident with the responsible compliance personnel. On November 3, 1988, a meeting was held with state officials, and the site was visited and photographed.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this incident is a small company with 22 years in the painting business. The company normally employs 12 to 16 individuals, all of whom work as painters. The company has no formal safety program.

SYNOPSIS OF EVENTS

The victim, working as a member of a three-man crew, was painting a highway bridge spanning a large river. The victim and his co-workers had been working on the same bridge for approximately 6 weeks prior to the incident.

On the day of the incident the victim and one co-worker had just finished lunch and were moving materials from one "bay" beneath the roadway to an adjacent "bay" prior to beginning the afternoon's work.

Both men were wearing a safety belt and lanyard, with the lanyards secured to a steel lifeline running along the side of the bridge. To reach the new work area it was necessary to step from one steel "I" beam to another approximately 4 feet away. An expansion joint in the area prevented the workers from making this step while their lanyards were connected to the lifeline.

Although the incident was not witnessed, it appears that the victim, while carrying a partially filled 5-gallon paint bucket, disconnected his lanyard and attempted to step across the 4-foot gap to the next beam. In doing so, he either slipped or lost his balance and fell 96 feet, striking the back of his head on the rocky ground below.

The co-worker, and a supervisor who arrived on the scene just as the incident occurred, immediately summoned local police and rescue personnel. The victim, who suffered partial decapitation, was pronounced dead at the scene by the local medical examiner.

CAUSE OF DEATH

The medical examiner gave the cause of death as multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fall protection should be provided and used at all times when the potential for a serious or fatal fall exists.

Discussion: A safety belt and lanyard, as referenced in 1910.28(g)(9) and 1926.104 or safety nets (1926.105), if utilized, could have prevented this fatality. While safety belt/lanyard combinations were used during actual work at this location, fall protection was not employed either when accessing the area (via vertical ladder from the bridge deck) or when moving from area to area beneath the bridge. Failure to employ fall protection during all phases of the operation resulted in this fatality.

Recommendation #2: Safety should be addressed during the planning phases of all work operations.

Discussion: Potential safety problems, such as the need for fall protection during access and when traveling from area to area beneath the bridge, should be noted prior to the start of work. Specific actions should be taken at that time to ensure that the workers are protected during all phases of the job.

Recommendation #3: Fall protection at the worksite should be sufficient to protect the worker from serious injury or death.

Discussion: The fall protection equipment employed at this site failed to provide continual protection to the worker, specifically during access to the worksite and while relocating from area to area at the site itself. In addition, the safety belt which could have prevented the fall had it been employed, might have inflicted severe or possibly fatal injuries to the victim. Individuals suspended by the traditional safety belt may experience breathing difficulties and other cardiopulmonary problems within a few minutes because of abdomen and chest compression. Because of the remote area where this incident occurred and the difficulty in conducting a rescue operation in this location, it is possible that a worker protected by a traditional belt/lanyard combination might have experienced asphyxiation before being rescued. Alternative forms of fall protection, such as the full body harness or safety nets below the worksite would greatly increase the chances that a falling worker will survive without serious injury.

Recommendation #4: Rescue operation procedures should be established prior to the start of work in all situations where such an operation may become necessary.

Discussion: The worksite in this case was remote, with extremely difficult and limited access. In such a case a rescue plan, developed prior to work Initiation, could increase a victim's chances for survival if he or she falls.

FACE 89-12: Ironworker Dies following a 12-Foot Fall from Metal Decking onto Concrete

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On December 13, 1989, a 20-year-old male ironworker died when he fell 12 feet onto a concrete floor.

CONTACTS/ACTIVITIES

Officials of the state Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. On January 26, 1989, an industrial hygienist, safety engineer, and occupational health nurse from DSR interviewed a company official, conducted a site evaluation, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed since his arrival in the U.S. as an ironworker by a small construction company that does steel erection and decking. He had only been in the U. S. about 7 months at the time of the incident. Although he spoke and understood English, his principal language was Spanish. The company has been in existence for 20 years. At the time of the incident about 60 people worked for the employer. Employees receive on-the-job training for all tasks by the foreman. The company has written safety rules; however, there is no specific safety officer. The job foreman acts as the company's safety representative. There had not been a safety meeting conducted on this particular jobsite, but one had been held with the same crew on a similar job about 1 month before the Incident. The company requires the workers to furnish their own work shoes. Other safety equipment, such as gloves, hard hats and safety belts, are supplied by the employer.

SYNOPSIS OF EVENTS

The victim was a member of an eight-person crew engaged in steel erection at a two-story building under construction. The structure had a floor area of about 30,000 square feet. The concrete ground floor had been finished earlier so that work could continue through the winter months. At the time of the incident the victim and a co-worker were placing corrugated metal decking on steel beam gridwork to serve as the formwork for a concrete floor. The 20-gauge steel decking sheets were 26-feet-long by 3-feet-wide and weighed about 120 pounds. One edge formed an inverted "U" that was slipped over the vertical edge of an adjacent sheet to secure the decking together. The decking rested on four 6-inch I-beams on 8-foot centers. After a sheet was positioned, it was tack-welded to the structural framework.

A co-worker stated that the victim was trying to handle a sheet of decking alone. The victim was dragging the sheet toward the edge of the installed decking when he lost his balance and fell backward. He landed striking the left side of his head against the concrete floor 12 feet below.

One worker went to aid the victim while another called the county emergency medical service (EMS). The EMS team was at the scene within 15 minutes of the incident. EMS care, including back and neck stabilization and oxygen, was provided at the scene and while the victim was being transported to a nearby hospital. The victim was pronounced dead shortly after arrival.

CAUSE OF DEATH

The medical examiner stated that head injuries sustained in the fall caused death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Whenever any work is performed from an elevation where the potential for a fall exists, employers should ensure that fall-protection equipment is provided and utilized by their employees.

Discussion: The use of a "traditional" safety belt/lanyard combination as required by 29 CFR 1926.104(d), is sometimes not practical during construction operations, particularly where worker mobility is required. Use of a retracting lifeline equipped with a locking device, and attached to a support line, can provide sufficient mobility in some cases. In this case, the work was being done only 12 feet above a concrete floor. A retracting lifeline, connected to a safety line and preplanned placement of the decking stack might have prevented this fatality. Alternative forms of worker protection, such as safety nets (as specified in 29 CFR 1926.105), or a catch platform, should be considered. Safety nets can effectively prevent injury or death when a worker falls. Also, in this situation, wheel-mounted scaffolding might have been placed under the workers to serve as a catch platform. This portable scaffolding can be moved to a new location as each area is finished. The use of alternative fall protection systems must be carefully considered, regardless of what height is involved.

Recommendation #2: Hazard identification should be done as a part of the initial job planning.

Discussion: The employer should identify all potential hazards. One way is by analyzing the sequential steps in routine operations to identify potential hazards, and attempting to develop procedures or other control measures which effectively eliminate or reduce the hazards. This type of analysis is known as job hazard analysis. Additionally, each specific job involves hazards particular to that job or working environment. Therefore, employers should conduct a jobsite survey, identifying all hazards, and implementing appropriate control measures prior to starting any job. A jobsite survey in this instance would have identified the need for some type of fall protection. Both job hazard analysis and pre-job survey techniques can be effectively used to train workers in hazard identification and appropriate control measures.

Recommendation #3: The employer needs to train employees in the recognition of hazards, and methods to control such hazards, including the use of appropriate safety equipment.

Discussion: According to 29 CFR 1926.21(b)(2), employers are required to instruct each employee in the recognition and avoidance of unsafe conditions, and to control or eliminate any hazards or other exposure to illness or injury. Although the Spanish-speaking victim could speak and understand English, he may not have fully understood the potential hazards involved with this job. In this and similar situations the employer may need to provide additional training to ensure that these employees understand the hazards and how to properly use safety equipment to protect themselves.

Recommendation #4: Designers of buildings such as this multitiered steel-framed structure should provide for fall protection anchorage systems as part of the overall design of the structure.

Discussion: The building design should allow construction and maintenance activities to be done utilizing safety equipment to protect the workers during potentially hazardous activities. This would include incorporating anchor points for lifelines and/or safety nets as part of the building structure. The incorporation and use of anchorage points in the building design could result in the possible prevention of fall-related fatalities by making it easier for workers to use fall protection during the construction phases of a building.

Recommendation #5: The employer should ensure that workers are using proper material-handling techniques.

Discussion: The victim in this incident was trying to drag a 120-pound piece of steel decking into place by himself. While attempting this task he lost his balance and fell. If another worker had been assisting the victim in placing the piece of decking, the victim may not have fallen.

FACE 89-13: Ironworker Dies Following a 25-Foot Fall through a Roof Opening

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On December 14, 1988, a 41-year-old male ironworker died when he fell 25 feet after stepping through a roof opening.

CONTACTS/ACTIVITIES

Officials of the state Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. On January 26, 1989, a research industrial hygienist, safety engineer, and occupational health nurse from DSR interviewed a company official, conducted a site evaluation, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for about 18 years as an ironworker by a small construction company that has done steel erection services for 20 years. At the time of the incident about 60 people worked for the employer. Employees receive on-the-job training for the tasks they perform. The company has written safety rules, but does not have a safety officer. The job foreman is expected to act as the company's safety representative. A safety meeting was held at this jobsite on November 16, 1988 (the topic of the meeting is unknown). Although workers are required to furnish their own work shoes, the company supplies other safety equipment, such as gloves, hard hats and safety belts.

SYNOPSIS OF EVENTS

The victim was part of an eight-person crew that was finishing the steel erection for a six-story building. Steel decking had been installed on all lower floors and part of the roof. At the time of the incident, the crew had just come back from a break and was going to finish laying the formwork decking in the mechanical area on the roof. (The mechanical area contained the elevator penthouse, and heating, ventilation, and air conditioning equipment).

When members of the crew noticed that the victim had not returned to the roof, they started looking for him. This was about 5 minutes after the rest of the crew was back on the roof. They found the victim lying semiconscious on the fifth floor, where he had apparently fallen after stepping into a 2-foot-square stairway ventilation opening on the roof. Presumably he had picked up a 3-foot by 6-foot piece of decking that had been placed over the opening to keep workers from stepping into the hole. A piece of decking of similar dimensions was needed in the work area. The victim had earlier stated that he knew where such a scrap piece was located. The victim apparently fell about 18 feet onto the concrete stairs and then another 7 feet to the floor where he was found lying across a guy wire.

Upon finding the victim, one worker went to call for emergency help while the others tried to assist the victim. The emergency medical service (EMS) was on the scene within 10 minutes of being notified. Treatment provided on the scene included stabilizing the victim for possible spinal injury. The victim was transported to a trauma center by helicopter 1 hour after he had fallen. He died at the trauma center 12 hours later.

CAUSE OF DEATH

Although the medical examiner's report was not available at the time this report was prepared, the traumatic injuries sustained in the fall are presumed to have caused death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should implement 29 CFR 1926.500(b)(8), which requires that all floor and roof openings be protected with standard railing or a floor hole cover secured against displacement.

Discussion: The roof opening was covered by a piece of decking which was neither secured in place nor identified as a protective covering. Thus, the victim picked up the decking without realizing it was covering an opening. Had the cover been secured in place and prominently labeled, it is less likely that the victim could have removed the cover and fallen through the opening.

Recommendation #2: Hazard analysis should be an ongoing part of each job phase.

Discussion: Before starting each phase of the job, the foreman needs to identify and review the potential hazards with the workers and discuss how the work can be done safely. These discussions should include information on hazards in the immediate work areas as well as information on the activities of other contractors on the site that could create hazards for the foreman's workers. Not only was the roof opening unguarded in accordance with 29 CFR 1926.500(b)(8), but the foreman also failed to inform the crew that he had placed a piece of decking over the stairway vent opening. This would have alerted workers of the opening underneath the piece of decking, and might have prevented this death.

Recommendation #3: The employer should consider cutting the roof openings as the last ironworking activity on the roof to help minimize exposure to this type of fall hazard.

Discussion: By cutting the roof openings as the last activity on the roof, the steel erector reduces the chance that a worker might step into one of these openings. At the time the openings are made in the roof, the steel erector should be required by contract to install covers which are secured in place and clearly labeled, so that other work crews on the roof will not be exposed to the potential fall hazard. The steel erection company foreman should check with the general contractor's representative on the jobsite to determine how the covers are to be secured and labeled. The general contractor will be responsible for the area after the erector leaves and needs to have some control over work activity at the roof opening(s). This can be done by labeling the cover and stating that the general contractor must be contacted for permission to work around the opening.

FACE 89-14: Carpenter's Helper Dies in 24-Foot Fall from Building Under Construction

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On January 6, 1989, a 26-year-old carpenter's helper died as the result of head and neck injuries sustained in a 24-foot fall from the second floor of a building under construction.

CONTACTS/ACTIVITIES

State Officials notified DSR of this fatality and requested technical assistance. On January 26, 1989, a research safety specialist met and discussed the incident with one of the two company owners and the Occupational Safety and Health Administration (OSHA) compliance officer assigned to the case. Photographs of the incident site were taken.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 3 days as a carpenter's helper by a small construction company that has been in operation for 6 years. The company employs 12 workers, including 6 carpenter's helpers. The employer has neither a written safety policy nor a safety program, and does not provide safety training to employees.

SYNOPSIS OF EVENTS

The construction company was hired to renovate and erect an addition to an existing building. The 30-foot-wide by 50-foot-long by 40-foot-high addition was to be used for a clothing store and business offices.

On the day of the incident the victim was working on the addition as a member of a six-person crew. The victim and a carpenter/foreman were on the second floor installing 2-inch by 6-inch gable studs of various lengths. The victim was using a pneumatic round head nailer to secure the bottom of the gable studs to the frame with 3-inch nails. The carpenter/foreman, working off an extension ladder, was securing the tops of the studs to the frame using a conventional claw hammer. Neither the victim nor the foreman was using fall protection and none was required by the company.

At the time of the incident the victim was kneeling on the floor, nailing the outside bottom of a stud to the frame. After the stud had been nailed the victim began to reposition the pneumatic nailer to the side of the stud when he unintentionally hit his left leg above the knee with the nose (i.e., the cylinder that discharges nails) of the nailer. The nailer discharged a 3-inch nail into the victim's leg. The victim called to the foreman and told him what had happened. The foreman descended the ladder, went to the victim, and tried to remove the nail from the victim's leg using the claw hammer. The foreman could not extract the nail with the hammer, so he decided to go to the floor below and borrow a pair of pliers from an electrician. When the

foreman returned to the area of the incident he noticed the victim still kneeling but slumping over toward the open end of the building. Before the foreman could reach him, the victim fell head first out of the opening onto an 8-foot-high stack of lumber that had been piled next to the addition, and then fell the remaining distance to a sand-covered asphalt road. (See Figure).

Emergency medical service (EMS) personnel were called and arrived at the scene in approximately 3 minutes (according to the employer). Advanced life support was provided at the scene and while the victim was being transported to a nearby hospital. Cardiopulmonary arrest occurred enroute to the hospital, and the victim was pronounced dead on arrival.

CAUSE OF DEATH

The Medical Examiner listed multiple traumatic injuries as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: When the potential for a serious or fatal fall exists, the employer should provide fall protection equipment and ensure that it is used by all employees working at elevations.

Discussion: The victim was working 24 feet above ground level in an area where the potential for a fall existed. According to 29 CFR 1926.28 (a), "the employer is responsible for requiring the wearing of appropriate personal protective equipment (PPE) in all operations where there is an exposure to hazardous conditions." If the employer had provided and required the use of fall protection (i.e., safety belt, lanyard, and lifeline) this incident may have been prevented.

Recommendation #2: The employer should design, develop, and implement a comprehensive safety program.

Discussion: A comprehensive safety program should address all aspects of safety, especially those related to specific tasks. These rules and procedures should include, but not be limited to, the recognition and elimination of fall hazards. The employer should comply with 1926-21(b)(2), by instructing each employee to recognize and avoid hazardous conditions and follow the regulations applying to the specific environment to control or eliminate any hazards.

Recommendation #3: Worker safety should be considered and addressed in the planning phase of construction projects.

Discussion: Safety concerns should be discussed and incorporated into all construction projects during planning and throughout the entire project. In this instance, there was no planning of safety procedures because employees were allowed to work in an area where the potential for a fall existed without any adequate fall protection.

Recommendation #4: The employer should design, develop, and implement procedures to be followed in the event of a medical emergency.

Discussion: Preceding the fall, the victim had embedded a 3-inch nail into his left leg above the knee. The foreman, after trying unsuccessfully to extract the nail from the victim's leg, left the victim alone in the area

where the potential for a fall existed. When the foreman returned he witnessed the victim slump over and fall out of the opening to his death. 29 CFR 1926.50(b) and (c) state that, "Provisions shall be made prior to commencement of the project for prompt medical attention in case of serious injury. Also, in the absence of an infirmary, clinic, hospital, or physician that is reasonably accessible in terms of time and distance to the worksite, which is available for the treatment of injured employees, a person who has a valid certification in first-aid training from the U.S. Bureau of Mines, the American Red Cross, or equivalent training that can be verified by documentary evidence, shall be available at the worksite to render first aid." The employer should develop and implement medical emergency procedures to be followed by all employees prior to beginning any project. These procedures should include, but not be limited to, providing for the victim's immediate safety following an incident (in this case moving the victim to a safe area, providing first-aid, and summoning trained paramedics).

Recommendation #5: The pneumatic round head nailer should be evaluated to determine whether the human factors engineering design is adequate.

Discussion: Although the pneumatic nailer was not directly responsible for the victim's death, it may have been a contributing factor. The pneumatic nailer weighs 9 pounds, 7 ounces, and has only a pistol-grip handle for the operator to hold. Also, the nailer is equipped with an automatic fastener feed, approximately 2 feet long, which makes it even more cumbersome to handle and work with, especially over a long period of time. (At the time of the incident, the nailer was being operated with 120 pounds per square inch of pressure.) Human factors engineers should evaluate this type of round head nailer to determine whether modifications can be made to improve its design. Even if this worker had not fallen, he still would have received a potentially serious injury from the nailer.

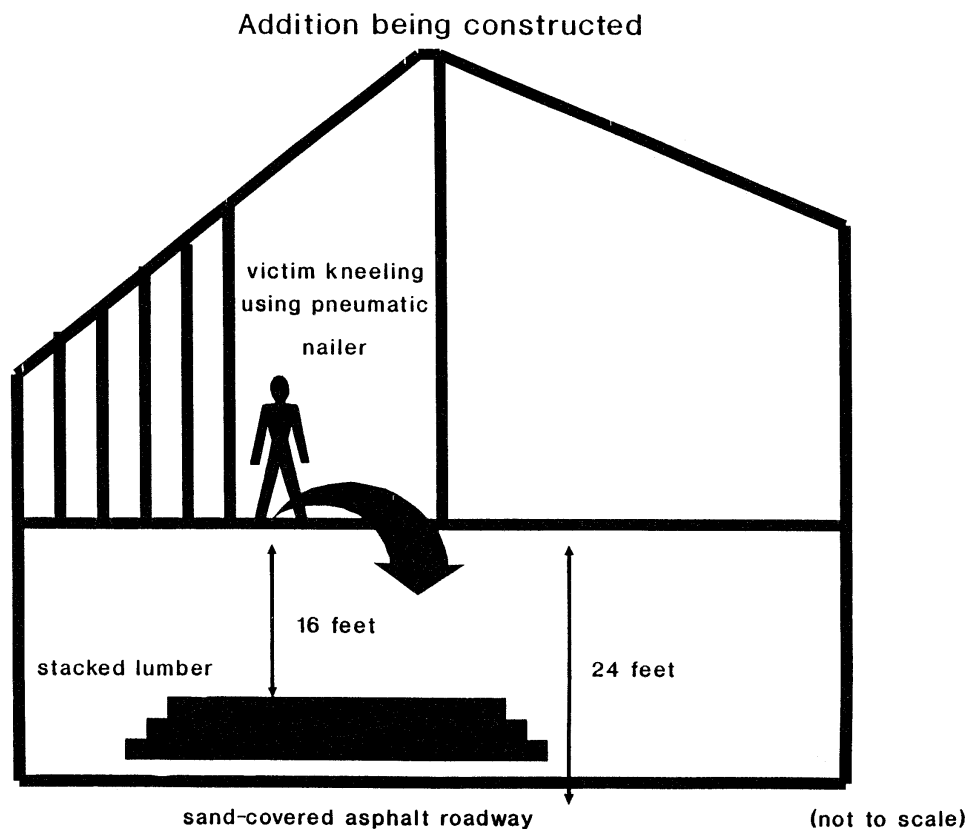


Figure.

FACE 89-20: Construction Worker Dies in 36-foot Fall at Construction site.

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On January 18, 1989, a 37-year-old male construction worker died when he fell 36 feet after a gust of wind caught a piece of metal decking material he was moving and blew him from the roof of a structure.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On February 21, 1989, a research safety specialist met with the employer and local emergency services personnel, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was employed by a steel erection firm which has been in operation for 22 years. The company has approximately 200 employees. The victim was one of approximately 40 workers--known as "sheeters"--who install metal sheeting for siding and roofing. The victim had 18 years' previous experience in sheet metal work, but had been employed by this company for only 2 weeks at the time of the incident. Although the company has written safety rules and procedures, it has no designated safety officer. The responsibility for safety is delegated to the foreman at each individual jobsite. Weekly tailgate meetings are held to discuss safety and conditions at each individual jobsite. No formal safety training program exists. The company had experienced a fatal fall at the same site 3 months prior to this incident.

SYNOPSIS OF EVENTS

At the time of the incident the victim was working as a part of a crew on the construction of a new steel mill. One portion of this mill consists of a 440-foot-long by 96-foot-wide tunnel which connects two of the main buildings at the mill. The height from the ground to the eave of the tunnel is 36 feet. The roof of the tunnel has a 1:12 pitch (one foot of rise for every 12 feet of width). A 2-foot-wide opening at the ridge of the tunnel roof runs the entire 440-foot length of the tunnel. Upon completion of the mill, a roof vent was to be installed in this opening.

On the day of the incident, the victim had been at work for approximately 1 hour when he and a co-worker were instructed to go to the roof of the tunnel and place a temporary cover over the 2-foot-wide opening at the ridge. They were to use 3-foot-wide by 36-foot-long sections of 24-gauge decking to cover the tunnel. Each of these sections weighed approximately 120 pounds.

To reach the roofed area of the tunnel, the victim and his co-worker crawled across an unroofed area of the tunnel on steel "I" beams. Although the beams were more than 36 feet above a concrete floor, neither employee used fall protection equipment.

When they reached the roofed section of the tunnel, the two men proceeded to the first section of decking material they were going to use to cover the ridge vent opening. This section of decking was lying diagonally on the roof of the tunnel. At the time of the incident, the roof surface was dry; however, the wind had been gusting intermittently.

As the co-worker lifted the high (ridge) side of the decking section to move it into position, the victim lifted the low side. The victim was 12 to 14 feet away from the edge of the roof. As the men lifted the decking material, a gust of wind caught it and lifted it upwards. The co-worker immediately released his hold on the section of decking, and the wind carried the decking, with the victim still holding on, over the edge of the roof. The victim was observed holding onto the decking even after he had cleared the roof.

The victim fell 36 feet, landing headfirst on a pile of metal scrap material. The local emergency medical service (EMS) was immediately summoned by telephone and arrived on the scene approximately 10 minutes later. Cardiopulmonary resuscitation was begun by EMS personnel and continued while the victim was transported to the local hospital. The victim was pronounced dead at the hospital approximately 1 hour after the incident.

CAUSE OF DEATH

The medical examiner gave the cause of death as cerebral hemorrhage due to massive head injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Whenever any work is performed at an elevation where the potential for a serious or fatal fall exists, the employer should ensure that fall protection equipment is provided and used by all employees.

Discussion: The victim was working more than 36 feet above ground level in an area where the potential for a fall existed. According to 29 CFR 1926.28(a), "the employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions." If the employer had provided and required the use of fall protection (i.e., safety belt, lanyard, and lifeline) this incident may have been prevented.

Recommendation #2: Management must actively support employee safety and ensure that workers understand hazards related to their job.

Discussion: This same company had experienced a fatal fall of a worker at this site just 3 months prior to this incident. In that incident, as in this one, no personal protective equipment was being used. Management's responsibility in regard to the use of personal protective equipment is clearly stated in 29 CFR 1926.28(a). The continued failure to enforce the use of fall protection indicates a lack of management concern for employee safety. Unless management stresses the need for work safety in both written policy and on the jobsite, deaths such as this will continue to occur.

Recommendation #3: Hazards posed by the weather should be addressed in all construction operations.

Discussion: Written company policy called for work to cease if the wind velocity exceeded 15 miles per hour; however, this was usually at the discretion of the site foreman. No consideration was given to the effect of sudden gusts of wind upon a large sheet of material such as was involved in this incident. If wind conditions had been considered and this work postponed until gusting had subsided, this incident might have been prevented.

FACE 89-22: Roofer/Carpenter Dies After 26-Foot Fall From Roof

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On January 3, 1989, a 28-year-old male roofer fell 26 feet, 6 inches from the roof of a newly constructed six-unit condominium complex. He died as a result of his injuries four days later.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On February 15, 1989, a safety engineer and two safety specialists from DSR met with the employer and discussed the incident with OSHA representatives and the state medical examiner.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was one of four employees (including the owner) of a roofing/aluminum siding company that has been in operation for 13 years. The company has no written safety policy or program. Training is provided on the job. New employees work directly with the owner until they demonstrate that they understand the proper way to perform the job. All employees are provided with safety belts and lifelines to be used as fall protection. The owner requires that all employees wear work boots that are in good condition with substantial tread on the soles. Jobsite tailgate safety meetings are held at the beginning of each job to detail the specific procedures to be followed for that job.

SYNOPSIS OF EVENTS

The company had been sub-contracted to install felt paper and asbestos shingles to the roof of a newly constructed six-unit condominium complex. The roof had a pitch of 6:12 (i.e., the roof rose 6 inches for every 12 inches in length). The structure was 120 feet long and 26 feet wide, and the edge of the roof was 26 feet, 6 inches above ground. On the day of the incident (the first day of work on the structure), the crew arrived at the site at 8:00 a.m. The crew consisted of the owner, his son, the victim, and one other worker (hereinafter referred to as the "co-worker"). All were carpenters experienced in roofing and siding work. Standard operating procedure called for the owner to inspect the roof of a new structure to see if it was properly prepared before his crew accessed the roof. On this day the entire crew climbed the ladders to the roof. Since the roof was wet from dew, the owner instructed the crew to sit on the bundles of shingles placed on the roof by the contractor and wait until the roof dried. The crew's safety equipment and tools were still in the owner's truck.

At 8:45 a.m. the owner felt that the roof had dried sufficiently and told the crew that he was going to inspect the roof. The owner and his son were on one side of the roof; the victim and the co-worker were on the opposite side. Both pairs of men, who were near the ridge (top) of the roof, began to walk toward the

opposite end of the structure. As the victim stepped around a bundle of shingles on the ridge of the roof, he fell to his hip and began to roll to the edge of the roof. The co-worker stepped toward the victim to grab him but was unsuccessful. The victim rolled off the roof and fell to the packed dirt surface below. The co-worker stated that the victim did not appear to slip, cry out, or attempt to halt his fall. Workers on the ground said that the victim fell in a prone position and made no visible effort to land on his feet.

A worker on the ground immediately summoned the emergency medical service (EMS), fire department, and police. The owner went to the road to show the rescue squad the way to the scene. The fire department arrived within 5 minutes. As the owner was speaking to fire department personnel, a worker yelled that the victim had stopped breathing. A member of the fire department crew administered cardiopulmonary resuscitation (CPR) and the victim began breathing on his own again. The EMS squad arrived and transported the victim to the local hospital. The victim was later transferred to a hospital with a shock-trauma unit. On January 4, 1989, the victim was placed on life-support systems. The victim was pronounced brain dead on January 6, 1989, the life-support systems were removed, and he died the following morning.

CAUSE OF DEATH

The medical examiner's report gave the cause of death as multiple injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Worker exposure to identified hazards should be limited and controlled.

Discussion: The company's standard procedure, whereby the owner inspects the worksite prior to allowing the crew to access the roof, limits the crew's exposure to fall hazards. In this instance, the crew did not follow the standard operating procedure, and climbed onto the roof before the owner inspected it. The owner unnecessarily exposed the crew to the fall hazard by permitting them to wait on the roof prior to and during roof inspection. Although this inspection procedure does not eliminate the initial exposure of the owner (during inspection) or the initial exposure of the workers when they access the roof prior to hooking their lifelines, it does reduce the duration of exposure without fall protection. The risk of falls from elevation in the roofing industry should always be minimized to the extent possible.

Recommendation #2: Existing OSHA standards related to fall protection need to be re-evaluated. Increased effort must be placed on developing new methods of fall protection which provide protection during all phases of the job, and promulgating new and revised standards where appropriate.

Discussion: Existing methods of fall protection such as perimeter netting, catch platforms, and air bags or other shock-absorbing materials should be evaluated for feasibility, cost effectiveness, and mechanical effectiveness to determine if they can be successfully used to prevent falls. Additionally, existing safety standards regarding falls must be re-evaluated to determine if they sufficiently address the safety hazards inherent in methods of construction that have been developed since the promulgation of OSHA Standards. Some jobs that expose workers to fall hazards, but are not adequately addressed by current OSHA standards include roofing, skylight installation, and pre-fabricated steel building construction. Increased efforts must be undertaken to develop new methods and safety standards to protect workers from falling. However, during standards development, employers must take the initiative to protect workers by using existing standards and new fall protection techniques and equipment.

FACE 89-23: Painter Dies in 25-Foot Fall from Tank Top onto Concrete Pad

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On December 8, 1989, a 63-year-old male painter died when he fell 25 feet from the top of a tank onto a concrete pad.

CONTACTS/ACTIVITIES

Officials of the state Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. On February 14, 1989, DSR representatives interviewed a company official, conducted a site evaluation and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The company, a small painting contractor, employed five people at the time of the incident. The victim, who had owned the company for most of its 40-year existence, sold it to his son (the present owner) a few years prior to the incident.

The company has a designated safety officer and written safety procedures. The procedures require that safety measures be discussed before each job. The victim and his son had attended a union safety seminar for painting contractors 2 weeks prior to the incident.

SYNOPSIS OF EVENTS

The company had a contract to paint the exterior of several outdoor tanks for a food processing company. The tank involved in the incident was 25 feet high and 10 feet in diameter. A guardrail nearly circled the perimeter of the domed top of the tank. A 2-foot gap in the guardrail permitted worker access to the top. However, the tank did not have a permanent vertical ladder for access. In order to reach the tank top, the painters climbed a permanent vertical ladder on an adjacent tank, then used small pipes, running between the two tanks, as a walkway to access the top of the tank to be painted. The distance between the two tanks was approximately 6 feet.

About a week before the incident, the victim and his son applied the primer coat to the exterior of the tank, using boatswain's chairs and spray guns. (A boatswain's chair is a seat supported by slings attached to a suspended rope, which is designed to accommodate one worker in a sitting position.) They decided not to use ladders because the small tank diameter made placement of the ladders difficult and unstable.

On the day of the incident, the victim was spraying on the finish coat of paint, a catalyzed urethane, using a boatswain's chair tied off to the guardrail atop the tank. He had reached the top of the tank to tie off the

boatswain's chair by climbing the ladder on the adjacent tank, and crossing on small pipes that run between the two tanks. After finishing one section of the tank from the boatswain's chair, he climbed onto the adjacent tank and crossed the pipes once again. While moving the ropes that secured the boatswain's chair to the guardrail, he slipped and fell through the unguarded gap in the guardrail about 25 feet onto the concrete around the base of the tank.

Two steamfitters working in the area saw the victim fall. They said that the victim made no sound and made no attempt to grab onto the railing when he fell. A call was made within minutes for emergency rescue personnel. The victim was pronounced dead at the scene.

Following the incident the victim's son learned that his father had slipped and struck his chest on a truck bed a few days prior to the incident. At least two witnesses reported seeing the victim appear to "black out" for short periods of time in the 2 days before the incident. The son thinks that his father may have had a "black out" spell while moving the boatswain's chair rigging, since he apparently made no attempt to stop the fall.

CAUSE OF DEATH

The medical examiner's report stated that death was caused by internal injuries resulting from the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer needs to identify specific job hazards and take corrective action to ensure the safety of his employees.

Discussion: A review of potential hazards associated with working on the tank would have identified the hazards inherent in climbing onto and working from the top of the tank. This particular tank did not have a permanent ladder providing access to the tank top. Also, the guardrail did not extend around the entire perimeter of the tank. Finally, there was no toe board around the perimeter of the top of the tank to prevent someone from sliding beneath the guardrail. When reviewing how to paint this tank, the employer should have identified methods for protecting workers assigned tasks atop the tank. For example, a section of scaffolding with rails could have been placed between the two tanks to provide safe access to the tank being painted. Also, the opening in the guardrail could have been closed with rope or other material to protect the worker moving the boatswain's chair. To offset the absence of a toe board, the worker should have been tied off with safety belt and lanyard while moving around on top of the tank. The employer used a similar hazard identification process in arriving at the decision not to use ladders to paint the tank.

Recommendation #2: The employer should require that appropriate safety equipment be used, and check to see that it is being used properly.

Discussion: In 29 CFR 1926.28(a), employers are given the responsibility to require that employees wear personal protective equipment when exposed to hazards. While working from the boatswain's chair and while positioned on top of the tank, the worker should have been required to wear a safety belt and lanyard attached to an independent lifeline. Thus if the boatswain's chair or rigging had failed, or if the worker had slipped or lost his balance while on top of the tank, he would not have fallen to the concrete below.

Recommendation #3: Since there are a number of tanks in the area of the plant with no protection at the opening in the guardrail and no toe boards, the food processing company which owns the tanks needs to review and revise company safety practices and procedures for working on the outside storage tanks.

Discussion: A guardrail opening for access needs a means of closure such as chains or gate as per 29 CFR 1910.23 (a)(2), which states that "a platform shall be guarded by a standard railing ... with the passage through the railing either provided with a swinging gate or so offset that a person cannot walk directly into the opening." When working on top of tanks without toe boards, workers should be required to tie off. Without a toe board, a worker could slip and fall under the railing. The owner also needs to determine how the tank top can be safely accessed. If the adjacent tank is to be used, a walkway should be installed between the tanks. If the tank will be accessed by lift or portable ladder, then use of the small pipes running between the tanks as means of access must be prohibited.

Recommendation #4: Designers of tanks of this type should incorporate anchorage points (for securing scaffolds and lifelines) and toe boards into the design of their products; owners of tanks of this type should consult with tank manufacturers to devise means of installing these safety features on existing tanks.

Discussion: Designers of permanent structures such as tanks of this type know that they will require regular maintenance. Designers and owners of such structures must design and install anchorage points on these structures (e.g., on tops of tanks) to which workers can secure scaffolds and lifelines. Omission of designed anchor points causes the workers to improvise anchors or not use them at all.

FACE 89-24: Carpenter Dies in 90-Foot Fall from Top of Parking Garage

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On October 29, 1988, a 49-year-old male carpenter fell 90 feet to his death from the top of a parking garage which was under construction.

CONTACTS/ACTIVITIES

Officials of the state Occupational Safety and Health Program notified DSR concerning this fatality and requested assistance. On February 14, 1989, two safety specialists and a safety engineer from DSR met with company representatives, and visited and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was employed by a construction company that has been in business for 14 years. The company's principal business is the erection of concrete structures. The company employs approximately 800 workers, including 530 carpenters. The employer has a safety officer and written safety rules and procedures. Weekly tool box safety meetings are held at the jobsite, and on-the-job training is provided. Most of the employees are members of local trade unions. The victim had been a carpenter for about 30 years, and had been working for this employer for about 7 months.

SYNOPSIS OF EVENTS

The victim and a co-worker were preparing a form for pouring a prestressed concrete column at the 10th-floor level of a parking garage. The design required that weld plates be embedded in the surface of the finished concrete column. The columns are designed to support precast concrete panels that form the exterior wall of the garage. The panels are secured to the columns by joining the panel weld plates to the column weld plates and then welding them together.

The stressing cable reinforcements, commonly called tendons, had already been installed in the column form and prestressed to their required load. (Prestressing is an operation that places tension in the cable or stretches it by putting it under an applied load of up to 200,000 pounds per square inch of cable cross-sectional area. This causes the cable to become taut much like a guitar string.) In order to get the column weld plates through the maze of reinforcement cables to their proper location, the workers had to use a pry bar to deflect the cables. The weld plate then had to be fitted and secured to the form.

The victim, working from a wooden beam, was tied off to a 1 1/2-inch- diameter rebar in the following manner. The victim secured one end of a 6-foot lanyard to one "D" ring on his safety belt, fed the other end of the lanyard through a second "D" ring on his belt, and then secured it to the first "D" ring. This created

a loop with the lanyard. He took an 8-foot lanyard and, at its midpoint, wrapped it several times around the 1 1/2-inch rebar. He took one end of the 8-foot lanyard, passed it through the loop of the 6-foot lanyard and fastened the snap hook to the snap hook at the other end.

The victim asked his co-worker to get him a portable power saw. The co-worker turned and saw the victim fall off the edge of the building. The victim did not cry out when falling. The co-worker said that he saw the lanyard unwrapping from the rebar.

The victim landed facedown in the dirt just outside the building. The co-workers on the scene moved the victim's head enough so that he could breathe. The emergency squad was called within a few minutes of the incident and arrived within 10 to 15 minutes. The victim had no pulse and was pronounced dead by a deputy medical examiner.

CAUSE OF DEATH

The medical examiner stated the cause of death was multiple internal injuries sustained from the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should train employees in the proper use of the safety equipment provided for worker protection.

Discussion: According to the employer, the victim was tied off in the manner previously described. Since the co-worker reported seeing the 8-foot lanyard unwrapping from the rebar as the victim fell, it is possible that one snap hook rolled out of the other snap hook. (Rollout occurs when the latch is forced open by a twisting or turning action. This typically occurs when two snap hooks are attached together. A typical snap hook needs only about 2 pounds of force to open the hook or latch.)

From the information obtained from state compliance personnel, there were tie-off points that the employees could have used to make the proper use of the available safety equipment. The employer said that the victim had been hired from a union hall and had received previous training. It is difficult to determine accurately what type and level of training a newly-hired employee received from previous employers. Therefore, each employee should be trained in the use of the specific types of safety equipment provided by the company. The employer should be aware of potential hazards (such as snap-hook "rollout") and inform employees of the circumstances that could allow this to happen.

Recommendation #2: The employer should evaluate potential tie-off points and determine if the available safety equipment can work as designed. If the equipment will not work as designed, the employer should contact equipment manufacturers to determine what equipment is available that can do the job properly.

Discussion: The employee tied himself off to a 1 1/2-inch rebar. It is possible that the snap hooks on the lanyards would not fit onto the rebar, and the employee had to come up with another method of securing himself to the rebar. By connecting the two hooks together, the employee created a situation where the potential for rollout existed. He apparently was not aware of this problem. The employer should verify that employees are tying off correctly. When incorrect methods are observed, the employer should take steps to correct the situation. Having employees use locking hooks might have prevented this fatality. (Locking hooks require over 200 pounds of force to open under pressure.)

FACE 89-25: Sheet Metal Mechanic Dies Following a 22-Foot Fall Through a Roof Opening

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On December 20, 1988, a 26-year-old male sheet metal mechanic died as a result of injuries that occurred when he was knocked through a roof opening and fell 22 feet to a concrete floor below.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On February 16, 1989, a DSR safety specialist met with an owner of the company involved in the incident, discussed the incident with the OSHA compliance officer, and visited and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a plumbing and heating contractor which has been in business for 22 years. The company employs 15 individuals, including 6 sheet metal mechanics. The employer has no written safety policy or safety program and does not provide safety equipment or safety training to the employees.

SYNOPSIS OF EVENTS

The company had been contracted to fabricate and install a sheet metal cap over an opening on the flat roof of a large fiberglass manufacturing plant. The 50-inch-square opening was created when an air conditioning duct was removed. The 54-inch-square cap was fabricated from galvanized steel with angle-iron reinforcement. This cap weighed approximately 75 pounds.

On the day of the incident the victim and a co-worker were preparing to install the cap. The victim and the co-worker leaned the cap against a 30-inch-high by 48-inch-wide metal frame that had been previously used to support the air conditioning unit. The frame, located approximately 34 inches from the roof opening, is constructed of 3-inch angle iron. The victim positioned himself between the leaning cap and the roof opening, while the co-worker positioned himself on the other side of the opening. Neither worker was wearing any type of fall protection equipment. The co-worker was kneeling and the victim was stooped over applying caulking to the 6-inch raised curb bordering the opening. A gust of wind blew the cap over. The cap struck the victim, causing him to fall headfirst through the roof opening, to a concrete floor 22 feet below (see Figure).

Workers inside the plant saw the victim fall and immediately summoned help from personnel within the plant. A plant nurse arrived within 3 minutes and initiated cardiopulmonary resuscitation. When the local emergency medical service was called, a local doctor heeded the emergency call over the radio and responded. He pronounced the victim dead at the scene.

CAUSE OF DEATH

The medical examiner's report stated that death resulted from multiple traumatic injuries.

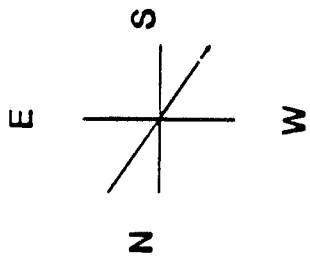
RECOMMENDATIONS/DISCUSSION

Recommendation #1: Whenever any work is performed at an elevation where the potential for a serious or fatal fall exists, the employer should ensure that fall protection equipment is provided and used by all employees.

Discussion: The victim was working 22 feet above ground level in an area where the potential for a fall existed. According to 29 CFR 1926.28 (a), "the employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions." If the employer had provided and required the use of fall protection (i.e., safety belt, lanyard, and lifeline) this incident may have been prevented.

Recommendation #2: The employer, should design, develop, and implement a comprehensive safety program.

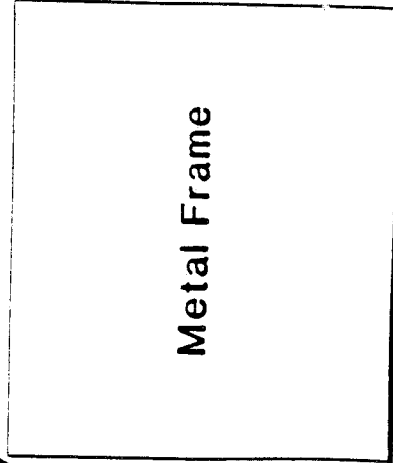
Discussion: A comprehensive safety program should address all aspects of safety, including job hazard analyses. A job hazard analysis should be performed by all employers, prior to the commencement of work, to identify and control all hazards likely to be encountered by all employees. Environmental conditions may also create or contribute to hazardous working conditions, and appropriate precautions should be addressed in the initial job hazard analysis. The employer should have performed a job hazard analysis at the worksite prior to the commencement of work. Such an analysis might have enabled the employed to identify the hazards (i.e., potential for fall, placement of fabricated cap, and gusting wind conditions) and take precautionary measures to protect the employees from injury. If a job hazard analysis had been performed this incident may have been prevented.



Wind out of S-W
Gusting to 21 m.p.h.

Victim Steeping Over

54" x 54" Galvanized Cap
approx. 75 lbs.



Metal Frame

6" High
Raised Curb



50" x 50" Roof Opening

Tar and Gravel Covered Flat Roof

not to scale

Figure.

FACE 89-30: Electrician's Helper Falls to His Death Through a Skylight

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On April 18, 1989, a 39-year-old male electrician's helper died after falling 16 feet through a skylight to a concrete floor.

CONTACTS/ACTIVITIES

State Officials notified DSR of this fatality and requested technical assistance. On April 27, 1989, a research safety specialist met and discussed the incident with the company's vice-president and the Occupational Safety and Health Administration (OSHA) compliance officer assigned to the case. Photographs and a police report of the incident were also obtained.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 9 months as an electrician's helper by an electrical contracting company that has been in operation for 21 years. The company employs 40 workers, including 10 electrician's helpers. The employer has a written safety policy and uses written safety rules and procedures. On-the-job training is provided to employees and weekly safety meetings are also conducted.

SYNOPSIS OF EVENTS

The company had been contracted to install lighting and outside receptacles, as well as remove an existing company sign at an industrial building. The building is 50 feet wide by 200 feet long and is divided into two sections. One section is 20 feet high and the other is 16 feet high.

On the day of the incident the victim was working with an electrician/foreman assigned to finish work on the building. All work had been completed except for removing the sign attached to the side of the 20-foot-high section. The foreman, working from a bucket truck, attached a hemp rope to the sign. The victim, who was on the roof, secured the rope to a fixed metal ladder which provided access between the roof of the lower section to the roof of the higher section. The rope was approximately 1 1/4 inches in diameter by 120 feet long. The foreman disconnected the electric power to the sign and unfastened the bolts which secured the sign to the side of the building. He raised the bucket to a position level with the roof of the building to help the victim lower the sign to the ground. After they lowered the sign, the foreman lowered the bucket to ground level so he could disconnect the rope and load the sign on a truck. The foreman told the victim, still on the rooftop, to coil up the rope and return it to the storage area.

The victim, apparently untied the rope from the ladder, and either tripped, stepped, or possibly sat on a 4-foot-square smoke dome type skylight located near the work area. The skylight broke and the victim fell

16 feet to a concrete floor (see Figures 1 and 2). A 1-foot length of rope was found hanging through the broken skylight following the incident.

The foreman, after loading the sign on the truck, drove around the building and went inside the warehouse section where he found the victim lying facedown on the floor. The foreman checked the victim for vital signs (i.e., pulse and breathing) and found none. He then summoned personnel outside the building to call for help.

Emergency medical service (EMS) personnel arrived at the scene approximately 17 minutes after being called. At this time no vital signs were present and the county medical examiner pronounced the victim dead at the scene.

CAUSE OF DEATH

The medical examiner's report for this incident has not been completed at this time, but severe head injuries incurred as a result of the fall are presumed to have caused death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should review, revise where applicable, and enforce a comprehensive safety program that is task specific.

Discussion: The majority of work performed by the employer is electrical-related and the employer's existing written safety rules and procedures applied primarily to electrical safety. Other safety aspects need to be taken into consideration (e.g., recognition and elimination of fall hazards), incorporated into the safety program, and enforced by the employer. A comprehensive safety program should address all aspects of safety, especially those related to specific tasks and work environments. These rules and procedures should include, but not be limited to, fall hazards. The employer should comply with OSHA standard 1926.21(B)(2), which requires the employer to instruct each employee in the recognition and avoidance of unsafe conditions and regulations applicable to the work environment to control or eliminate any hazards or other exposure to illness or injury.

Recommendation #2: Worker safety should be considered and addressed in the planning phase of all work projects.

Discussion: Safety concerns should be discussed and incorporated into all work projects during planning and throughout the entire project. In this instance, the planning of safety procedures was incomplete for the work being performed by allowing employees to work in an area where the potential for a fall existed without providing adequate written and verbal instructions to recognize and avoid fall hazards. In addition, employers should inform workers of the potential hazards associated with stepping, standing or sitting on skylights.

Recommendation #3: Skylight manufacturers and owners of buildings where skylights have been installed should voluntarily affix accident prevention signs on the skylights, and at or near points of access (e.g., roof hatches, fixed ladders, stairways, doors, etc.) to areas containing these skylights.

Discussion: Although skylights are required to withstand specified amounts of weight (e.g., OSHA standard 1910.23(e)(8) - at least 200 pounds applied perpendicular at any one area), deaths still occur as

a result of workers falling through these skylights. Skylight manufacturers should voluntarily affix accident prevention signs (Figure 3) at conspicuous places on the skylights. Also, owners of building where skylights have been installed should voluntarily affix similar signs (Figure 4) at or near points of access to areas containing these skylights. These signs would visually warn individuals of the potential fall hazard posed by stepping, standing, or sitting on a skylight. Characteristics of accident prevention signs and tags (i.e., classification, design, color, layout, finish, lettering, placement, illumination, and symbols), should comply with the American National Standards Institute (ANSI) standards Z35.1-1972, and OSHA standards (general industry and construction industry) 29 CFR 1910.145 and 1926.200.

Signs should be easily visible to anyone approaching the area, should contain specific information on procedures, should be inspected on a regular basis, and should be printed both in English and in the predominant language of non-English-reading workers. Also, workers unable to read posted signs should receive instructions regarding hazardous area.

Recommendation #4: Designers/manufacturers of skylights should evaluate current designs with a view toward increasing load capacities and/or incorporating safeguards.

Discussion: Skylight materials may weaken due to age and/or environmental conditions. As a result, the probability that a person could exert sufficient pressure to break through skylights may increase. Designers/manufacturers should consider design modifications to skylights which would strengthen these units sufficiently to enable them to support a person should that person step, sit or fall onto a skylight. If the smoke venting effectiveness of the skylight would be adversely affected by such changes, consideration should be given to development and utilization of other alternatives for increasing the strength of skylights, e.g., a dome-shaped wire cover to fit over the skylight.

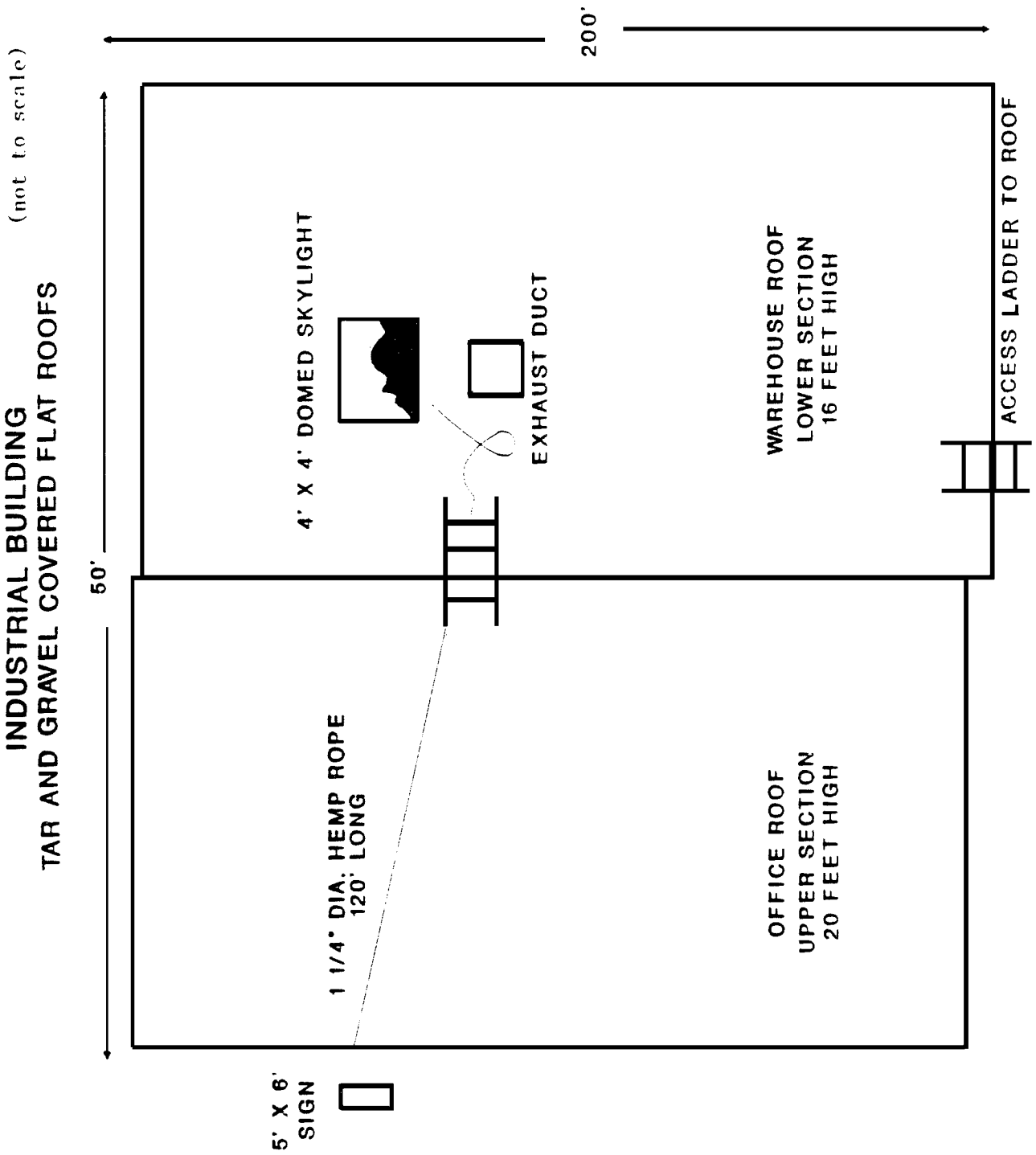


Figure 1. A Diagram Showing the Roof Area of the Industrial Building



Figure 2. This Figure Shows an Intact Smoke Dome Type Skylight Just Opposite the Broken Skylight. The Fixed Ladder Providing Access to Roof of the Higher Section of the Building is Shown at Left.



Figure 3. Recommended Accident Prevention Sign to be Installed at Areas Containing Skylights.



Figure 4. Recommended Accident Prevention Sign to be Applied to Skylights.

FACE 89-34: Ironworker Dies in Fall from a Warehouse Under Construction

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On April 29, 1989, a 40-year-old male ironworker died as a result of injuries that occurred when he fell nearly 40 feet from a steel beam of a warehouse under construction.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On May 17, 1989, two research safety specialists discussed the incident with the company and the Occupational Safety and Health Administration's (OSHA) district office. The county coroner was contacted and photographs of the incident site were taken.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 13 years as an ironworker by a steel erection company. The company, which has been in business for 15 years, normally employs 5 workers. The company does not have a written safety and health program. At the time of the incident, hard hats were the only personal protective equipment being used by the company's employees.

SYNOPSIS OF EVENTS

The construction company had been subcontracted to erect the steel framework for a 300,000-square-foot distribution warehouse. The warehouse frame was constructed mainly of vertical "I" beams measuring 37 feet 8 inches tall, 5 1/2-inch-wide flange horizontal "I" beams, and bar joists (i.e., light steel joists of open web construction with a single zig-zagged bar welded to upper and lower chords at the points of contact) to support the roof.

On the day of the incident the victim was working as a member of a six-person crew which included the company owner. Since only half of the building frame had been erected, the crew was still in the process of erecting the skeleton steel.

The victim's task was to connect bar joists to the horizontal 5 1/2-inch-wide flange "I" beams. The victim was positioned on the top of a beam (approximately 38 feet above the ground) in order to connect the beams with bolts and nuts. After completing a connection, he stood up on the beam and began moving to the location of the next connection. The owner, who was operating a crane to move a bar joist into position for connection, saw the victim slip and fall from the beam. The victim struck a horizontal "I" beam 15 to 20 feet below, and then fell to the brick-and dirt-covered ground.

The owner/crane operator told an employee to telephone for an ambulance. The Emergency Medical Service (EMS) responded in approximately 4 minutes after being called. The EMS provided advanced life support and transported the victim to the local hospital. The victim was pronounced dead in the hospital's emergency room a short time later.

CAUSE OF DEATH

The county coroner stated that death resulted from multiple traumatic injuries sustained from the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Whenever any work is performed at an elevation where the potential for a serious or fatal fall exists, the employer should ensure that fall protection equipment is provided and used by all employees.

Discussion: The victim was working 37 feet 8 inches above the ground in an area where the potential for a fall existed. The Code of Federal Regulations (29 CFR 1926.28 (a)) states that "the employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions." If the employer had provided and required the use of fall protection (i.e., safety belt, lanyard, and lifeline) this incident may have been prevented.

Additionally, when the traditional safety belt/lanyard combination is impractical, an alternate form of fall protection (e.g., safety nets as specified in 29 CFR 1926.105) should be used. The use of safety nets may also have prevented this death.

Recommendation #2: Worker safety should be considered and addressed in the planning phase of construction projects.

Discussion: Safety concerns should be discussed and incorporated into all construction projects during planning and throughout all construction phases of the project. In this instance, there was no planning of safety procedures because employees were allowed to work in an area where the potential for a fall existed without adequate fall protection. Employees walked across steel beams without using fall protection (e.g., lifeline, belt/lanyard) or having passive fall protection (e.g., nets, catch platforms) in place.

Recommendation #3: The employer should design, develop, and implement a comprehensive safety program.

Discussion: In this company the acceptance of a potentially serious or fatal fall, as indicated by the normal operating procedures of working without fall protection during connecting operations, demonstrates a lack of commitment to employee safety. Employers should emphasize safety of their employees by designing, developing, implementing, and enforcing a comprehensive safety program to prevent incidents such as this. The safety program should include, but not be limited to, the recognition and avoidance of fall hazards and the use of appropriate fall protection.

Recommendation #4: Prime contractors and subcontractors should abide by 29 CFR 1926.16 (a), Rules of Construction, which states: "In no case shall the prime contractor be relieved of overall responsibility for compliance with this part for all work to be performed under the contract."

Discussion: Although the subcontractor failed to provide a safety and health program for the employees, the prime contractor was equally at fault by not addressing the issue. The prime contractor should use contract language that requires subcontractors to identify how they intend to implement a site safety and health program. The program should be consistent with the prime contractor's program and differences should be negotiated before the subcontractor begins work. In this particular case, it is evident that the prime contractor did not require the subcontractor to utilize fall protection measures. Had such language been in the contract and enforced on the site, the subcontractor would probably have implemented some type of fall protection measures along with a written safety and health program for this particular site.

FACE 89-41: Carpenter Dies After 13-foot Fall Through Roof Opening Onto Concrete Floor

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On June 8, 1989, a 27-year-old male carpenter fell through a duct opening on a roof, to a concrete floor 13 feet, 4 inches below, sustaining massive head injuries. He died 6 days later from the injuries.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On June 27, 1989, a DSR research team consisting of a safety engineer and a safety specialist conducted a site visit, interviewed a company representative, photographed the site of the incident, and discussed the incident with local emergency personnel and state medical examiner personnel.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 2 months by a construction company that was building a shopping mall. He was hired as an experienced carpenter from the local union hall. The company has about 70 employees total, had 3 carpenters at the shopping mall site. The company has no designated safety officer. The job superintendent has conducted safety meetings in the past, but indicated that the last safety meeting he conducted was over a year prior to the incident. The company has written safety rules that were not made available to the investigators. The company provides no safety training, relying upon the union and previous employers to provide safety training.

SYNOPSIS OF EVENTS

The company had been contracted to construct a small shopping mall. The victim had been made the lead carpenter of a 3-man carpenter crew about a week before the incident. On the day of the incident, the victim and the job superintendent discussed what work was to be performed. The victim intended to work on the roof with electric power tools. He told co-workers that he was going onto the roof to drop an electrical cord down for someone at floor level to plug into an outlet.

A short while later, co-workers heard the sound of a piece of wood falling. Upon investigation, they found the victim lying on the concrete floor of the structure bleeding from injuries to the right side of his forehead. The victim was conscious and one co-worker provided first aid while another notified the superintendent, who immediately called for emergency services. Local fire department personnel responded within 6 minutes of notification and, upon evaluating the situation, called for a trauma transport unit. Emergency medical service (EMS) personnel stabilized the victim's head, took vital readings, did a spinal immobilization, provided oxygen, and prepared for transportation by helicopter. A medical helicopter transported the victim to the trauma unit of an area hospital. The victim died in the hospital 6 days after the incident.

There were no eyewitnesses to the incident. Investigation of the scene after the incident revealed that the nails had been removed from one side of a 4-foot by 8-foot sheet of 5/8-inch plywood that was placed over a 37-inch by 67-inch roof opening for a heating, ventilation, and air conditioning unit. The victim apparently removed the nails from one side of the plywood cover so that he could drop an electric cord down to the floor where power outlets were available. He apparently knelt down and leaned into the opening with the plywood resting on his back in order to look for somebody to plug the cord into an electrical outlet. While kneeling, the victim either lost his balance or the weight of the plywood caused him to fall headfirst onto the concrete floor below.

CAUSE OF DEATH

The medical examiner's report has not yet been received; presumably, multiple traumatic injuries resulting from the fall caused his death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: During planning for any job, consideration should be given to providing temporary power to locations where powered tools will be needed.

Discussion: The job planning should have identified that electrically-powered tools would be needed to work on the roof. Provisions should have been made to provide temporary electrical outlets on the roof at several locations. This would have eliminated the need to drop a cord down through an opening and could have prevented this incident.

Also, the installation of temporary power on the roof would allow management to establish specific tool use areas. Minimizing the number and length of electrical cords at worksite locations minimizes the creation of tripping hazards, and the potential that insulation on the electrical cords might be damaged, possibly leading to electrical shock hazards.

Recommendation #2: Warning signs should be present on all roof covers.

Discussion: The cover should have been affixed with a warning sign indicating that the plywood sheet was covering an opening and should not be removed without the job superintendent's permission. The victim obviously knew there was an opening below the plywood since he was attempting to provide electric power to the roof by dropping a cord through the opening. A warning sign might have made him stop to evaluate if there was a safer place to drop the electric cord down to the ground floor.

Recommendation #3: The company should develop and implement an active safety program.

Discussion: The company has no active safety program. The job superintendent indicated that he had not had a safety meeting in over a year. The company should implement a safety training program in compliance with CFR 1926.21(b)(2), which requires employers to instruct all employees in the recognition and avoidance of unsafe conditions that could lead to injury.

Areas that the safety program should cover include:

- Housekeeping (The housekeeping in the building was poor.)

- Hazard recognition. (An employee without a hard hat was cleaning up trash immediately below workers on the roof.)
- Fall protection (A carpenter was working 15 feet above the ground without any fall protection equipment.)
- Ladder safety (A ladder that was used to access the roof did not extend 3 feet above the roof and was tied off with a piece of scrap binder twine.)

FACE 89-47: Laborer Falls to His Death Through a Skylight Opening

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On July 24, 1989, an 18-year-old male laborer died after falling through a skylight opening 27 feet to a concrete floor.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On August 23, 1989, a DSR field team met and discussed the incident with a company representative and an Occupational Safety and Health Administration (OSHA) compliance officer assigned to the case. On the following day, the DSR team conducted an investigation at the incident site. Police, emergency medical service, and coroner reports relating to the incident were obtained.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed as a laborer for 8 days by a roofing and metal fabrication contractor. The company, which has been in business since November 1984, employs 60 workers, including 20 laborers. At the time of the incident, the employer had no written safety policy or safety program. The employer provides on-the-job training, and requires each employee to view a 15-minute videotape on general safety.

SYNOPSIS OF EVENTS

The company had been contracted to install foam insulation boards and single-ply rubber roofing over a newly constructed 225,000-square-foot, corrugated-steel-paneled roof. The main roof is flat and contains an area (penthouse) which extends 7 feet higher than the main roof. Lengthwise, the 30-foot-wide penthouse spans the width of the main roof. At the time of the incident, the penthouse roof contained 4 unguarded 10-foot-square openings, which were to be used for installing skylights.

On the day of the incident, the victim was part of a six-person crew assigned to move insulation boards from a storage area on one side of the main roof, over the penthouse roof, to the other side of the main roof where the boards were to be installed. The subcontractor had intended to place the boards on the same side of the main roof where they were to be installed, but wet ground conditions precluded moving the crane to that side of the building and the boards were unloaded on the opposite side of the roof. Two members of the crew carried insulation boards from the storage area to the penthouse area. Two other crew members, including the victim, carried the boards to the opposite side of the penthouse where the remaining two crew members moved the boards to the work area. At some point during the task, the victim was walking backwards dragging insulation boards when he fell through the skylight opening to a concrete floor 27 feet below (see Figure 1).

A crew member immediately notified the job foreman, who called the local rescue squad. The rescue squad responded within 5 minutes and stabilized the victim. The victim was then evacuated from the site to a hospital trauma center by a state police helicopter. The victim died the following day.

CAUSE OF DEATH

The medical examiner's report listed multiple head and chest injuries as cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Prime contractors and subcontractors should contractually agree on specific site safety and health programs to be implemented prior to the initialization of work.

Discussion: Although the subcontractor failed to provide a safety and health program for the employees, the prime contractor should ensure that all subcontractors address safety and health issues on the jobsite. The prime contractor should use contract language that requires all subcontractors to identify how they intend to implement a site safety and health program. The subcontractor programs should be consistent with the prime contractor's program and differences should be negotiated before the subcontractors initiate work.

In this particular case, it is evident that the prime contractor did not require the subcontractor to utilize fall protection measures (e.g., provide guarding for roof openings). Had such a requirement been in the contract and enforced on the site, the subcontractor would probably have implemented some type of fall protection measures along with a written safety and health program for this particular site.

Recommendation #2: The prime contractor or subcontractor should have implemented 29 CFR 1926.500 (f)(6), which requires that all skylight openings that create a fall hazard be guarded with a standard railing, or covered with a material capable of supporting the maximum intended load and so installed as to prevent accidental displacement.

Discussion: Employers should assume the responsibility of providing for the safety and health of the workers. Neither the prime contractor nor the subcontractor took the necessary precaution--guarding the skylight opening. If the skylight had been guarded in accordance with 29 CFR 1926.500 (f)(6), the incident may have been prevented.

[Note: During the DSR investigation, it became apparent that guards had been installed around the skylight openings subsequent to the incident. These guardrails, however, did not appear to meet the requirements specified in 1926.500 (f)(1) (see Figure 2). The guardrails, as erected, did not include an intermediate rail midway between the top rail and toeboard.]

Recommendation #3: Worker safety should be considered and addressed in the planning phase of construction projects.

Discussion: Safety concerns should be discussed and incorporated into all construction projects during planning and throughout the entire project. In this instance, planning was inadequate. Employees were allowed to work in close proximity to unguarded skylight openings without adequate fall protection.

Recommendation #4: The employer should design, develop, implement, and enforce a comprehensive safety program.

Discussion: This company accepted the risk of a potentially serious or fatal fall by failing to provide fall protection for workers exposed to unguarded skylight openings. Employers should emphasize safety of their employees by designing, developing, implementing, and enforcing a comprehensive safety program to prevent incidents such as this. The safety program should include, but not be limited to, the recognition and avoidance of fall hazards.

[Note: The employer has designed and implemented a written safety program since the time of the mishap.]

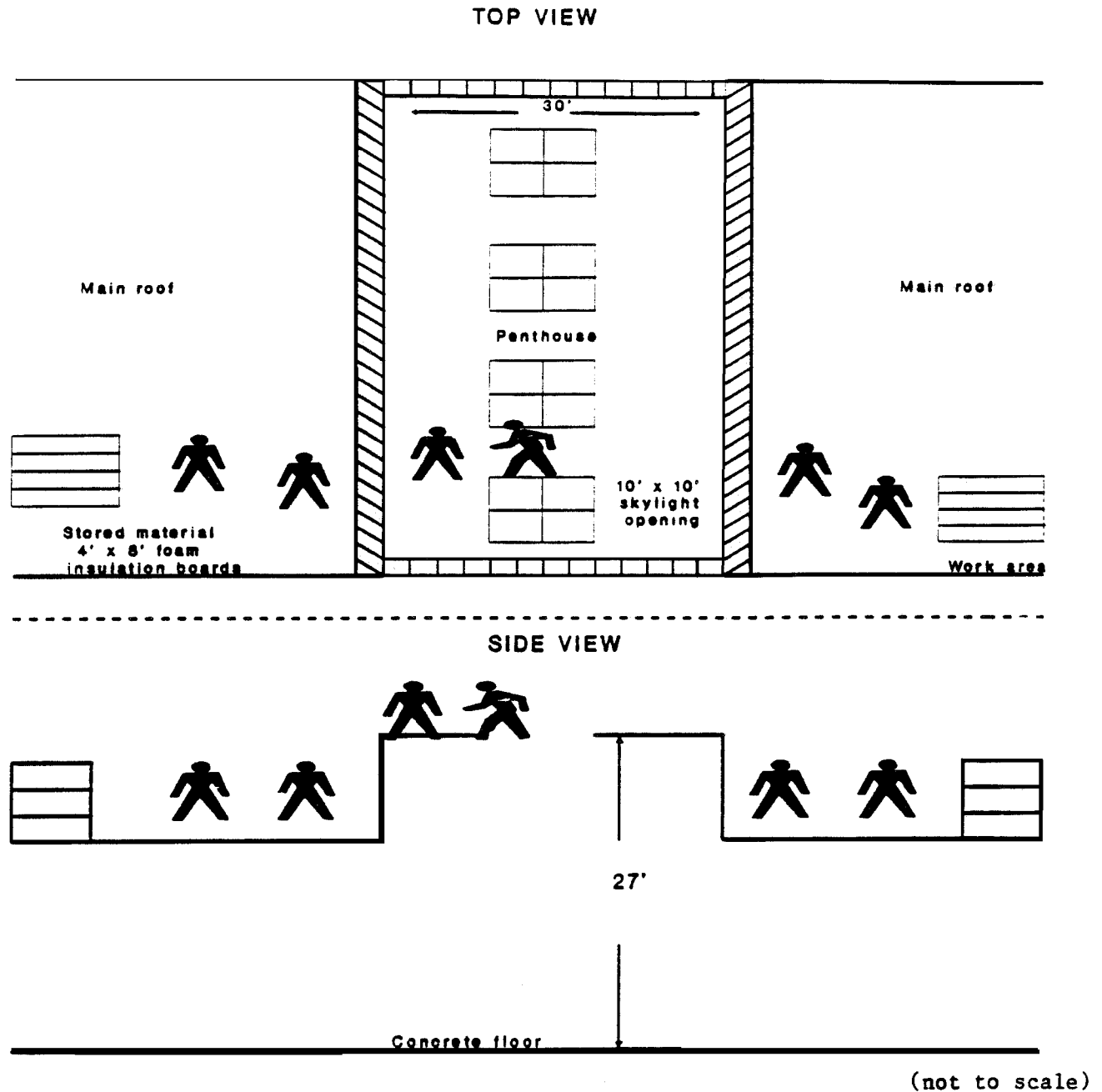


Figure 1. Top and Side Views of the Roof Area Where the Fatal Fall Occurred.

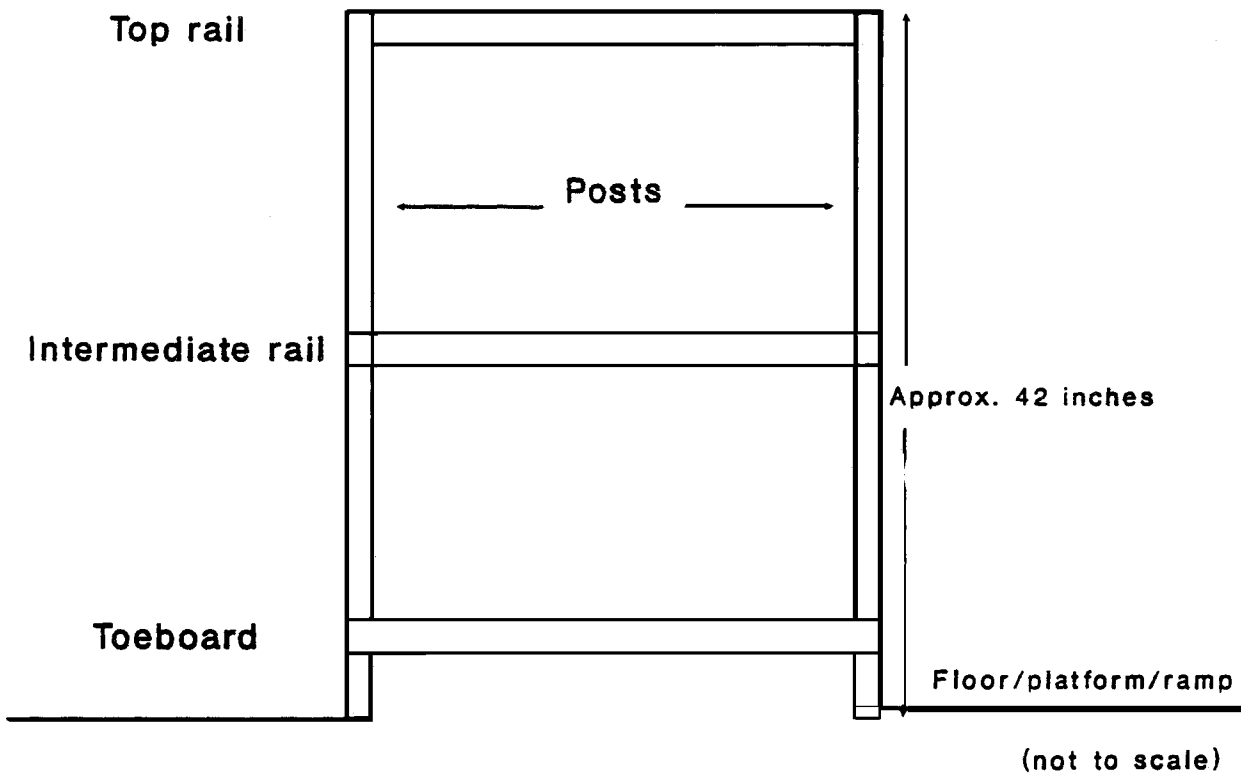


Figure 2. Specifications for Guardrails as Contained in 29 CFR 1926.500 (f) (1)

FACE 89-49: Window Mechanic Dies in 250-Foot Fall

INTRODUCTION

The National Institute for occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On August 17, 1989 a 30-year-old male window mechanic died when he fell 250 feet through a window opening while attempting to replace the window.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On September 20, 1989 a DSR safety specialist and an epidemiologist conducted an investigation and met with local officials and the manager of the property where the incident occurred. The DSR representatives then visited and photographed the incident site and discussed the case with witnesses.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim in this incident was self-employed. He had worked in the glass business for several years prior to going into business for himself approximately 4 1/2 years ago. The victim had one employee. The company had no safety program.

SYNOPSIS OF EVENTS

On the day of the incident, the victim and his employee went to a 21-story office building to replace a damaged window on the 21st floor. The exterior walls of the building were brick, with rows of windows, 9-feet-high by 56-inch-wide at each floor and on all sides of the building. These windows consisted of an outer pane of bronze-tinted glass and an inner pane of clear glass separated by a 1/2-inch air space. A single metal frame held the two panes of glass in place.

The outer pane of a window in one corner of a large conference room on the 21st floor broke several days prior to the incident. To prevent possible injuries to pedestrians, building security personnel, after making sure there was no one below, tapped on the inner pane and window frame to dislodge the broken pieces of glass, causing them to fall to the ground below. The inner pane of glass was left intact in the frame.

The victim was contracted to replace the damaged window. He had replaced damaged windows in the same building on several previous occasions. To replace the window, the victim first had to loosen and remove the bolts which secured the window frame to the structure, and then remove the existing inner pane and frame from the opening. Subsequently, he could install a new window and frame combination in the opening, and complete the job by installing the bolts to hold the new frame in position.

The victim and his employee arrived at the incident site accompanied by a security guard. The victim began removing the bolts which held the window frame in place. In order to reach the bolts at the top of the frame the victim placed a 3-foot-high wooden stepladder next to the window. Standing on the second step of this ladder, he attempted to loosen one of the bolts (located above his right shoulder) by striking the bolt with a hammer held in his right hand. In doing so, he missed the bolt and struck the window pane. The window shattered under the impact of the hammer, and the victim and the ladder on which he was standing, fell sideways through the window opening to a brick courtyard 250 feet below.

The corporate security director observed the victim falling past his 14th floor office window and immediately had his secretary call local emergency services (911). Fire, rescue, and police personnel were on the scene within 7 minutes of the incident.

The victim was pronounced dead at the scene.

CAUSE OF DEATH

The medical examiner listed the cause of death as generalized trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fall protection options should be considered, and selected methods and/or equipment used whenever the potential for serious or fatal falls exists.

Discussion: Windows of the type involved in this incident are designed to be of sufficient structural strength and integrity to prevent someone from falling through them. However, when a window, or any other structural component, is damaged, and the resultant structural strength and integrity is not evaluated, any task or activity involving the damaged component should be approached with extreme caution. Had the work proceeded to the point at which the window was removed, the resultant unprotected wall opening would have posed a serious fall hazard to the workers installing the new window. In this case, the most prudent approach may have been to treat the damaged window as if it were an unprotected wall opening during the entire course of the dismantling and replacement work.

An Occupational Safety and Health Administration (OSHA) standard (29 CFR 1926.500(c)) requires that any wall opening "from which there is a drop of more than 4 feet, and the bottom of the opening is less than 3 feet above the working surface" be guarded. Since the removal of the window would have been impeded if not precluded by installation of a guardrail, and the use of a portable ladder may have offset the protection afforded by a guardrail anyway, this protective option would probably have been impractical in this instance. However, personal fall protection equipment, such as safety belts with lanyards attached to a structurally sound anchorage point, could have been employed instead. The use of personal fall protection equipment by maintenance personnel dismantling and replacing damaged windows, such as in this incident, may prevent future similar incidents.

While the men in this case were working within a completed structure, the work they were performing would have resulted in the creation of a large vertical opening when the window was removed. The fact that they were intending to create this opening should have prompted them to employ fall protection equipment (safety belts with lanyards) while accomplishing this work. Had they used this equipment this fatality could have been prevented.

Recommendation #2: Work near a known damaged window should be accomplished from the side rather than from directly in front of the window whenever possible.

Discussion: The work being performed by the victim at the time of the incident could just have easily been accomplished with the ladder (and the victim) positioned by an adjacent, undamaged, side window instead of directly in front of the damaged window unit. Had this been done this incident might have been prevented.

FACE 90-15: Ironworker Foreman Dies Following a 37-foot Fall Through Platform Opening in Indiana

SUMMARY

An ironworker foreman died after falling 37 feet from a steel grating platform. This incident occurred as the foreman and his crew of four ironworkers were installing foundry process equipment from the platform. Running vertically through the platform was an 8-foot-diameter vent stack. The platform had been installed with a 12-inch annular space between the vent stack and the grating in anticipation of placing insulation material around the vent stack. The foreman was standing approximately 1 foot away from the annular space with his back to the vent stack giving task-related instructions to his crew. After giving the instructions, he stepped backwards and fell through the annular space, landing on the concrete floor 37 feet below. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers and employees must:

- *guard floor openings with a railing or a floor opening cover secured against displacement*
- *conduct a hazard analysis before each job and implement appropriate controls.*

INTRODUCTION

On September 12, 1989, a 46-year-old male ironworker foreman (the victim) died after he fell 37 feet from an industrial building platform. On November 2, 1989, officials of the Occupational Safety and Health program from the State of Indiana (State OSHA) notified the Division of Safety Research (DSR) of the death and requested technical assistance. On December 7, 1989, a research industrial hygienist from DSR traveled to the incident site to conduct an investigation. The DSR investigator reviewed the incident with company representatives and State OSHA personnel, and obtained photographs and diagrams of the incident site.

The employer in this incident is an industrial building construction company that employs an average of 1500 workers. Most of the employees are ironworkers, carpenters, electricians, pipefitters, boilermakers, and laborers hired through their respective local union halls. The victim had a total of 10 years' experience as an ironworker and had been employed by the company for 12 months as an ironworker foreman. The company has a corporate-level, full-time safety manager and written safety requirements specifying procedures concerning the use of fall protection equipment and fall prevention methods. The general foreman at each construction site is responsible for jobsite safety issues and "tailgate" safety meetings, which are conducted weekly.

INVESTIGATION

The employer had been contracted to construct an industrial vacuum degassing building for a foundry. The work included the installation of vacuum degassing process machinery and equipment. Approximately 150 construction workers were employed on site to complete this project. The project, which had been under construction for about 12 months, was nearing completion. The building structure had been completed and most of the equipment had been installed. According to company representatives, workers were using appropriate fall protection equipment during this period of construction. The victim had been supervising a crew of 4 ironworkers who were assigned to finish installing equipment 37 feet above the ground floor on a permanently installed steel grating platform. The edge of the platform was surrounded by a steel railing 3 1/2 feet high. An 8-foot-diameter vent stack ran vertically through the center of the platform (Figure). The

platform had been installed with a 12-inch annular space between the vent stack and the grating in anticipation of placing insulation material around the vent stack. The annular space was not protected with a temporary cover or railing because the victim did not consider it large enough for a worker to fall completely through. However, the platform opening was built with a 4-inch vertical lip (toeboard) around the edge.

The crew had been at work for about 1 hour on the morning of the incident. Standing on the platform with his back to the vent stack (and approximately 1 foot away from the annular space), the victim began giving task-related instructions to the crew. After giving instructions to the workers, the victim turned slightly while stepping backwards and fell through the annular space to the concrete floor 37 feet below. The foundry emergency medical service (EMS) was immediately notified, and arrived at the site within 3 minutes, administered emergency medical care to the victim (who was still breathing), and transported him by ambulance to a local hospital where he died 1 hour later.

CAUSE OF DEATH

The coroner listed the cause of death as skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Platform and floor openings large enough for workers to fall through should be adequately guarded.

Discussion: The employer should implement 29 CFR 1926.500(b)(1) and (8), which require that all floor and platform openings be protected with a standard railing or a floor opening cover secured against displacement. Although the annular space in the platform was only 12 inches wide, it was, nevertheless, a "floor opening" (according to 29 CFR 1926.502(b)). The platform opening did have a toeboard. However, a standard railing or floor opening cover should also be installed to comply with the aforementioned standards. At the time of the incident, the platform had another unprotected opening near the vent stack (triangular in shape, measuring approximately 2 1/2 feet by 4 feet). This opening was not protected at the time of the incident because it was being used for hoisting equipment and materials. Even though the victim did not fall through this opening, it did pose a hazard to workers in the area and therefore should have been guarded.

Recommendation #2: Hazard analysis should be included as an ongoing part of each construction phase.

Discussion: Before starting each phase of the construction, each crew foreman should identify and review the potential hazards with his crew and discuss how to control the hazards and how the work can be done safely. These discussions should include information on hazards in the immediate work area as well as information on the activities of other work crews on the site that could create additional hazards for workers. Such a procedure might have identified the floor openings as hazards such that corrective action to guard the openings could have been taken.

REFERENCES

1. Office of the Federal Register Code of Federal Regulations, Labor 29 CFR Part 1926. U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C. 1989.

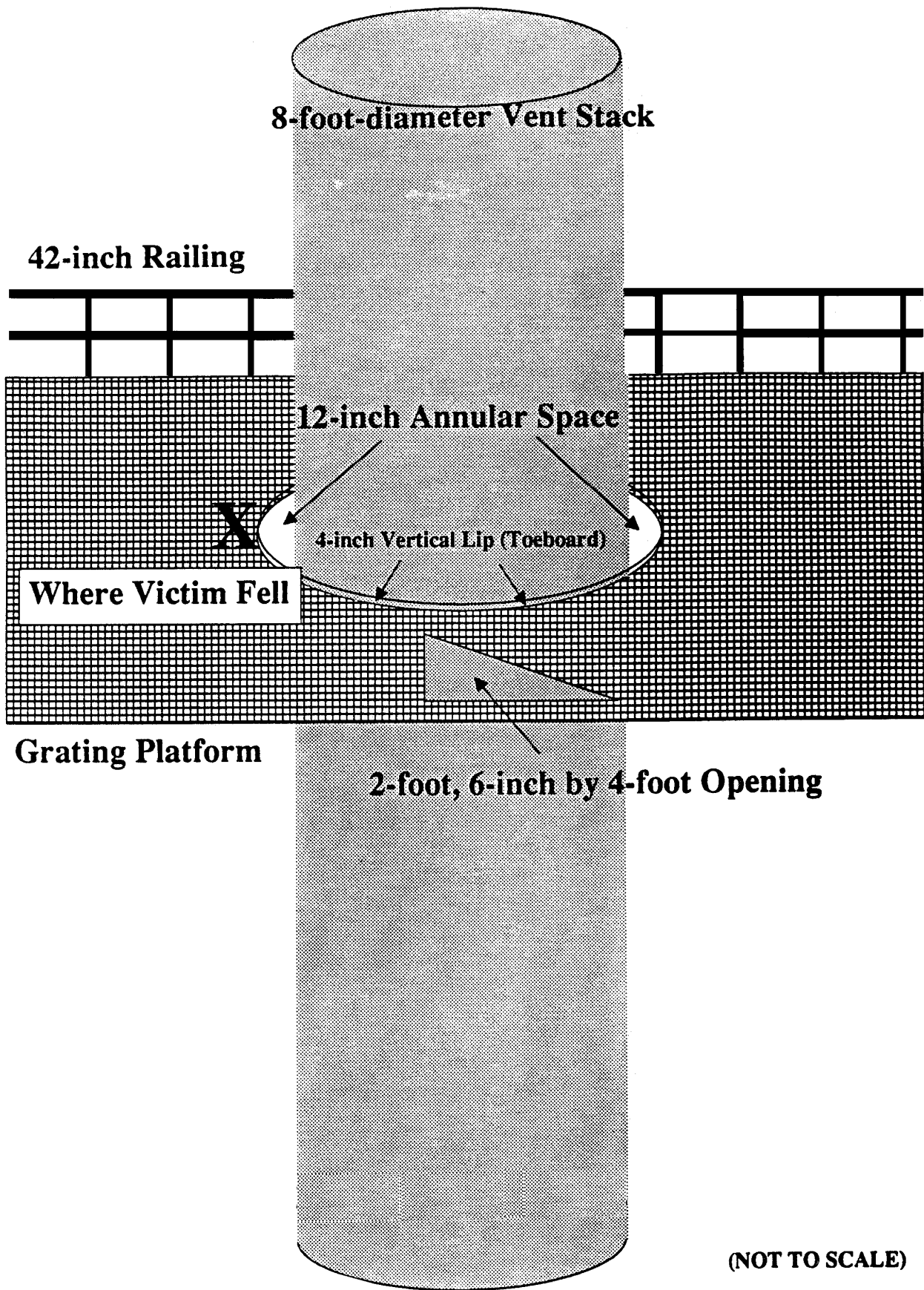


Figure. Vacuum Degasser

FACE 90-19: Welder Dies after Falling 22 Feet from a Roof at Mall Construction Site in Maryland

SUMMARY

A welder fell 22 feet to the ground from a bundle of roof decking stacked on the roof of a mall under construction and died as a result of his injuries less than an hour later. The victim was welding bridging in place between roof bar joists when his welding cables became snagged. The victim stood on a bundle of roof decking and tried to free the cables by whipping them up and down and pulling on them. The welding cable connectors separated and the victim lost his balance and fell headfirst to the ground. Although the victim was wearing a safety belt and lanyard, he was not tied off at the time of the incident. Based upon investigation findings, NIOSH suggests that, in order to prevent future similar occurrences, employers should:

- *provide the necessary fall protection equipment and the means and training to properly use the equipment*
- *develop and implement safe methods for handling welding cables with employees*
- *develop and implement comprehensive safety training programs with task-specific safety procedures*
- *consider the use of other approaches, such as elevated work platforms, in reducing worker exposure to falls from elevations*

INTRODUCTION

On November 4, 1989, a 48-year-old welder died as a result of injuries sustained from a 22-foot-fall. On November 9, 1989, the Maryland Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On December 13, 1989, a DSR safety engineer conducted an investigation and met with a company official to discuss the incident. The DSR investigator photographed the incident site and reviewed emergency medical services (EMS) records.

The employer is a small construction welding company that has been in business for 10 years. The company has seven full-time employees, including five welders. The company has no safety officer and no written safety rules. Since this incident the owner has contacted his insurance company for assistance in developing a safety program.

The victim worked for this company only 5 days before the incident. He had 20 years of experience as a welder and had worked as a welding instructor in the local vocational technical school.

INVESTIGATION

The company had contracted to weld structural steel components at a new mall complex being built in the area. The victim was electric arc welding bridging between the roof bar joists which were 22 feet above ground. (Bridging is a system of lateral braces placed between joists to distribute the load on the roof, and hold the joists in position.) At the time of the incident, the victim was wearing a safety belt and lanyard. The victim, as well as the other welders, typically secured their lanyards to a structural member when working in one area for an extended period of time. Since the victim was only working in an area for a few minutes, he did not attach his lanyard to any structural member. The victim needed an additional foot of

welding cable to complete the weld on a piece of bridging. When the victim pulled on the cables, he discovered they had become snagged. In an attempt to get the additional cable, the victim stood on the edge of a bundle of decking placed on the roof and whipped the cables up and down while pulling on them. As he did so, a welding cable connector came loose, causing the victim to lose his balance and fall backward through the bar joists to the ground (Figure). Witnesses stated that he landed on his head and shoulders.

Workers in the area saw the victim fall and called emergency medical services. The co-workers did not move the victim for fear of causing further damage. The rescue squad arrived about 12 minutes after the victim fell, placed the victim on a backboard with an immobilizer, and started cardiopulmonary resuscitation (CPR). The victim was transported to the local hospital where he died less than an hour after the fall.

CAUSE OF DEATH

The medical examiner's report stated that the cause of death was neck injuries sustained from the fall.

RECOMMENDATIONS/DISCUSSION:

Recommendation #1: Employers should provide the necessary safety equipment and means to properly use the equipment.

Discussion: 29 CFR 1926.18(a) requires an employer to ensure that employees properly use personal protective equipment when exposed to hazardous conditions. The victim was wearing a safety belt and lanyard, but was not able to tie off to a lifeline as none was present. After this incident, the employer installed lifelines to enable the people working at elevations to tie-off while working. Prior to this incident, the employer did not require workers to tie off when working at heights. The employer has since instructed his employees to tie off whenever they are working above 10 feet.

Recommendation #2: Employers should develop and implement safe methods of handling welding cables.

Discussion: When welding cables are caught, the correct way to handle the situation is to trace the cables back to where they are caught. Either the welder or a co-worker should check the cables to determine where they are caught, and free them if possible. A brief, periodic "toolbox" discussion of the proper methods of handling cables might have reinforced the victim's understanding of the need to take a few minutes to handle the cables in a safe manner.

Recommendation #3: Employers should develop and implement a comprehensive safety training program with task-specific safety procedures.

Discussion: There were no safety training or safety programs in effect. Since this incident, the employer has contacted his insurance company for assistance in establishing a written safety policy, a comprehensive safety training program, and task-specific safety procedures. In the past, the employer has relied on the previous experience of his employees to substitute for safety training. Safety training should address:

- care and inspection of the welding equipment
- personal protective equipment such as eye protection, safety shoes, clothing, fall restraints, etc.

- the need to tie-off while working at heights (particularly during work on structural components which are not always fully secured, as sudden movement may cause a worker to lose balance and fall).

Recommendation #4: Employers should consider the use of other approaches for reducing worker exposure to falls from elevations.

Discussion: Use of an elevated work platform, such as a scissors lift or other device, might have reduced the welder's exposure to this fall hazard. Another approach to fall protection would be the use of safety nets. An alternative method of construction would be to assemble sections of bar joists and bridging on the ground and then lift the completed sections into place, provided it would not expose workers to additional hazards.

REFERENCES

1. 29 CFR 1926.18(a) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.
2. OSHA Instruction STD 3-31 July 18, 1983 Subject: Fall Protection in Construction: 29 CFR 1926.28(a) and 29 CFR 1926.105(a)

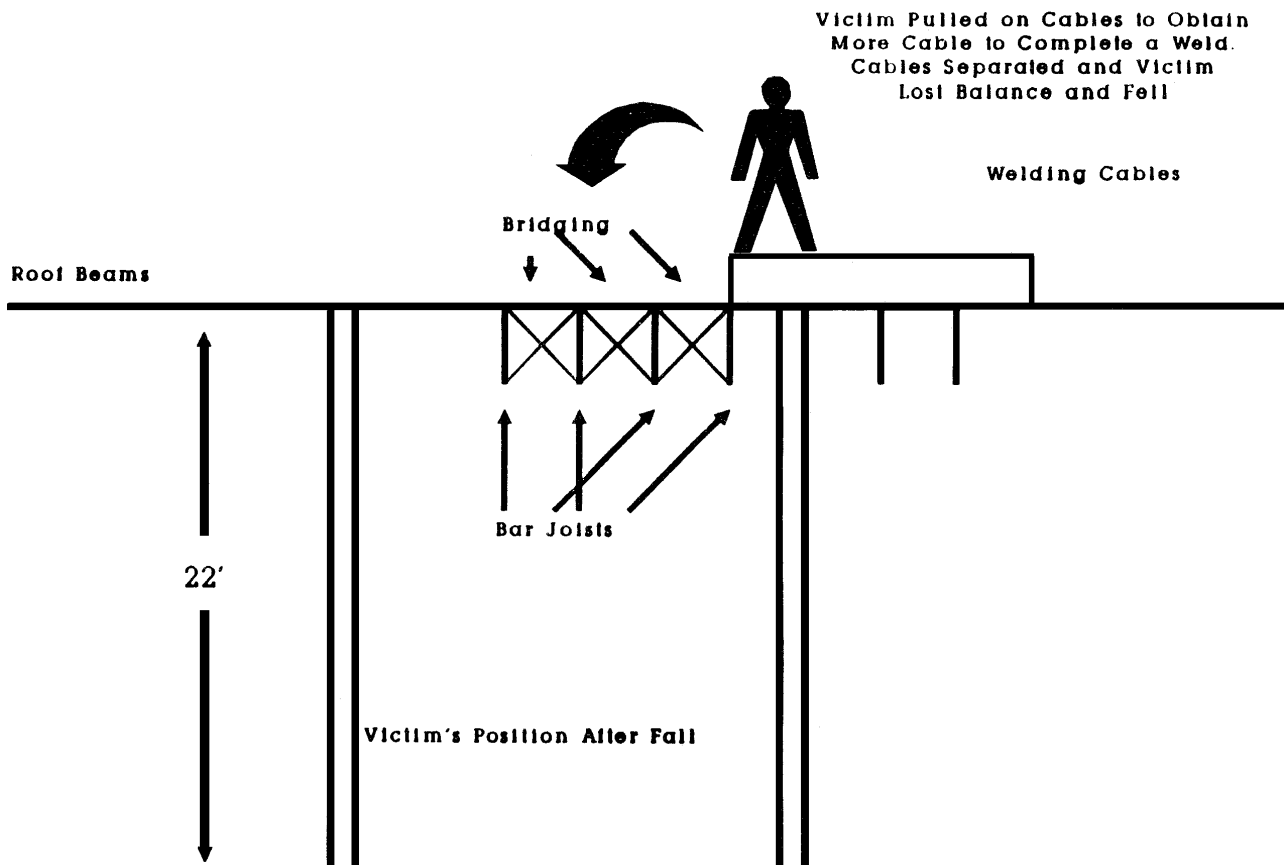


Figure.

FACE 90-21: Roofer Dies after Falling through Skylight Fixture in Maryland

SUMMARY

A roofer died from injuries sustained after falling 30 feet through a skylight fixture. The victim was part of a crew removing a tar and gravel built-up roof. He positioned a wheelbarrow full of gravel alongside a skylight so that he could talk to one of the company managers. As he turned back to resume work he fell through the skylight to the concrete floor below. NIOSH investigators concluded that, in order to prevent future similar concurrences:

- *employers should take steps to protect workers from falling through skylights by installing guardrails or covers over the skylights*
- *prime contractors and subcontractors should ensure that safety and health issues are included as part of the contract provisions*
- *building owners should consider installing protective covers over skylights*
- *designers/manufacturers of skylights should evaluate load capacities of current designs and consider strengthening skylight components and/or incorporating safeguards, such as protective screens, into skylight designs. NIOSH has prepared a Hazard Alert publication detailing the hazards associated with falls through skylights and roof openings (DHHS (NIOSH) Publication No. 90-100).*

INTRODUCTION

On November 6, 1989, a 51-year-old male roofer fell through a skylight 30 feet to the concrete floor below. On November 17, 1989, Maryland Occupational Safety and Health Officials notified the Division of Safety Research (DSR) of the fatality and requested technical assistance. On December 14, 1989, a DSR safety engineer conducted an investigation. The DSR investigator examined and photographed the incident site, interviewed company personnel about the incident, and obtained emergency medical services (EMS) and police records.

The employer in this incident is a small roofing and siding contractor who has been in business for 10 months. At the time of the incident, the company employed about 20 people. The company does not have a safety officer but has a written safety policy and safety procedures that were obtained from another roofing company. The co-owners of the company do conduct toolbox safety meetings and on-the-job safety training. The victim had been working for the company for 3 months.

INVESTIGATION

The employer had been subcontracted by the prime contractor to replace the roofing on a bottling plant. The prime contractor was installing insulation below the roof while the subcontractor was to remove the tar and gravel built-up roof and replace it with a new rubber membrane material. The victim and fellow employees were removing the gravel from the roof top.

The roof has 15 rectangular smoke-dome-type, curb-mounted skylights (42 inches by 80 inches). As the victim was moving a full wheelbarrow of gravel toward a trash chute, he stopped and set the wheelbarrow

next to a skylight and went over to talk to a company manager. When he returned to the wheelbarrow, he fell through the skylight 30 feet to the floor below. None of the workers on the roof saw the victim fall, but they heard the victim scream as he fell through the skylight. Workers within the bottling plant observed the victim fall feet first and strike a 3-foot-high pallet of bottles, which caused his body to flip and his head to hit the concrete floor.

The EMS was called within a few minutes of the incident. The time of arrival was not included in the emergency services report. When the medical technicians arrived at the scene, the victim was not breathing and had no vital signs. The victim was transported to a hospital where he was later pronounced dead. The EMS records had no information on the time of death. After the incident the employer removed all of the skylights and secured plywood over the openings. The skylights were reinstalled when the work on the roof was completed.

CAUSE OF DEATH

The medical examiner's report stated that the cause of death was traumatic injuries sustained from the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should initiate measures to protect their employees from falling through skylights.

Discussion: According to the subcontract with the prime contractor, the roofing contractor (the victim's employer) was responsible for protecting employees from falls. Methods for protecting workers from falls through skylights include removing the skylights and covering the openings, as was done after the incident, in accordance with CFR 1926.500(b)(4). Alternatively, temporary guardrails or other means of preventing the worker from falling through the skylight could have been installed. Additional information pertaining to falls through skylights and roof openings is contained in a NIOSH Alert on this topic (DHHS(NIOSH) Publication No. 90-100).

Recommendation #2: Prime contractors and subcontractors should ensure that safety and health issues are included as part of the contract provisions.

Discussion: All contracts should contain provisions that ensure the safety and health of all workers covered by that contract. Where prime contractors and subcontractors are involved, the contract must contain clear and concise language as to which party is responsible for a given safety and health issue. Once the provisions for these responsibilities have been established, the respective parties should ensure that the provisions of the contract regarding safety and health are upheld.

Recommendation #3: Building owners should consider installing protective covers over skylights to guard against falls through skylights.

Discussion: Building owner should consider installing guardrails or skylight screens on the skylights as outlined in CFR 1910.23(a)(4). Although the employees of the bottling plant rarely go onto the roof, the new membrane material, which becomes very slick when wet, poses a new hazard for anyone working on the roof and near the skylight. The NIOSH investigator had to move very carefully while inspecting the incident site to keep from falling. With the new roofing material in place, an individual walking on the roof could easily slip and fall through a skylight.

Recommendation #4: Designers/manufacturers of skylights should evaluate current designs to determine the feasibility of increasing load capacities and/or incorporating other safeguards.

Discussion: Designers/manufacturers of skylights should evaluate the materials used to fabricate skylights and current skylight designs to determine the feasibility of increasing load capacity. Load capacity could be increased to provide a margin of safety in the event of an inadvertent fall against a skylight. Additionally, a metal grid or screen installed over the skylight would reduce the exposure to fall hazards for workers on roofs.

REFERENCES

1. DHHS (NIOSH) Publication No. 90-100, Request for Assistance in Preventing Worker Deaths and Injuries from Falls Through Skylights and Roof Openings
2. 29 CFR 1926.500(b)(4). Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register
3. 29 CFR 1910.23(a)(4). Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

FACE 90-23: Carpenter Falls 62 Feet to His Death While Attempting to Enter a Personnel Basket at a Bridge Construction Site in Maryland

SUMMARY

A carpenter fell 62 feet to his death when he attempted to enter a stripping basket while working on a bridge construction project. The victim was spacing rebar inside a concrete form pier cap (the top part of a bridge pier which uniformly distributes the concentrated loads from the bridge over the pier). He ran out of spacers and signalled the crane operator to move the basket over to the pier he was working on. As the crane operator attempted to move the basket to the pier, the basket bumped the pier form and swung away. The victim reached out for the basket as it was moving away and lost his balance, falling 62 feet onto the concrete footing at the base of the pier. NIOSH investigators concluded that, in order to prevent similar occurrences, employers should:

- *ensure that established safety procedures be followed at all times*
- *conduct scheduled and unscheduled safety inspections regularly at each jobsite*
- *conduct a thorough evaluation of accessing piers to determine the safest method.*

INTRODUCTION

On January 30, 1990, officials of The Maryland Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death of a 30-year-old male carpenter, who fell 62 feet from the top of a pier cap at a bridge construction site on January 26, 1990. The state officials requested technical assistance. On February 12 through 14, 1990, a DSR safety engineer conducted an investigation of this incident. The safety engineer reviewed the incident with company representatives and obtained witness statements, the state police report, photographs and a diagram of the incident site.

The employer, a heavy construction company that has been in operation for 87 years, employs 450 full-time employees, including a safety director and assistant safety director. The company has a comprehensive safety program and provides on-the-job training to the employees. Additionally, the company conducts monthly safety meetings that are related to the type of work being done at the jobsite. Some of the topics of recent safety meetings included personnel baskets, crane signals and flagman signals, housekeeping, hand injuries and fall protection. Quarterly, the company mails safety information to the employees' homes and presents safety awards to employees with good safety work records.

Before work was started at this jobsite, the company evaluated various methods of having the employees gain access to the pier forms. They had rented lift equipment such as scissors lifts and scaffolding; however, based on the existing ground conditions (marshy soils and unstable fill) and other factors, the company decided that the use of stripping baskets and cranes was the safer means of getting employees to and from the work areas.

The victim had been employed by the company as a carpenter for over 5 years. He had taken the new employee safety orientation training and participated in the monthly safety training meetings. He had also recently taken the safety training for personnel transport baskets and fall protection.

INVESTIGATION

The company had been contracted to build a bridge over a waterway. Concrete piers were being built to support the bridge deck. The piers consisted of a footing with a rectangular pillar 20 feet long by 5 1/2 feet wide, rising 26 feet (Figure). The top portion of the pillar, which was "V" shaped, rose 36 feet above the pillar and was 46 1/2 feet wide at the top. The concrete pier was reinforced with steel rebar. The form for the concrete pier was set in place and the reinforcing steel for the upper section was placed in the form. The last section of the form was then put in place. The victim was inside the form, installing spacer blocks between the reinforcing steel and the form. He had run out of spacers and needed to return to the ground to obtain more spacers. He signaled the crane operator that he needed to come down. The crane operator, who had just put a worker on another pier, swung the basket 150 feet to the pier the victim was working in. The basket, which weighed approximately 4000 pounds and was approximately 8 feet wide by 20 feet long, was designed as a stripping basket to be used in placing and removing parts on the forms. The stripping basket was also used to transport personnel. As the basket was slowing to a stop, it struck the form, causing the basket to move away from the form. An eyewitness stated that the victim, standing on the 8-inch flange on top of the form, lost his balance while reaching for the basket and fell 62 feet to the concrete footing below.

Co-workers rushed to the victim within a minute of the fall and found that he had a gash in his head and was not breathing. Calls were made to the emergency medical service (EMS) and the state police. Cardiopulmonary resuscitation (CPR) was attempted by one of the co-workers without success. The victim was transported to a regional hospital where he was pronounced dead on arrival one hour after the incident.

The companies' written procedure required that workers stand inside the pier on the reinforcing steel. Additionally, written company policy requires that the basket be secured against movement before entering or exiting the basket. The basket had a rope on its railing that was to be used as a tie off to secure the basket to an anchor point inside the pier form during entry and exit.

At the time of the incident, the victim was wearing a safety belt and lanyard. While working inside the form, workers were not required to tie off. However, when riding in the basket, company policy required workers to secure their lanyard to the tie-off bar in the basket.

CAUSE OF DEATH

The attending physician stated the cause of death was due to head injuries.

RECOMMENDATIONS/DISCUSSION:

Recommendation #1: Employers should ensure that established safety procedures be followed at all times.

Discussion: Established company safety procedures state that a basket should be secured against movement with a tie-off before an employee enters or exits the basket when it is elevated as required by 29 CFR 1926.550(g)(6)(ii). The rope on the basket railing was provided for this purpose. Additionally, company policy requires that employees stand inside a form until the basket is secured in place to be boarded. Employers should ensure that workers are aware of established company safety procedures, and take steps to enforce their implementation.

Recommendation #2: Employers should conduct scheduled and unscheduled safety inspections regularly at each jobsite.

Discussion: Employers should conduct, or appoint safety personnel to conduct, scheduled and unscheduled safety inspections at each jobsite to ensure that established safety procedures are being followed. Conducting such safety inspections demonstrates to workers a management commitment to enforcing its safety policies and procedures.

Recommendation #3: Employers should conduct a thorough evaluation of accessing piers to determine the safest method.

Discussion: Employers should evaluate alternative methods for providing worker access to piers; such alternatives could include, loading and unloading the workers inside the concrete forms.

REFERENCE

1. 29 CFR 1926.550(g)(6)(ii) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

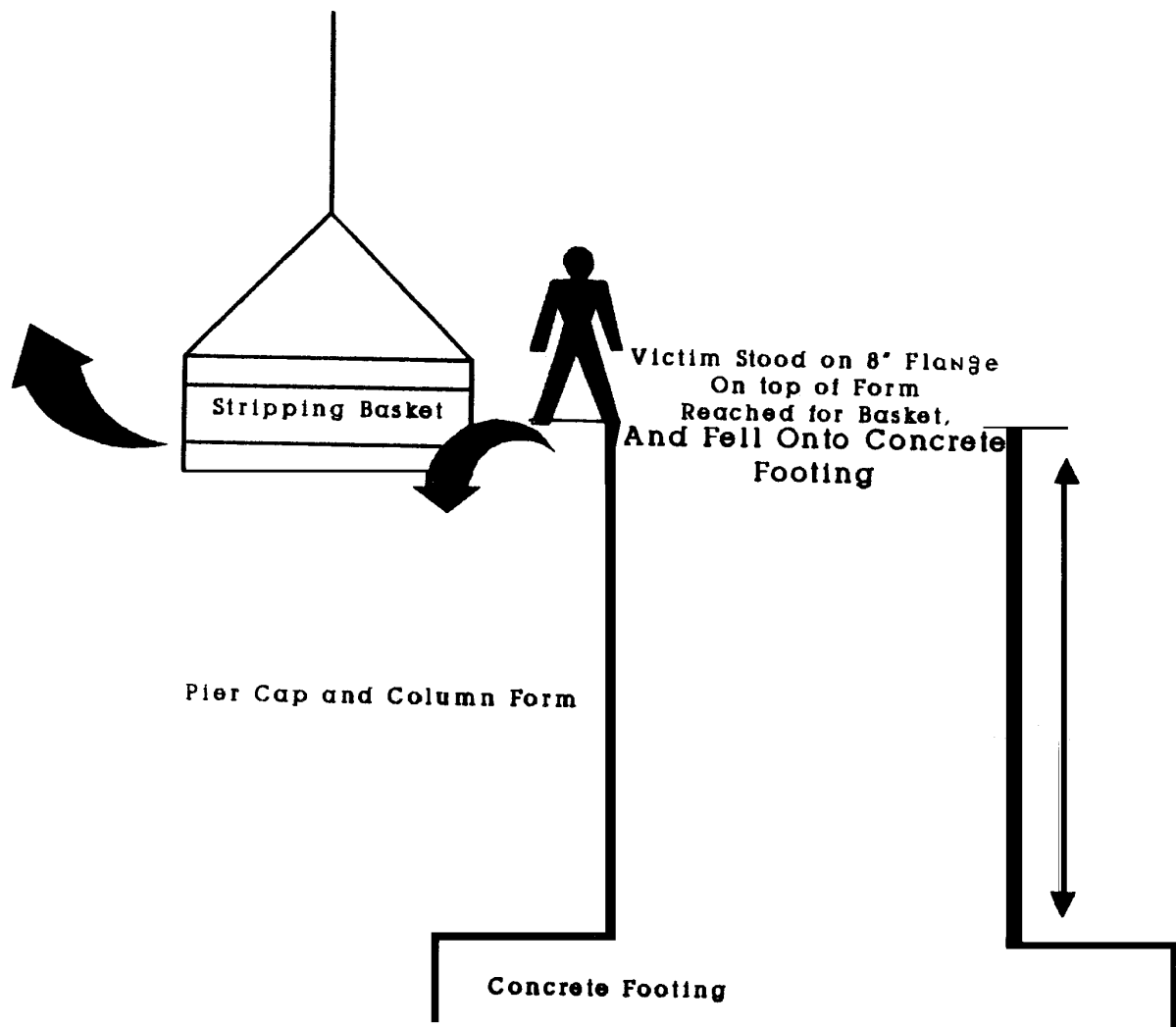


Figure.

FACE 90-24: Ironworker Foreman Dies after Falling 50 Feet from Structural Steel in South Carolina

SUMMARY

A 41-year-old ironworker foreman died as a result of injuries sustained in a 50-foot fall from an 8-inch "I" beam at a construction site. The victim was the foreman of a steel erection crew which had assembled the steel "skeleton" of a large structure at the site of a new paper mill. The crew had completed their work on the structure several days prior to this incident, and had then removed the safety netting, which had been in place during the construction process. As part of their work, the crew had installed a pair of 8-inch "I" beams to serve as a track for an overhead crane. On the morning of the incident, an electrician, who had been working on the overhead crane, told the victim that the "I" beam rails on which the crane operated were misaligned. The victim and one of his co-workers used a cherry-picker manlift (a small crane or derrick that can work and lift in cramped spaces) to access the beam. After looking at the beam, the victim told the co-worker to move the manlift to the far end of the beam while he walked out on the beam to check for the problem. A heavy frost the night prior to the incident had left a coating of ice on the beam. The co-worker mentioned the slipping hazard to the victim and was told by the victim not to worry about it. The victim then stepped from the manlift to the beam and walked approximately 40 feet across the beam before slipping and falling 50 feet to the ground below. NIOSH investigators concluded that, in order to prevent similar occurrences in the future, employers should:

- *ensure that workers comply with existing safety policies and procedures at all times*
- *continually stress to all employees the importance of following established safe work procedures at all times*
- *ensure that the proper chain of command is followed when problems or potential problems are reported.*

INTRODUCTION

On January 27, 1990, a 41-year-old male ironworker foreman died after falling 50 feet from structural steel. On January 30, 1990, officials of the South Carolina Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. A DSR safety specialist discussed this case with compliance personnel, and traveled to the incident site on February 26, 1990, to conduct an investigation. The safety specialist reviewed the incident with representatives from the responding Emergency Medical Service (EMS), the coroner's office, and the employer; and then investigated and photographed the incident site.

The employer in this incident is a large paper manufacturing firm employing 1,300 individuals at the site of a new pulp and paper plant under construction. On-site safety personnel include a full-time safety engineer with a staff of five. The company has a comprehensive safety program which actively addresses the various hazards likely to be encountered in the construction trades. Safety training sessions are presented to all employees weekly. In addition, the safety program provides for regular periodic inspection of all safety equipment at the site. Violation of company safety policies is grounds for dismissal, with the safety engineer having full authority to enforce this provision.

INVESTIGATION

The victim worked as the foreman of a structural steel erection crew. This was one of several such crews at the site, all under the general supervision of an "iron superintendent."

This particular crew had erected the structural steel "skeleton" for a large building at the site. When their work on this structure had been completed (several days prior to the incident), the crew removed the safety nets used during the erection of the "skeleton." The removal of these nets was completed 2 days prior to the incident. A 75-ton overhead crane was installed in this structure following the completion of the structural steel work. The exterior walls and the roof of this structure were to be installed at a later time by different work crews.

Standard practice calls for the "iron superintendent" to lay out groundwork for his crews each day. The crews then spend the first few hours of the workday on the ground accomplishing these tasks. During this time, the "iron superintendent" inspects the sites to be worked on that day. After the "iron superintendent" determines that the steel in the area is dry and free of ice, and that no other problems with the steel erection process exist, the crews are allowed to begin work on the steel itself.

On the day of the incident, the victim and his crew reported to work at 7:00 a.m. (their normal starting time). A few minutes after reporting for work, the victim was approached by an electrician (who worked for a subcontractor at the site), who told him that something was wrong with the alignment of the I-beam "rails" upon which the overhead crane was to run. Upon hearing of this supposed defect in work accomplished by his crew, the victim and one of his workers went to the area in question without informing the iron superintendent or any other member of management.

The victim and his co-worker used a "cherry picker" manlift to reach the I-beam rail in question. The rail ran parallel to the floor of the structure at a height of approximately 50 feet. A heavy frost the preceding night had left a coating of ice on all exposed steel at the site.

After visually looking at the beam in question for a moment, the victim told his co-worker to lower the manlift, move it to the other end of the beam, and meet him (the victim) there. In the meantime he (the victim) would exit the manlift and walk the beam to check it out.

The co-worker told the victim that the beam was covered with ice and that he could not walk on it, whereupon the victim told the co-worker not to worry about it. The victim then stepped from the manlift to the beam. The co-worker lowered the manlift bucket from the beam and began to move it to the area designated by his supervisor.

As the co-worker was moving the manlift to the new position, he observed the victim lying on the ground approximately 40 feet down the rail from his starting position. Although the fall was not witnessed, it appears the victim slipped on the ice-covered beam.

The co-worker immediately summoned assistance and the plant Emergency Medical Technicians (EMT's) responded to the scene. The victim was still breathing at this time, and the EMT's attempted to stabilize the victim while awaiting the arrival of an ambulance to transport the victim to the hospital. The local ambulance squad was called by both radio and telephone, and arrived on the scene approximately 25 minutes after the incident.

The victim was placed in the ambulance and transported to the local hospital. En route to the hospital, the victim stopped breathing and the EMT's were unable to detect a pulse. At this time they began Cardiopulmonary Resuscitation (CPR). The victim was pronounced dead shortly after arrival at the hospital.

It was later determined that the problem with the overhead crane had nothing to do with the "alignment" of the frame rails, but was instead an electrical problem.

CAUSE OF DEATH

The coroner's report gave the cause of death as massive head injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should continually stress to all employees the importance of following established safety rules and procedures at all times.

Discussion: In accordance with the OSHA Act, P.L. 91-596, Section 5(b), "Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders ... which are applicable to his own actions and conduct." The employer in this incident managed a comprehensive and detailed safety program on the project which addressed the hazards to which their employees could reasonably expect to be exposed. Existing company safety policies at the time of the incident required all employees to be tied-off whenever they were working above ground level, prohibited going out onto structural steel without authorization from the iron superintendent, and prohibited entering a work area without authorization. Violation of any one of these policies would have been grounds for dismissal. The fact that the incident occurred in spite of these policies clearly shows the need for employers to continually remind all employees of the importance of following established safety rules and procedures at all times.

Recommendation #2: Employers should ensure that workers are aware of and follow established "chain-of-command" reporting procedures whenever any problems or potential problems are detected.

Discussion: An established chain-of-command procedure existed for reporting any problems detected at the jobsite. Had this procedure been followed, the electrician would have reported the perceived problem to his supervisor, who would then have reported the problem to the iron superintendent for resolution.

REFERENCE

1. Public Law 91-596, December 29, 1970, the "Occupational Safety and Health Act of 1970", Section 5(b).

FACE 90-25: Concrete Contractor/Finisher Dies in Virginia Following a 36-foot Fall Through a Floor Opening

SUMMARY

A concrete contractor/finisher fell 36 feet to his death through a floor opening after stepping on a sheet of particle board which had been laid across the opening to cover it. At the time of the incident, concrete had been poured onto floor panel forms on the third story of a building under construction. The victim and a co-worker, holding opposite ends of a 16-foot aluminum strike-off (a straightedge used to remove excess freshly-placed concrete), were moving backward as they screeded (smoothed off/leveled up) the concrete. The victim had reached a point on the floor where an 8-inch by 8-inch support "H" column was located. Directly behind the "H" column was a 48-inch by 91-inch floor opening covered by a sheet of particle board. As the victim worked around the "H" column, he inadvertently stepped on the particle board. The particle board bowed causing it to slip from its supports, and the victim fell 36 feet to the ground floor. The victim was pronounced dead 1 hour later at the incident site. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *implement 29 CFR 1926.500 (f)(5)(ii), which requires that floor opening covers be capable of supporting the maximum intended load and so installed as to prevent accidental displacement*
- *consider and address worker safety in the planning phase of construction projects*
- *develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training and educating employees in the proper methods of covering/guarding floor openings to prevent falls through the openings.*

Additionally, prime contractors should:

- *utilize contract language that requires subcontractors to implement a site-specific safety and health program prior to the initiation of work.*

INTRODUCTION

On February 6, 1990, a 42-year-old, male concrete contractor/ finisher died after falling 36 feet through a floor opening. On February 20, 1990, officials of the Virginia Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On March 1, 1990, a safety specialist traveled to the incident site to conduct an investigation. The safety specialist reviewed the incident with the general contractor of the project and the state OSHA compliance officer assigned to the case, and investigated and photographed the incident site. Reports (police, emergency medical service, and medical examiner) were obtained at this time.

The employer in this incident was a concrete contractor/finisher who had been in operation for 20 years. The contractor employed 6 workers and had no written safety rules or procedures. Additionally, the contractor did not require the use of any personal protective equipment on the job.

INVESTIGATION

A concrete contractor/finisher had been subcontracted to supply and finish the concrete for flooring work in a newly constructed three-story 60,000-square-foot building. The building skeleton steel, outer walls, floor joists, concrete floor form panels, and reinforcement wire had been previously constructed at the third-story level.

On the day of the incident, two crews of three men each were working in different locations on the third floor of the building. The crews were screeding (smoothing off/leveling up) the concrete as it was being poured on the formwork. The victim (the owner) and one co-worker were using a 16-foot aluminum strike-off (a straightedge used to remove excess, freshly-placed concrete, mortar, or plaster) to screed the concrete surface, while the third co-worker spread the concrete with a rake (Figure). The three workers were moving backwards as they worked on the concrete surface. An 8-inch by 8-inch support "H" column was located directly in the path of the victim. Approximately 2 feet behind the "H" column was a 48-inch by 91-inch floor opening designed to accommodate future ductwork for the heating, ventilation, and air-conditioning system. The floor opening was covered with a 1/2-inch-thick by 48-inch-wide by 92 1/2-inch-long section of particle board (a generic term used to describe panel products made from discrete particles of wood or other ligno-cellulosic material rather than fibers). The words "DO NOT STEP ON THIS" were painted on the surface of the covering. As the victim and fellow co-worker screeded the concrete near the "H" column, the victim moved backwards around the column and stepped on the floor opening cover. The cover bowed under the victim's weight, causing it to dislodge from its supports. The victim and cover fell through the opening 36 feet to the ground floor. Upon landing on the floor the victim struck the back of his head on the concrete foundation supporting the "H" column.

Workers on the ground floor observed the victim falling and striking the ground, whereupon they immediately summoned help. An emergency medical service (EMS), located two blocks from the incident site, arrived approximately 3 minutes after being called. Upon arrival at the scene, the EMS checked the victim but could not detect any vital signs. The medical examiner arrived 1 hour after the incident occurred and pronounced the victim dead at the scene.

CAUSE OF DEATH

The medical examiner's report listed the cause of death as extensive basilar skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.500 (f)(5)(ii), which requires that floor opening covers shall be capable of supporting the maximum intended load and so installed as to prevent accidental displacement (1).

Discussion: Employers should ensure that all floor openings are guarded with covers which can support the intended weight, and are installed to prevent movement or displacement.

Recommendation #2: Employers should consider and address worker safety during the planning phase of construction projects.

Discussion: Safety concerns should be addressed and incorporated into all construction projects during planning and throughout the entire project. Such a procedure would allow for the identification of potential hazards prior to the initiation of work so that appropriate intervention strategies could be implemented.

Recommendation #3: Employers should develop, implement, and enforce a comprehensive safety program.

Discussion: Employers should emphasize worker safety by developing, implementing, and enforcing a comprehensive safety program to reduce and/or eliminate worker exposures to hazardous situations. The safety program should include, but not be limited to, the recognition and avoidance of fall hazards and include appropriate worker training.

Recommendation #4: Prime contractors and subcontractors should contractually agree on specific site safety and health programs to be implemented before subcontractors begin work.

Discussion: Prime contractors should use contract language that requires all subcontractors to identify how they intend to implement a site-specific safety and health program prior to the initiation of work. Subcontractors' safety programs should be consistent and compatible with the prime contractor's safety program. Any differences should be negotiated before work begins.

REFERENCE

(1) Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. p. 193. July 1, 1989.

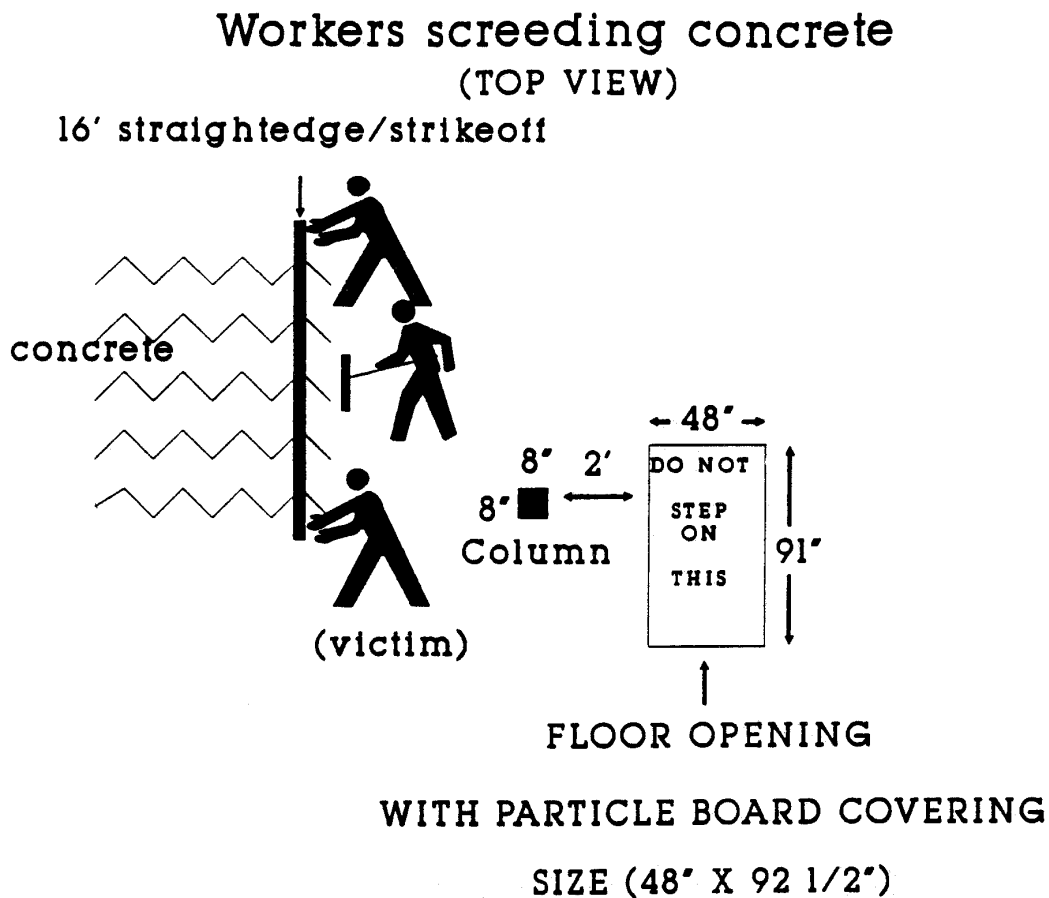


Figure. Three Story Building Under Construction

FACE 90-28: Carpenter Dies Following an 11-foot Fall from a Roof in North Carolina.

SUMMARY

A carpenter died after falling 11 feet from the roof of a garage under construction. Prior to the incident, the walls of the garage had been finished with brick veneer, the roof trusses were covered with sheets of plywood, and the frame work for a dormer, which was located on the apex of the garage roof, had been completed. On the day of the incident, the victim and a co-worker were assigned the task of boxing up (i.e., closing in, by nailing sheeting to studs or otherwise encasing) the dormer. The men climbed a ladder to the roof, ascended the roof to the dormer, and positioned themselves on opposite sides of the dormer. The victim apparently slipped or tripped, fell to a sitting position, and slid feet-first down and off the edge of the roof. He struck the back of his head on the brick veneer garage wall upon landing at ground level. The victim was pronounced dead approximately 24 hours later in the local hospital. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *implement 29 CFR 1926.104, which requires the use of safety belts, lifelines, and lanyards when working from elevations*
- *consider and address worker safety in the planning phase of construction projects*
- *develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training in fall hazard recognition and the use of fall protection devices.*

INTRODUCTION

On February 22, 1990, a 34-year-old male carpenter died after falling 11 feet from a garage roof the previous day. On February 22, 1990, officials of the North Carolina Occupational Safety and Health Administration (OSHA) notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On March 29, 1990, two safety specialists from DSR travelled to the incident site, and conducted an investigation. The DSR investigators reviewed the incident with the owner of the company, the jobsite foreman, and the state OSHA compliance officer assigned to the case, investigated and photographed the incident site, and obtained a copy of the victim's death certificate.

The employer is a general contractor who has been in operation for 23 years. The contractor employs 205 workers, including 15 carpenters. The contractor has no designated safety officer or written safety procedures, but does conduct bi-weekly "tool box" safety meetings from safety articles obtained outside the company. The victim had worked for the employer for 3 years and 5 months.

INVESTIGATION

The general contractor had started work on a private residence with an attached 26-foot by 39-foot garage, 4 months prior to the incident. The structure had been partially completed. The foundation, framing, exterior walls, wiring, plumbing, and windows had all been installed; and the roof trusses had been covered with plywood sheeting.

On the morning of the incident, a total of 10 workers (brick masons, laborers, and carpenters) were continuing work on the structure at different locations. The victim and a co-worker had been assigned to

complete boxing up the dormer located on the apex of the garage roof. The roof had a 5:12 pitch (i.e., the roof rose 5 inches for every 12 feet in length) with bare plywood sheeting covering the roof trusses. The edge of the roof was approximately 11 feet above the ground (Figure).

Prior to the incident, the walls of the garage had been finished with brick veneer, the roof trusses were covered with sheets of plywood, and the frame work for a dormer, which was located on the apex of the garage roof, had been completed. On the day of the incident, the victim and his co-worker climbed a ladder to the garage roof and proceeded to the dormer. The workers positioned themselves on opposite sides of the dormer and started to work. Exactly what happened is unknown, but the victim either slipped or tripped, fell to a sitting position, then slid feet-first down the plywood covered roof and fell off the roof edge. The victim fell approximately 11 feet to the ground where he struck the back of his head against the brick veneer garage wall. The jobsite foreman, who was approximately 20 feet away talking with a mason, saw the victim fall and strike the ground. The foreman told the mason to telephone for help. An emergency medical unit arrived in less than 5 minutes. They stabilized the victim and then transported him to the local hospital. The victim was pronounced dead approximately 24 hours later.

CAUSE OF DEATH

The death certificate listed the cause of death as severe head injury. An autopsy was not performed.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.104, which requires the use of safety belts, lifelines, and lanyards when working from elevations.

Discussion: When working from elevations employers should provide personal protective equipment (PPE) (i.e., safety belt, lifeline, and lanyard) to employees exposed to fall hazards. Employers should provide and enforce the use of PPE in accordance with 29 CFR 1926.104. (1)

Recommendation #2: Employers should address worker safety in the planning phase of construction projects.

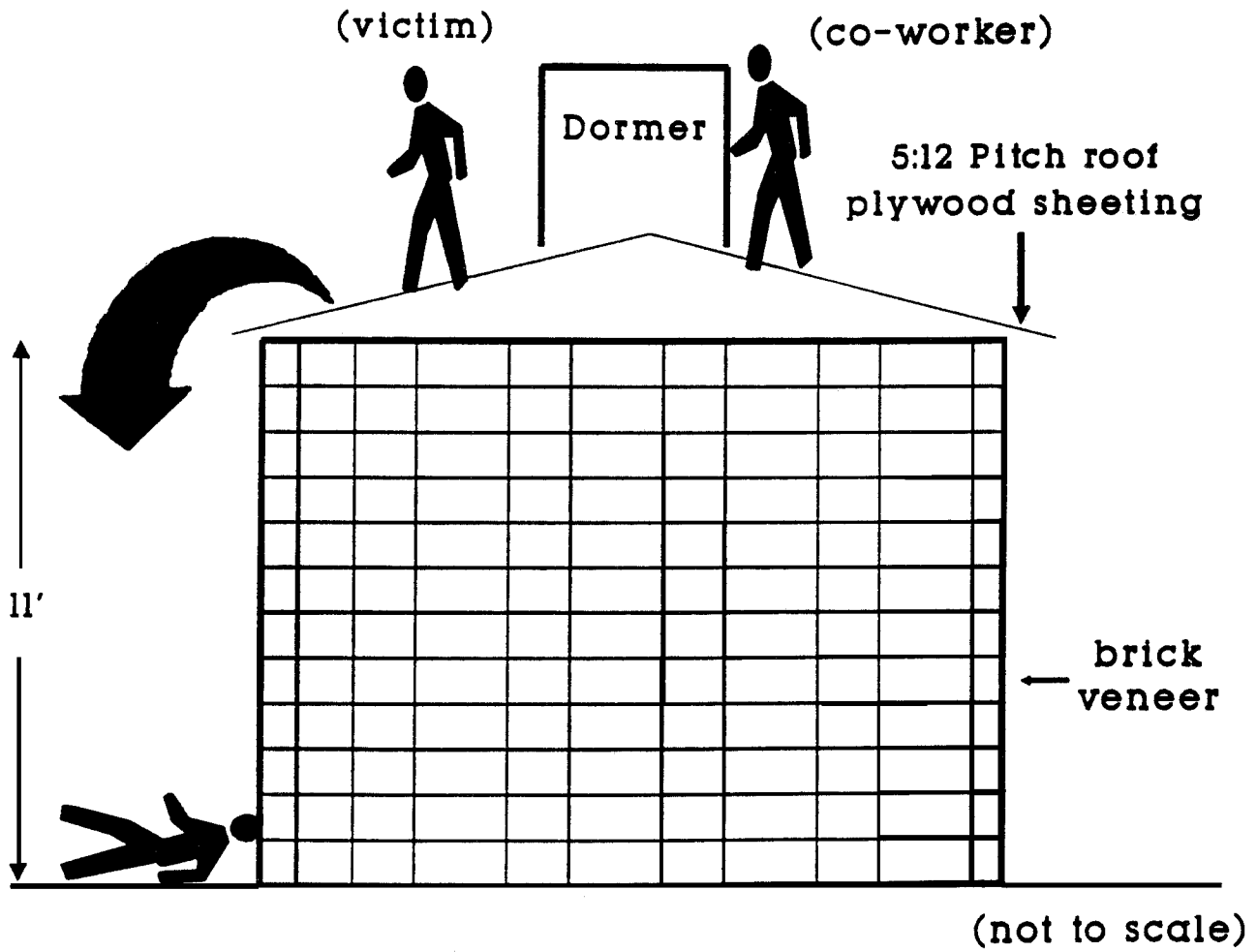
Discussion: Worker safety issues should be discussed and incorporated into all construction projects during planning and throughout the entire project. The planning for and incorporation of safety measures, prior to any work being performed at construction sites, will help to identify potential worker hazards so that preventive measures can be implemented at the site.

Recommendation #3: Employers should develop, implement, and enforce a comprehensive safety program.

Discussion: Employers should emphasize safety of their employees by developing, implementing, and enforcing a comprehensive safety program. The safety program should include, but not be limited to, training workers in the proper selection and use of PPE, along with the recognition and avoidance of fall hazards.

REFERENCE

(1) Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. pp. 105-106. July 1, 1989.



*Figure. Brick Veneer Garage
(side view)*

FACE 91-07: Sheet Metal Worker Dies After Falling 35 Feet to a Concrete Floor

SUMMARY

A 54-year-old male sheet metal installer (victim) died after falling 35 feet while installing roof rake angle iron on an outer roof edge of a processing plant under construction. The rake angle sets the wall line at the top of a building and provides anchor points for the structure's exterior panels. On the day of the incident the victim and a co-worker were installing 10-foot sections of rake angle iron to the outer roof edge of the structure. The rake angle iron was being attached to the outer edge of 5-inch-wide I-beams which supported the steel roof joists. The perpendicular I-beams were bolted to 35-foot-high, 8-inch steel "H"-shaped support columns. The victim was carrying a piece of rake angle iron across the I-beam when a co-worker saw him lose his balance and fall 35 feet to a concrete floor. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *comply with existing OSHA regulations regarding fall protection for workers exposed to fall hazards*
- *evaluate alternative methods of installing rake angle*
- *develop and implement a safety program designed to help workers recognize, understand, and control hazards.*

INTRODUCTION

On November 12, 1990, a 54-year-old male sheet metal worker died after falling 35 feet onto a concrete floor from a steel I-beam. On November 14, 1990, officials of the South Carolina Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On December 6, 1990, two safety specialists traveled to the incident site to conduct an investigation. The incident was reviewed with the jobsite superintendent and the OSHA compliance officer. Photographs of the incident site, the police and coroner's report, and the death certificate were obtained during the investigation.

The employer is a general contractor that specializes in constructing industrial complexes and commercial and multi-family dwellings. The employer has been in operation for 15 years and employs 254 workers, including 12 sheet metal workers. The employer has no written safety policy or safety program. Safety materials supplied by insurance companies have been collected over the years and are used during weekly "tailgate" safety meetings conducted by the jobsite superintendent. Worker training is conducted on the job.

INVESTIGATION

The company had been contracted to construct a 74,000-square-foot mineral processing plant. Company employees had been working at the site for 7 months. On the day of the incident, the victim and a co-worker were attaching 10-foot-long sections of rake angle iron to the outer roof edge of the structure. The rake angle iron sets the wall line at the top of the structure and provides anchor points for the structure's exterior siding panels. The rake angle iron was being attached to the outer side of 5-inch-wide I-beams. The I-beams were attached to the top of 35-foot-high, 8-inch steel "H"-shaped support columns (Figure). The bolts attaching the I-beams to the support columns protruded 2 inches above the top of the beam.

The victim was walking along the 5-inch I-beam flange carrying a piece of angle iron. A co-worker was walking behind him. Both men were wearing safety belts with lanyards, but neither man was tied off to a lifeline. No lifelines or catenary lines were present on the roof. The men would tie off to the 4-inch steel purlins (ceiling joists) only when sitting and making connections. The co-worker saw the victim suddenly lose his balance and fall to the concrete floor below, landing on his face.

The job superintendent, who also saw the victim fall, immediately summoned the emergency medical service (EMS) by telephone from the company trailer. Co-workers could not detect any vital signs. They did not initiate cardiopulmonary resuscitation (CPR) because the victim's face was crushed. Upon arrival, EMS personnel called the medical examiner, who pronounced the victim dead at the scene.

The co-worker stated that the victim had been in an area where bolts were protruding through the I-beam, when he lost his balance. The co-worker was not certain whether the victim tripped over the bolts or lost his balance for some other reason.

CAUSE OF DEATH

The county coroner listed head trauma as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should comply with existing OSHA regulations regarding fall protection for workers.

Discussion: 29 CFR 1926.105 (a) states, "Safety nets shall be provided when workplaces are more than 25 feet above the ground or water surface, or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical." Both men were wearing safety belts and lanyards. However, there were no lifelines or catenary lines present on the roof to use as tie-off points.

Recommendation #2: Employers should evaluate alternative construction methods for installing rake angle components.

Discussion: Lifelines were not present on the roof because the workers only tied off to the steel purlins when they were sitting and making connections. No fall protection was afforded the workers while they were walking across the beams and purlins. Alternative methods of installation that lessen worker exposure to falls should be explored. At the time of the NIOSH investigation, a scissors lift was present at the jobsite. One possible alternative work procedure might be to install the rake iron while working from the scissors lift. This method may have reduced the exposure to a fall hazard.

Recommendation #3: Employers should develop and implement a safety program designed to help workers recognize, understand, and control hazards.

Discussion: OSHA Standard 29 CFR 1926.21(b)(2) states, "the employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury." Companies should evaluate the tasks performed by workers, identify potential hazards, develop and implement a safety program addressing these hazards, and provide worker training in safe work procedures.

REFERENCES

29 CFR 1926.105(a) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

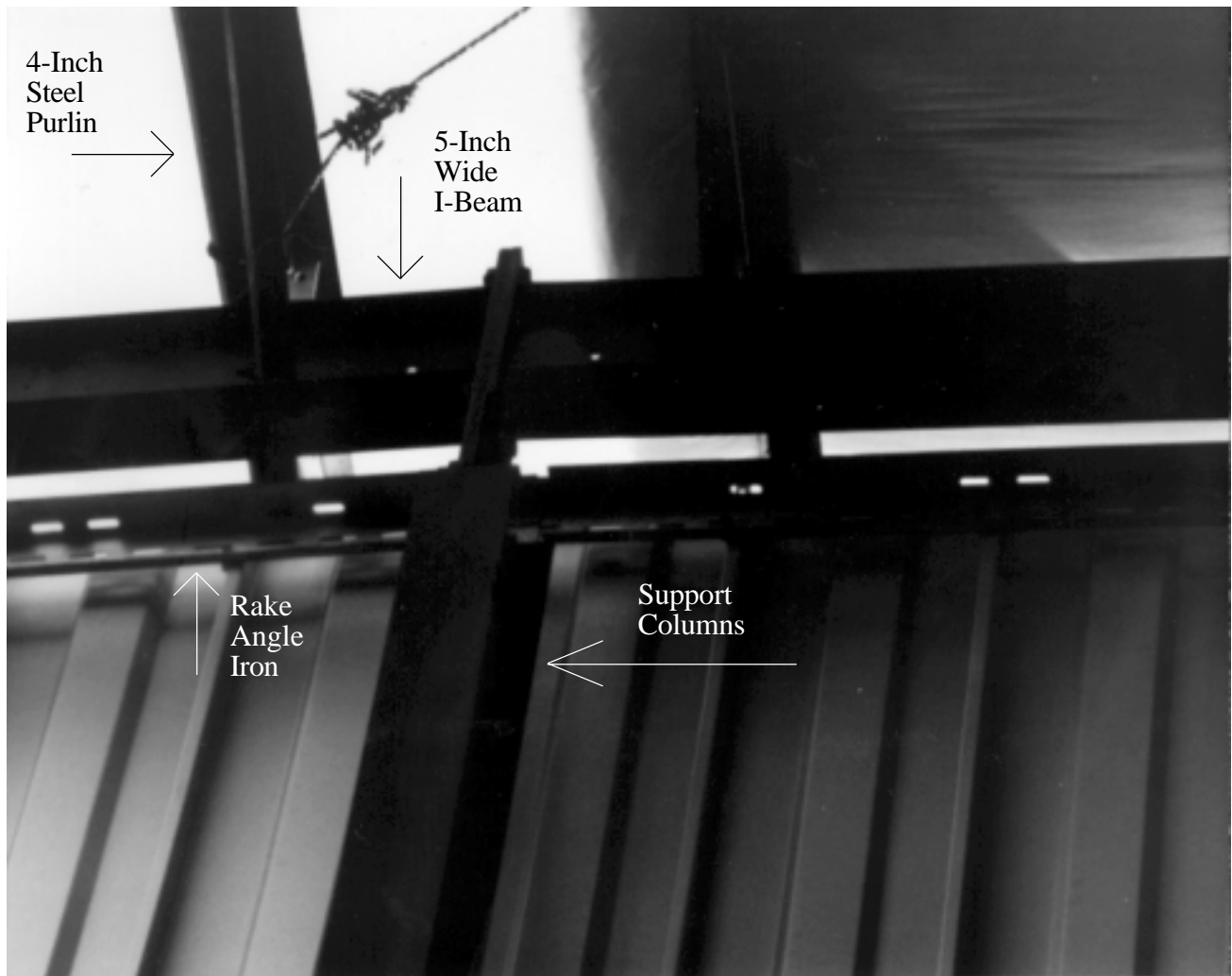


Figure.

FACE 91-11: Ironworker Dies in Ohio Following a 20-foot Fall Through a Skylight Opening

SUMMARY

A 38-year-old ironworker (the victim) fell 20 feet to his death through an unguarded skylight opening. At the time of the incident, a roof had been constructed over the enclosure surrounding a new bottling operation inside an existing bottling plant. The victim and a foreman were working overtime to finish welding support hangers for the heating, ventilation, and air-conditioning (HVAC) system. The foreman was welding on the roof of the existing building (external roof), while the victim worked on the newly constructed roof (enclosure roof), about 15-20 feet directly below. The victim was apparently in the process of putting fire blankets over the existing ductwork when he either tripped and fell, or stepped, into an 18-inch by 24-inch skylight opening. The victim fell 20 feet and landed on the concrete floor, striking the back of his head. The victim was pronounced dead 2 hours later at the emergency room of a local hospital. NIOSH investigators concluded that, to prevent future similar occurrences, employers should:

- *implement 29 CFR 1926.500 (b)(4) and 1926.500 (f)(6), which require that wherever there is danger of falling through a skylight opening, it shall be guarded by a fixed standard railing on all exposed sides, or a cover capable of supporting the maximum intended load and so installed as to prevent accidental displacement*
- *develop and/or enforce safety programs that include, but are not limited to, training and educating employees in the proper methods of covering/guarding skylight openings to prevent falls through the openings*
- *identify hazards and appropriate safety interventions in the design and review phases of construction projects*
- *provide fall protection measures along unguarded roof perimeters as required by 29 CFR 1926.500 (d)(1)*
- *install permanent railings around skylight perimeters or protective screens over individual skylights once construction is completed.*

Additionally, property owners, prime contractors, and subcontractors should:

- *ensure that areas of responsibility for safety and health issues are clearly specified as part of the contract provisions.*

INTRODUCTION

On January 28, 1991, a 38-year-old ironworker died after falling 20 feet through a skylight opening. On February 19, 1991, officials of the Ohio Bureau of Workers' Compensation, Division of Safety & Hygiene, notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On March 14, 1991, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with personnel from the Bureau of Workers' Compensation, the employer, and the victim's foreman. A video of the incident site and the medical examiner's report were also obtained.

The employer involved in this incident is a metal fabrication and erection contractor which had been in operation for 18 months. The contractor employs 55 workers, including 20 ironworkers. The employer has a safety policy, designated safety officer, and a comprehensive safety program which contains specific safe job procedures. The employer provides on-the-job training, which is included in the 3-year apprentice program, and jobsite foremen conduct weekly tool box safety meetings. The victim worked for the employer for only 6 weeks, but had 20 years' experience as an ironworker.

INVESTIGATION

A metal fabrication and erection contractor had been selected as a subcontractor to supply and erect an enclosure around a bottling operation located inside an existing building. At the time of the incident, the enclosure's steel skeleton and roof had been constructed. The roof frame was constructed with 3-inch angle steel, with 3-foot by 8-foot sheets of 14-gauge stainless steel welded to the frame. The roof area was 36 feet long, by 30 feet wide and contained twelve 18-inch by 24-inch skylight openings. The roof had a 1:6 pitch (i.e., the roof rose 1 foot for every 6 feet in width; see Figure).

On the day of the incident, two workers--the victim and a foreman--agreed to work overtime to finish welding support hangers for the HVAC system. About 6:45 p.m. the foreman was welding on the external roof, directly above the newly-constructed enclosure roof, attaching support hangers to the external roof's structural steel. Previously, before the welding began, the victim had been instructed to cover ductwork located below the welding operation with fire blankets (i.e., material with the ability to withstand fire).

Although no one saw the victim fall, evidence at the site suggests that the victim was in the process of covering the ductwork with a fire blanket and either tripped on the angle iron and fell into, or stepped backwards into, a skylight opening. The victim apparently fell 20 feet and landed on the concrete floor, striking the back of his head.

The foreman, who had seen the victim 15 minutes previously, discovered the victim lying on the concrete floor. The victim was conscious, but bleeding from the ears, nose, and mouth. The emergency medical service was called and arrived about 25 minutes later. The victim was transported to the emergency room of a local hospital where he died 2 hours later.

CAUSE OF DEATH

The medical examiner's report listed the cause of death as extensive basilar skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.500 (b)(4) and 1926.500 (f)(6), which require that skylight openings be guarded by a fixed standard railing on all exposed sides, or a cover capable of supporting the maximum intended load, and so installed as to prevent accidental displacement.¹

Discussion: The surface of the roof, 30 feet by 36 feet, contained twelve 18-inch by 24-inch skylight openings. Employers should ensure that all skylight openings be secured with a fixed standard railing on all exposed sides, or a cover which would support a worker's weight, and which would not be subject to displacement.

Recommendation #2: Employers should develop and enforce safety programs that include, but are not limited to, reducing or eliminating worker exposures to hazardous situations.

Discussion: Employers should emphasize worker safety by implementing and enforcing existing safety programs to reduce or eliminate worker exposures to hazardous situations. Safety programs available at the time of this incident included the recognition and avoidance of fall hazards and included worker training which emphasized methods and materials for covering/guarding skylight openings to prevent falls through the openings. About 2 weeks prior to the incident, the victim attended a tool box meeting which addressed recognition and avoidance of fall hazards.

Recommendation #3: Employers should identify hazards and appropriate safety interventions in the design and review phases of construction projects.

Discussion: Worker safety requirements should be addressed and incorporated into construction project designs and working drawings during the planning phase and throughout the life of the project. Hazard identification at this preliminary stage allows lead time for training, intervention and protective equipment allocation. As review and design can be ongoing processes, hazard recognition and safety intervention can also be ongoing.

Recommendation #4: Employers should implement 29 CFR 1926.500 (d)(1), which requires that every open-sided floor or platform 6 feet or more above adjacent floor or ground level shall be guarded by a standard railing, or the equivalent.

Discussion: Employers should use an appropriate fall protection system, or a combination of applicable systems (e.g., warning lines, guardrails, platforms, safety belts, nets, safety monitoring system, etc.), to protect employees from falling off the edge of roofs, as required by 29 CFR 1926.500 (d)(1).

Recommendation #5: Building owners should consider installing permanent railings around skylight perimeters or protective covers over individual skylights once construction is completed, to guard against falls through skylights by maintenance or other personnel who must access the roof.

Discussion: After completing construction of the enclosure, maintenance or other employees of the bottling plant will still have foreseeable needs to access the roof. The possibility of falling through a laminate covered skylight will still exist. Building owners should consider installing permanent railings around the perimeter of the skylight area, or protective screens over individual skylights, to eliminate the hazard of falling through the skylights once construction is completed.

Recommendation #6: Property owners, prime contractors, and subcontractors should ensure that areas of responsibility for safety and health issues are clearly specified as part of the contract provisions.

Discussion: Contracts between all parties (i.e., property owners, prime contractors, and subcontractors) should contain language that identifies the specific site safety and health programs to be implemented before the initiation of work. Any safety program should be consistent and compatible with the agreed upon language, and any differences should be negotiated before work begins. Where prime contractors and subcontractors are involved, the contract should contain clear and concise language as to which party is responsible for each safety and health issue. The respective parties should periodically inspect worksites to ensure that the provisions of the contract regarding safety and health issues are being upheld.

REFERENCE

1. Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. PO-13.108-Rule. July 1, 1990.

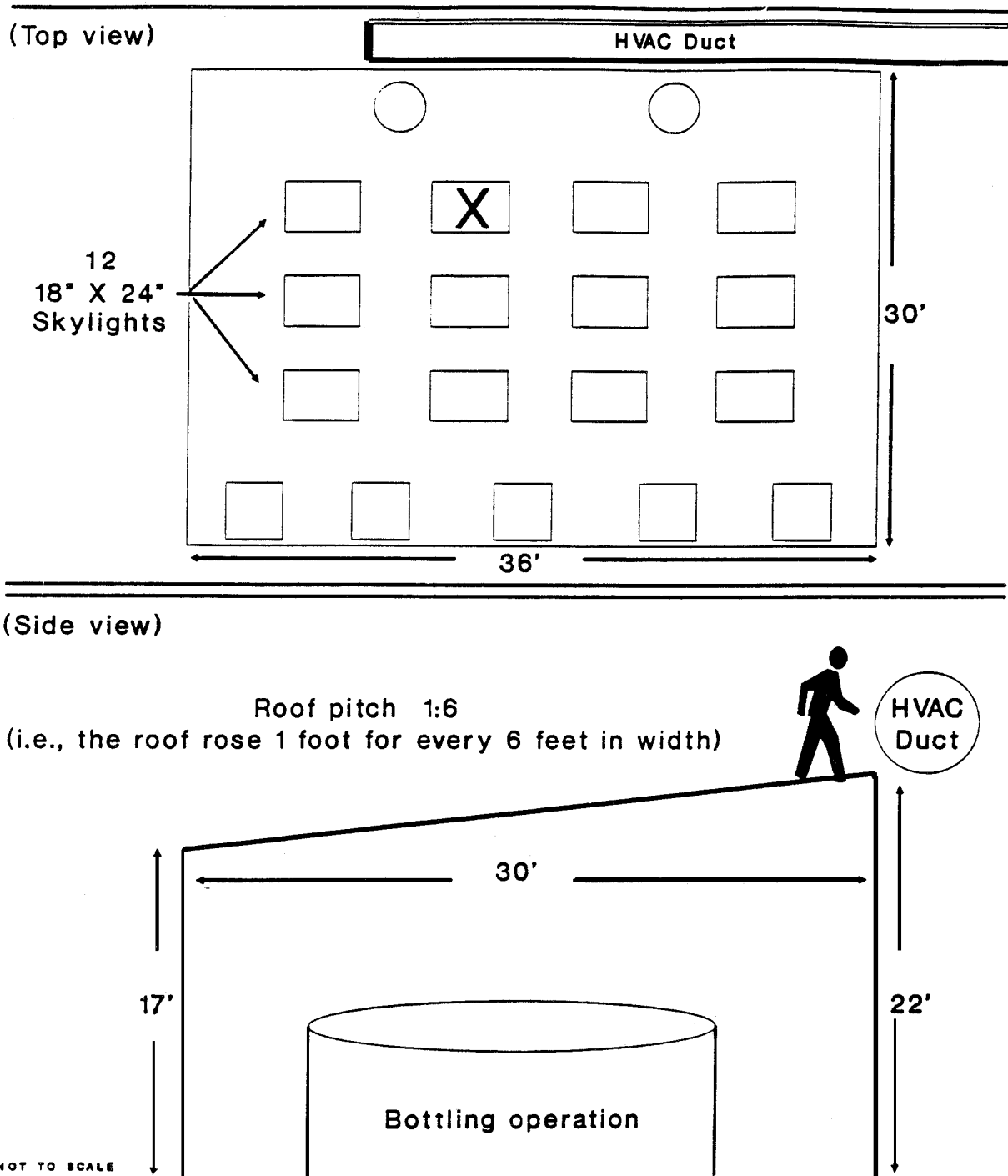


Figure. Bottling Line Enclosure/Roof

FACE 91-15: Millwright Foreman Dies in South Carolina Following a 41-foot Fall Through a Platform Opening

SUMMARY

A 36-year-old millwright foreman (victim) fell 41 feet to his death through an unguarded platform opening. At the time of the incident, an open-sided steel structure had been constructed to support eight air-conditioning units on the platform. Four air-conditioning units had been installed and the fifth unit had been lifted into position by a crane. In order to level the unit, three millwrights were positioned on one side of the air-conditioning unit, while the victim was kneeling on the opposite side. The victim stood up and apparently tripped or stumbled and fell backwards landing on the steel grating of the platform walkway. Momentum from the fall caused the victim to roll into an adjacent opening which was about 17 feet long by 7 feet wide. The victim fell through the opening, struck a steel support crossbeam about 20 feet below, and fell an additional 21 feet to the ground. The victim was pronounced dead 4 hours later at the emergency room of a local hospital. NIOSH investigators concluded that, to prevent future similar occurrences, employers should:

- *implement 29 CFR 1926.500 (b)(1) and 1926.500 (f)(5)(ii), which require that wherever there is danger of falling through a floor opening, it shall be guarded by a standard railing and toeboards on all exposed sides, or a cover capable of supporting the maximum intended load and so installed as to prevent accidental displacement*
- *identify hazards and appropriate safety interventions in the design and review phases of construction projects*
- *provide fall protection measures along unguarded roof perimeters as required by 29 CFR 1926.500 (d)(1), and install permanent railings around the perimeter of the platform once construction is completed*
- *conduct scheduled and unscheduled safety inspections to ensure that safety procedures are being followed.*

INTRODUCTION

On April 22, 1991, a 36-year-old millwright foreman died after falling 41 feet through a platform opening. On April 29, 1991, officials of the South Carolina Occupational Safety and Health Administration (OSHA), notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On May 30, 1991, two DSR safety specialists and a safety engineer traveled to the incident site to conduct an investigation. The incident was reviewed with a representative from the company and with the OSHA compliance officer assigned to the case. Photographs of the incident site and a copy of the death certificate were obtained.

The company involved in this incident has been in business for 8 1/2 years and provides various services, including crane and tractor-trailer rentals, steel erection, and equipment/machinery installation. The company employs 50 workers, including 3 millwright foremen. The company has a written safety policy, designated safety director, and a written safety program, which includes a hazard communication program. The foremen conduct monthly safety meetings, and all employees are given safe work practices handbooks

at the time they are hired. The victim worked for the employer for 5 years, but had approximately 11 years' experience as a millwright foreman.

INVESTIGATION

The company had been sub-contracted to erect an open-sided steel structure and platform, about 40 feet high, and to install eight air-conditioning units on top of the flat platform. The steel structure and platform had been completed and four air-conditioning units had been installed at the time of the incident. The steel-grating platform was 36 feet wide by 60 feet long with eight openings, which were each approximately 17 feet long by 7 feet wide. Air conditioning units were installed in four of the openings, and installation of the fifth air conditioner was in process (see Figure).

On the day of the incident, a crew of four workers, consisting of a millwright foreman and three millwrights--a millwright is a mechanic specializing, in the installation of heavy machinery/equipment--were continuing work to complete the installation of the air-conditioning units. The fifth air conditioner had been positioned in the opening on the platform by crane.

At the time of the incident, the crew was working on all four sides of the air conditioner, positioning shims under the unit to level it. The foreman was kneeling on the steel grating between the air conditioner and an adjacent opening. When he tried to stand up, he apparently tripped or stumbled, and fell backwards, onto the steel grating of the platform walkway. Momentum from the fall caused the victim to roll into the opening. The victim fell through the opening, struck a steel crossbeam about 20 feet below, and fell an additional 21 feet to the ground.

Two millwrights rushed to the victim, while the third millwright ran to a telephone and called the emergency medical service (EMS). The EMS arrived about 10 minutes after being contacted, stabilized the victim, and transported him to the local hospital. The victim was later transported by helicopter to another hospital where he was pronounced dead 4 hours after the incident occurred.

CAUSE OF DEATH

The death certificate listed the cause of death as severe closed head injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.500 (b)(1) and 1926.500 (f)(5)(ii), which require that wherever there is danger of falling through a floor opening, it shall be guarded by a standard railing and toeboards on all exposed sides, or a cover capable of supporting the maximum intended load and so installed as to prevent accidental displacement. (1)

Discussion: The floor surface of the platform, 36 feet by 60 feet, contained eight 16-foot 8-inch long by 6-foot 8-inch wide openings. Employers should ensure that all platform openings be secured with a fixed standard railing and toeboards on all exposed sides, or a cover which would support a worker's weight, and which would not be subject to displacement.

Note: A safety belt and lanyard was found on the platform at the incident site, but whether or not the safety equipment had been used prior to the incident could not be ascertained.

Recommendation #2: Employers should identify hazards and appropriate safety interventions in the design and review phases of construction projects.

Discussion: Worker safety requirements should be addressed and incorporated into construction project designs and working drawings during the planning phase and throughout the life of the project. Hazard control procedures specified in various working drawings point to newly created or developing hazards, and allow lead time for developing safe work practices and procedures, including training and protective equipment needs. As review and design are ongoing processes, hazard recognition and safety intervention should also be ongoing processes.

Recommendation #3: Employers should provide fall protection measures along unguarded roof perimeters as required by 29 CFR 1926.500 (d)(1) (2), and building owners should consider installing permanent railings around the perimeter of the platform once construction is completed.

Discussion: Employers should use an appropriate fall protection system, or a combination of applicable systems (e.g., warning lines, guardrails, platforms, safety belts, nets, safety monitoring system etc.), to protect employees from falling off the edge of roofs, as required by 29 CFR 1926.500 (d)(1).

Additionally, after construction of the platform and installation of the air-conditioning units is completed, maintenance or other employees will still have foreseeable need to access the platform. The possibility of falling off the sides of the platform will still exist. Building owners should consider installing permanent railings around the perimeter of the platform to eliminate the hazard of falling off the sides of the platform once construction is completed.

Recommendation #4: Employers should conduct scheduled and unscheduled safety inspections regularly at each jobsite.

Discussion: Although the company has a written safety program which includes monthly safety meetings, scheduled and unscheduled safety inspections should be conducted on a regular basis. To be effective, a safety program must be enforced at the worksite. Regular company safety inspections demonstrate to workers that the company is committed to enforcing its safety policies and procedures.

REFERENCE

1. Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. p. 190 and p. 193 July 1, 1990.
2. Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. p. 191 July 1, 1990.

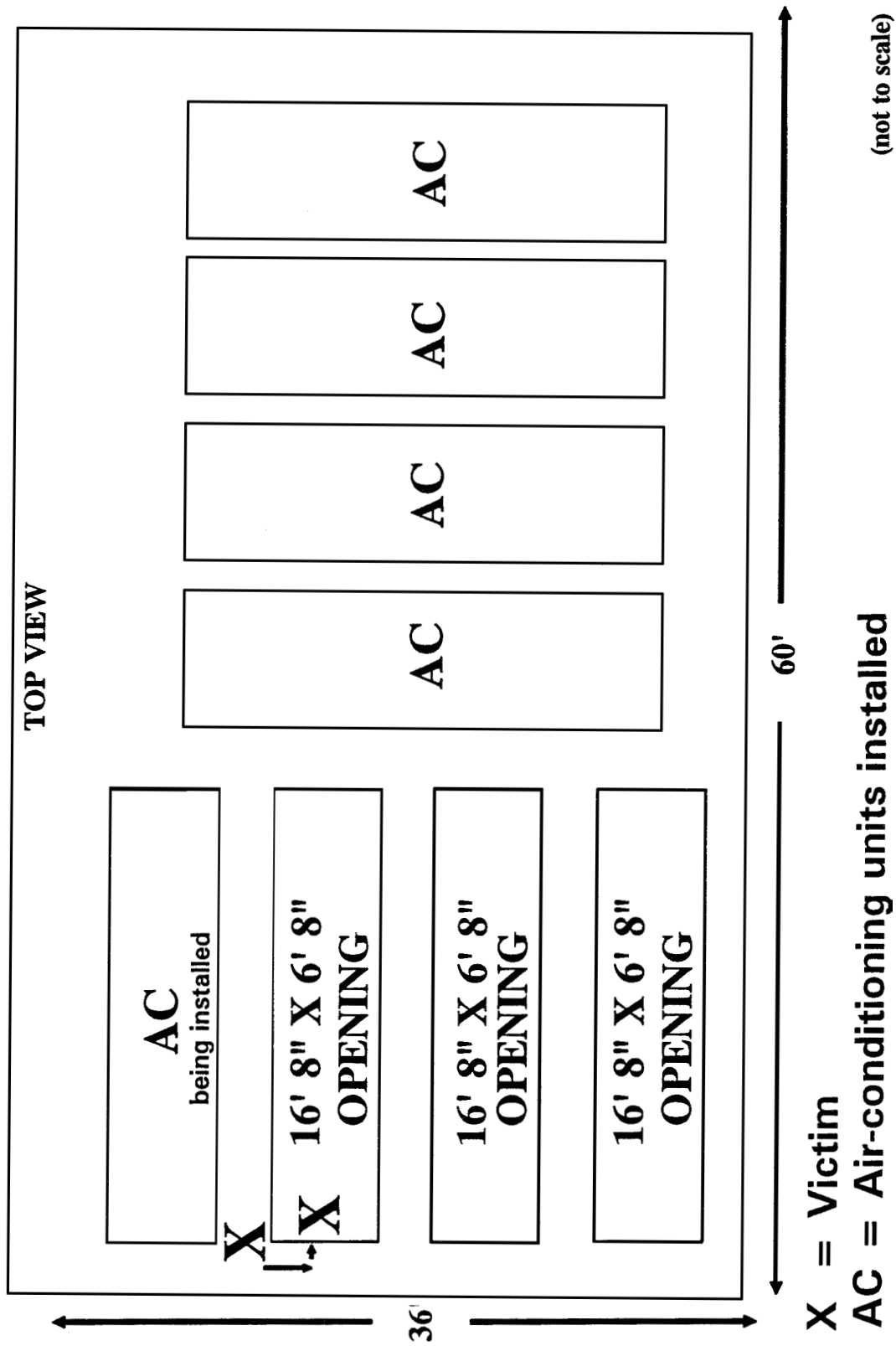


Figure. Open-sided Steel Structure Platform.

FACE 91-18: Journeyman Ironworker Dies Following a 22.5-foot Fall From a Walkway in Maryland

SUMMARY

A journeyman ironworker died after falling 22.5 feet from the structural steel supports for a walkway platform which was under construction. The walkway had been partially completed (i.e., the structural steel frame, steel grating, and handrails/toeboards had been installed up to the position where the crew members were working). Before the incident, the victim had been welding structural steel support beams for the walkway from a position approximately 8 feet above the co-worker. While the fall was unwitnessed, the co-worker stated he felt something hit his welding hood, and when he looked around he saw the victim falling. The victim struck a drive shaft located in a pit about 12 feet below the area where he was working, and came to rest at the base of the pit about 22.5 feet below the walkway platform (Figure). NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *provide and enforce the use of personal protective equipment*
- *conduct a jobsite hazard analysis before each job and implement appropriate controls*
- *periodically monitor jobsites to evaluate field compliance with company safety rules and procedures.*

INTRODUCTION

On May 26, 1991, a 62-year-old male journeyman ironworker (victim) fell 22.5 feet from a walkway platform which was under construction. The victim died 2 days later as a result of injuries he sustained in the fall. On May 30, 1991, officials of the Occupational Safety and Health program from the State of Maryland, notified the Division of Safety Research (DSR) of the death and requested technical assistance. On June 20, 1991, a safety specialist from DSR traveled to the incident site to conduct an investigation. The DSR investigator reviewed the incident with the employer, plant representatives, and State OSHA personnel. Photographs of the incident site and copies of the police report were also obtained.

The employer in this incident is an industrial building construction company with about 5000 employees throughout the country. At the time of the incident, 300 employees were working at the jobsite, including 45 journeymen ironworkers. Most of the employees are ironworkers, carpenters, electricians, pipefitters, boilermakers, and laborers hired through their respective local union halls. The victim had approximately 20 years of experience as a journeyman ironworker and had been employed by the company for only 2 days. The company employs a safety staff of 10 persons, including a corporate-level safety manager, a manager of field safety, a safety engineer, and several field safety personnel. The employer has a written safety policy and written procedures on the use of fall protection equipment and fall prevention methods. The general foreman at each construction site is responsible for jobsite safety issues, and "tailgate" safety meetings are conducted weekly.

INVESTIGATION

The employer had been contracted to build various structures as part of a renovation project for a steel producing facility. About 300 construction employees were working at the jobsite. Work at the incident

site included the installation of a walkway platform to access process machinery, piping, and control panels. The walkway platform had been partially completed (i.e., walkway sections complete with steel grating and handrails and toeboards had been installed).

On the day of the incident, the victim and a co-worker had been assigned to continue their work installing additional sections of the walkway platform. The walkway platform section being worked on was approximately 6-feet wide by 10-feet long. Supports for the section were being welded by the victim, while the co-worker was welding brackets in a pit below the walkway platform. The victim was positioned on the structural steel supports next to a pit about 22.5 feet deep, while the co-worker welded brackets in the pit area about 8 feet below him (Figure). Although both workers were wearing safety belts and lanyards, neither worker was tied off.

While the fall was unwitnessed, the co-worker stated he was welding when something hit his welding hood, and as he looked around, he saw the victim falling. The victim fell about 12 feet and struck, face first, a metal drive shaft in the pit. The victim's body then landed on the concrete floor of the pit about 22.5 feet below the walkway platform.

The co-worker yelled "man in the hole," and climbed down to help the injured worker. A foreman working in the area heard the call for help and radioed for emergency medical service. In the interim, other workers brought a stretcher to the victim and removed him from the incident area. Within 3 minutes an emergency medical technician (EMT) arrived at the scene, checked the victim, and found no pulse or respiration. The EMT began cardiopulmonary resuscitation while awaiting the ambulance that arrived 15 minutes after the incident occurred. The victim was stabilized and transported to an airlift landing zone. He was then flown by helicopter to a shock-trauma unit at a nearby hospital, where he remained in the critical care unit on assisted life support until his death 2 days after the incident.

CAUSE OF DEATH

The medical examiner's report listed the cause of death as head and neck injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should comply with existing OSHA regulations regarding fall protection for workers.

Discussion: 29 CFR 1926.28(a) states, "The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions or where this part indicates the need for using such equipment to reduce the hazards to the employees." Both workers were wearing safety belts and lanyards. However, neither worker was tied-off to a secure point, and no lifeline was present to use as a tie-off point.

Recommendation #2: Hazard analysis should be included as an ongoing part of each construction phase.

Discussion: Before starting each phase of the construction, each crew foreman should identify and review the potential hazards with his crew and discuss how to control the hazards and how the work can be done

safely. These discussions should include information on hazards in the immediate work area as well as information on the activities of other work crews on the site that could create additional hazards for workers.

Recommendation #3: Employers should periodically monitor jobsites to evaluate field compliance with company safety rules and procedures.

Discussion: Employers should conduct periodic scheduled and unscheduled safety inspections to ensure that employees are performing their assigned tasks according to established safe work procedures. To be effective, a safety program must be enforced at the worksite. Regular company safety inspections show workers that the company is committed to enforcing its safety policies and procedures. Any violations of safety rules should be corrected immediately.

REFERENCES

1. Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. p. 21 July 1, 1990.

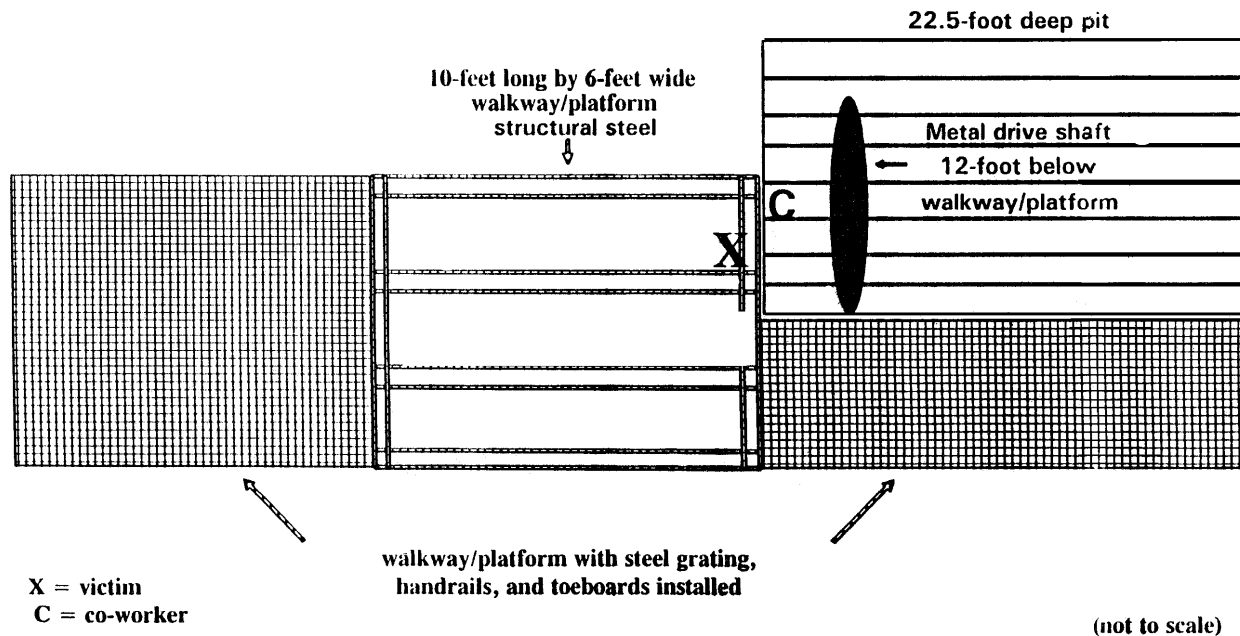


Figure. Walkway/platform (Top view)

FACE 91-27: Cleaning Maid Dies in Ohio Following a 12-foot Fall Through a Floor Opening

SUMMARY

A 71-year-old cleaning maid (victim) fell 12 feet to her death through an unguarded floor opening. At the time of the incident, an access door to a lower-level boiler room had been left open in the floor of the hall to the men's showers; a maintenance mechanic was servicing the heating plant for the municipal swimming pool. The cleaning maid, who was walking backwards as she mopped down the floor to the men's showers, backed into the access door opening and fell about 12 feet onto the cement floor below. The victim was transported to the trauma center of a hospital in a neighboring state where she died 7 days later from injuries sustained in the fall. NIOSH investigators concluded that, to prevent future similar occurrences, village and municipal administrations should:

- *implement 29 CFR 1910.23 (a)(3)(i), which requires that every hatchway floor opening shall be guarded by a hinged floor opening cover of standard strength and construction equipped with standard railings or permanently attached thereto so as to leave only one exposed side. When the opening is not in use, the cover shall be closed or the exposed side shall be guarded at both top and intermediate positions by removable standard railings*
- *develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training and educating employees in the proper methods of covering/guarding floor openings, and of surveying work areas prior to beginning work, to prevent falls through openings*
- *conduct scheduled and unscheduled safety inspections to ensure that safety procedures are being followed.*

INTRODUCTION

On July 26, 1991, a 71-year-old cleaning maid fell 12 feet through an open floor-level access door. On August 5, 1991, officials from a Pennsylvania Coroner's Office notified the Division of Safety Research (DSR) of the victim's subsequent death on August 2, 1991, and requested technical assistance. On August 21, 1991, a supervisory industrial hygienist traveled to the incident site to conduct an investigation. The incident was reviewed with representatives from the village. Photographs of the incident site and a copy of the death certificate were obtained.

The village involved in this incident had been incorporated for 79 years and provided various services, including parks and the municipal swimming pool. The village employed 37 to 47 workers, including 7 regular full-time and 30 to 40 part-time laborers. The village had no written safety policy, designated safety director, nor written safety program. The victim had worked as a cleaning maid for the village for 8 years 3 months.

INVESTIGATION

The village had a municipal swimming pool constructed in a structure shared with the municipal fire department. The swimming pool was serviced each day by two cleaning maids who mopped floors and performed other janitorial work. On Mondays, Wednesdays and Fridays, a mechanic from the village would arrive before doors opened to the public to add chlorine to, and service the filters and boilers on, the pool water system.

On the day of the incident, both cleaning maids were mopping the men's locker room when the mechanic stopped in to let them know that he would be in and out of the mechanical/maintenance room servicing the pool. The mechanic left and the cleaning maids continued mopping the area. One cleaning maid continued mopping into the hall and adjoining ladies locker/shower facilities, while the other cleaning maid (victim) mopped in the other direction through the men's shower facilities into the connecting hallway to the pool area. This hallway also served as the access to the main and lower-level mechanical/maintenance areas of the building.

As the victim was mopping backwards down the hall, she backed into a access opening in the hall floor that had been left open by the mechanic as he traveled to-and-from the pool from the lower-level mechanical room. The victim fell through the opening, and landed on the concrete floor of the mechanical room, 12 feet below. The mechanic, who was working in the mechanical room at the time, heard the fall and immediately summoned the other cleaning maid to call for help. The local emergency medical service (EMS) was called to the scene. Because of the victim's condition, EMS elected to transport the victim by helicopter to a trauma center at a regional hospital. The victim died 7 days later from injuries sustained from the fall.

CAUSE OF DEATH

The death certificate listed the cause of death as blunt force trauma to the head and chest with atherosclerotic cardiovascular disease contributing.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Village and municipal administrations should implement 29 CFR 1910.23 (a)(3)(i), which requires that every hatchway floor opening shall be guarded by a hinged floor opening cover of standard strength and construction equipped with standard railings or permanently attached thereto so as to leave only one exposed side. When the opening is not in use, the cover shall be closed or the exposed side shall be guarded at both top and intermediate positions by removable standard railings. (1)

Discussion: Standard removable railings installed at the location of the open, hinged floor cover would prevent someone from walking directly into an opening and falling through. Entry through a swinging gate or offset in the railing would prevent direct, inadvertent access to such an opening.

Recommendation #2: Village and municipal administrations should develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training and educating employees in the proper methods of covering/guarding floor openings, and of surveying work areas for hazards prior to beginning work, to prevent falls through openings.

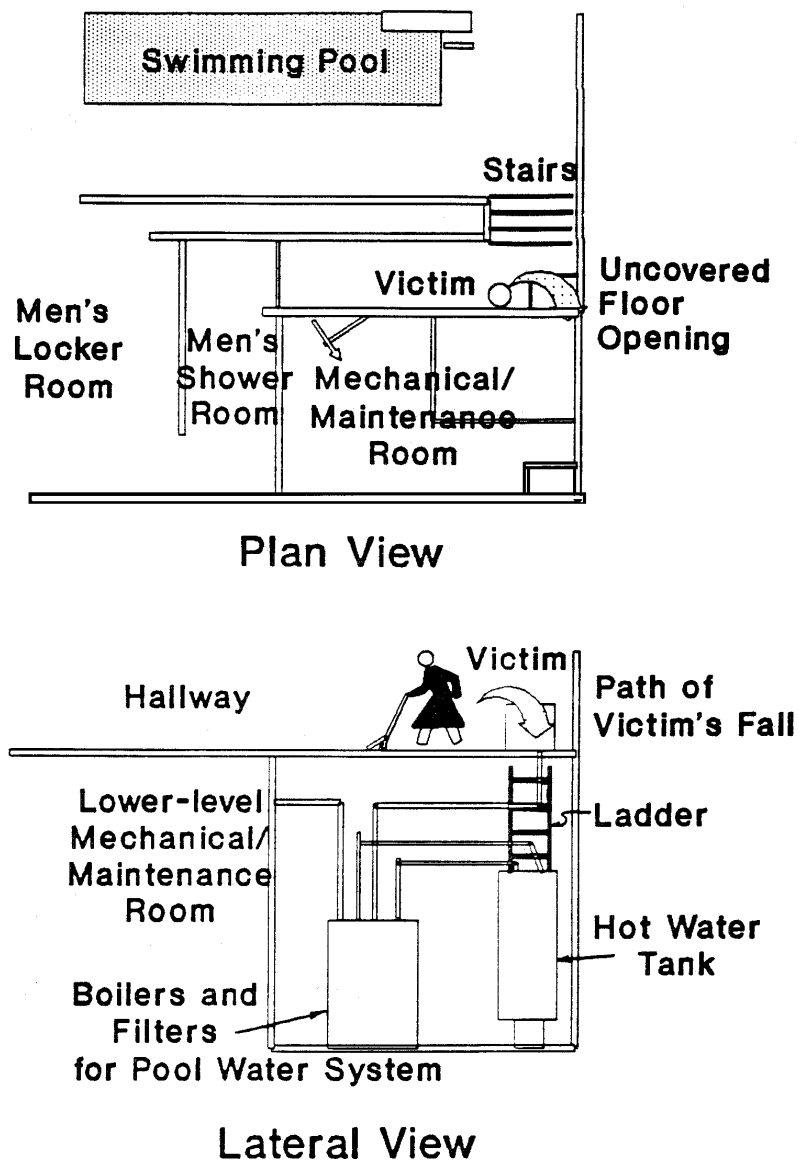
Discussion: Whenever a floor-level opening is left uncovered/ unguarded, there is a danger of falling through that should be controlled by some type of barrier or temporary cover. A warning sign could be used to provide additional protection. It is also inherently unsafe to work backwards into an area that has not first been surveyed for hazards. A comprehensive safety program based upon job safety analyses for all village work positions should be developed and implemented.

Recommendation #3: Employers should conduct scheduled and unscheduled safety inspections regularly at each jobsite.

Discussion: To be effective, a safety program must be enforced at the worksite. Regular safety inspections demonstrate to workers that the village or municipality is committed to enforcing its safety policies and procedures. These inspections also provide opportunity to observe previously unidentified hazards and implement appropriate preventative or intervention controls. Assessments of occupational safety and health hazards as addressed by federal and state standards should be an active part of this safety inspection process.

REFERENCE

1. Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1910. p. 98. July 1, 1990.



FACE 91-33: Iron Worker Dies Following an 89-Foot Fall Through an Opening in Temporary Metal Flooring in Virginia

SUMMARY

A 26-year-old male iron worker (victim) died from injuries sustained after falling through an unguarded temporary floor opening to the ground 89 feet below. Workers had begun removing temporary metal flooring from the fourth floor of a new paper processing facility. The workers then left the site without safely securing a newly created 5-foot by 28-foot floor opening. The victim, who had been working on the roof deck, descended to the fourth floor to get a drink from a water cooler. While there, co-workers reminded him of some bolting he had missed on the same level. The victim was still wearing his safety belt and lanyard, but did not tie-off to the existing static lines. As he was looking upward for missed bolting locations, he walked off the edge of the flooring at the opening, and fell 89 feet to the ground. During the fall, his head and chest struck against structural steel members causing massive injuries that resulted in his death. NIOSH investigators concluded that, in order to prevent similar occurrences, employers should:

- *ensure that workers do not leave a workplace until all floor openings have been safely secured by barriers with warning signs or safety railings*
- *ensure that workers continually adhere to established safe work practices*
- *encourage all workers to actively participate in workplace safety.*

INTRODUCTION

On July 12, 1991, a 26-year-old male iron worker died from injuries sustained after falling through an unguarded opening in a temporary metal floor to the ground 89 feet below. On August 29, 1991, officials of the Virginia Department of Labor and Industries (VAOSHA), notified the Division of Safety Research (DSR) of the fatality, and requested technical assistance. On September 25, 1991, a DSR Safety Engineer traveled to the site to conduct an investigation. The fatality was reviewed with company representatives and the VAOSHA compliance officer, and police and coroner reports were obtained. Photographs of the site immediately following the incident were reviewed, and additional photographs were taken.

The employer was a steel erection company subcontracted to install the main structural steel elements of a paper processing facility. The company had been in business for 18 months and had 55 employees, including 6 iron workers. The company had a corporate safety officer, a comprehensive written safety program, written safety procedures, and occasional, unscheduled safety meetings. Upon hire, employees received general safety training with manuals and videos.

INVESTIGATION

The victim was one of six iron workers bolting-up (placing large nuts on bolts and then tightening) the structural steel at the time of the incident. The structure was six stories high with a small seventh-story penthouse. A 1/2-inch, wire-rope static line had been installed around the perimeter of each floor, and also across the working space in several areas, for convenient tie-off. All employees had safety belts and lanyards, and their use was rigorously enforced. Safety nets were also used, as appropriate. The work area was very noisy and windy. On the morning of July 12, 1991, the victim and a co-worker were bolting-up

steel on the roof deck (sixth floor). There were several hundred bolt locations on this job and many were difficult to find.

About an hour before the fall, some of the temporary metal flooring had been removed from the fourth floor because most of the work had been completed at that level. This left an opening 5 feet wide and 28 feet long. The workers who removed the flooring left the fourth floor without safely securing the new opening. At about 11:30 a.m., the victim left the roof deck to get a drink from the water cooler on the fourth floor. Co-workers on the fifth floor shouted to the victim that he had missed a few bolts on that floor.

At about 11:55 a.m., the victim began walking along the fourth floor, looking upward for the missed bolts. He was not tied off; the last time the victim had been on the fourth floor, all the flooring had been in place. Co-workers above the victim saw him approach the floor opening and shouted warnings. The victim did not hear them and fell through the opening. His head and chest struck against steel members during the fall, and he struck the ground with such force that he was embedded six inches in the sandy soil. The site owners' emergency response team responded within 2 minutes and started cardiopulmonary resuscitation (CPR). At 12:00 p.m., an emergency medical service (EMS) arrived. The victim was completely unresponsive, and bleeding profusely from the nose and mouth. He was transported to a local hospital, by the EMS, where he was pronounced dead on arrival.

CAUSE OF DEATH

The attending physician listed the cause of death as massive injuries to the head, neck, and chest.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that employees do not leave a workplace until all floor openings have been safely secured by barriers with warning signs or by safety railings.

Discussion: When the victim had previously been on the fourth floor, it had been completely covered with the temporary metal decking. The victim was not aware of an opening in the floor, so he casually walked about. 29 CFR 1926.750(b)(1)(iii) contains specific requirements concerning floor periphery safety railing for skeleton steel erection. Additional instruction in the avoidance and recognition of hazards may be necessary to comply with 29 CFR 1926.21(b)(2) which states, "The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury." The National Safety Council also recognizes the need to guard floor openings (3).

Recommendation #2: Employers should ensure that workers continually adhere to established safe work procedures.

Discussion: In this case, the victim removed his tie-off and descended to a lower level to get a drink of water. He did not tie-off again upon reaching the lower level. Established company work practices required that he tie off at both levels.

Recommendation #3: Employers should encourage all workers to actively participate in workplace safety.

Discussion: If all workers actively participate in workplace safety, the level of awareness and avoidance of hazards will improve. In this case, co-workers above the victim could see he was not tied-off, yet did nothing to remind him to secure himself until it was too late to help. When the fall became inevitable, the victim could not hear their warnings.

REFERENCES

1. Office of the Federal Register: Code of Federal Regulations, Labor, Title 29, Subtitle B, Chapter XVII, Part 1926.21 (b) (2), p. 20. July 1,1990.
2. Office of the Federal Register: Code of Federal Regulations, Labor, Title 29, Subtitle B, Chapter XVII, Part 1926.750 (b) (1) (iii), p. 265. July 1,1990.
3. National Safety Council [1988]. Accident prevention manual for industrial operations: engineering and technology, 9th ed. Laing pm, ed. Chicago, Il: R.R. Donnelley & Sons, p. 25.

FACE 92-03: Roofer Helper Dies Following a 22-foot Fall Through a Roof Opening in Virginia

SUMMARY

At the time of the incident, a crew of five workers, including a 21-year-old roofer helper (victim), were performing various tasks on a newly constructed gymnasium roof. The victim finished applying weather insulating strips on top of some corrugated metal roof panels, and asked the foreman what had to be done in the area around the plywood. The foreman replied, "Wait until I finish cutting around this unit and I'll show you, because there is a hole there." The victim walked to the area where a 4-foot-wide by 8-foot-long sheet of plywood was covering the roof opening. The incident was unwitnessed; investigators believe the victim either intentionally moved the plywood, lost his balance and fell, or unintentionally displaced the plywood and stepped or tripped into a 29 1/2-inch by 35 3/4-inch roof opening. The victim fell 22 feet onto the concrete floor, striking his head. The victim died approximately 17 hours later at the local hospital. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *implement 29 CFR 1926.500 (b) and 1926.500 (f)(5)(ii), which require that wherever there is danger of falling through a floor opening, it shall be guarded by a standard railing and toe-boards, or cover capable of supporting the maximum intended load and so installed as to prevent accidental displacement*
- *design, develop, and implement a verbal and/or written examination to reinforce and evaluate the effectiveness of the safety training program.*

INTRODUCTION

On October 2, 1991, a 21-year-old roofer helper died after falling 22 feet through a roof opening. On October 18, 1991, officials of the Virginia Occupational Safety and Health Administration (VAOSHA) notified the Division of Safety Research (DSR) of the fatality, and requested technical assistance. On November 25, 1991, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with a representative from the company and the VAOSHA compliance officer assigned to the case. A schematic of the incident site and a copy of the medical examiner's report were obtained.

The employer in this incident was a roofing and sheet metal contractor who had been in operation for 81 years. The contractor employed about 80 workers, including 20 roofer helpers. The employer had a written safety policy, a comprehensive written safety program, and a full-time designated safety officer. The employer provided on-the-job training, and each new employee viewed a series of three safety-oriented video tapes. The employer offered yearly cardiopulmonary resuscitation certification and first aid training on a voluntary basis. Additionally, the jobsite foreman conducted toolbox safety meetings, and the safety officer conducted unscheduled safety inspections at each jobsite. The victim had worked for the employer for only 3 weeks prior to the incident.

INVESTIGATION

A roofing and sheet metal contractor had been subcontracted to provide and install roofing materials on an addition to the gymnasium at a middle school. Work had been intermittent for about 1 year prior to the incident. At the time of the incident, corrugated roofing panels had been secured to the roof deck, and

weather insulating strips were being applied over the panels. The roof area was approximately 114 feet long by 96 feet wide, and contained one roof hatch opening 29 1/2-inches wide by 35 3/4-inches long. The opening was covered by a 4-foot-wide by 8-foot-long sheet of 5/8-inch-thick plywood. The roof had a 1:48 pitch (i.e., the roof rose 1 foot for every 48 feet) (Figure).

On the day of the incident, five workers--a foreman, two roofers, and two roofer helpers--were placing insulating strips over the panels on the roof deck. About 8:25 a.m., the foreman was working on the roof deck approximately 20 to 25 feet away from the roof opening. The victim, after finishing a task, approached the foreman and asked what was to be done at the plywood area. The foreman replied "wait until I finish cutting around this unit and I'll show you, because there is a hole there." The victim walked away in the direction of the plywood as the foreman continued his task.

Although no one saw the victim fall, evidence at the site suggests that the victim had either intentionally removed the plywood from the opening, lost his balance and fell, or unintentionally displaced the plywood and stepped or tripped into the opening. The victim fell 22 feet to the concrete floor, striking his face and head.

The foreman, upon hearing a noise, turned around and saw the victim falling through the opening. The foreman yelled to the other crew members and they all descended from the roof to aid the victim. The victim was conscious, but bleeding from the ears, nose, and mouth. The emergency medical service (EMS) was called and arrived about 10 minutes later. The victim was transported to the local hospital where he died 17 hours later.

CAUSE OF DEATH

The medical examiner's report listed the cause of death as a fractured skull and cerebral edema.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.500 (b) and 1926.500 (f)(5)(ii), which require that floor openings be guarded by a standard railing and toe-boards, or a cover capable of supporting the maximum intended load, and so installed as to prevent accidental displacement. (1)

Discussion: Although the one remaining roof opening was covered with a 4-foot-wide by 8-foot-long by 5/8-inch-thick piece of plywood, the plywood was not secured to prevent inadvertent displacement. Since the incident was unwitnessed, a determination could not be made as to whether the victim intentionally or unintentionally moved the plywood. Securing the plywood properly would have eliminated any unintentional movement. Employers should ensure that all roof openings which have the potential of becoming hazards during construction, be safeguarded in one of the following manners: The roof opening should be secured with a standard railing and toe-boards on all exposed sides, or with a cover capable of supporting a worker's weight without danger of displacement.

Recommendation #2: Employers should design, develop, and implement a verbal and/or written post-training examination to reinforce and evaluate the effectiveness of the safety training program.

Discussion: Safety programs available at the time of this incident included the recognition and avoidance of fall hazards, and worker training which emphasized methods and materials for covering roof openings to prevent falls through openings.

Additionally, about 3 weeks prior to the incident, the victim viewed three video tapes which addressed recognition and avoidance of fall hazards. The incident occurred in spite of the safety program, which included the video tapes. Employers should design, develop, and implement a verbal and/or written post-training examination to reinforce and evaluate the effectiveness of the training program immediately after initial training and at regular intervals (e.g., monthly, quarterly, yearly, etc.) thereafter.

REFERENCE

Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926. p. 190. July 1, 1990.

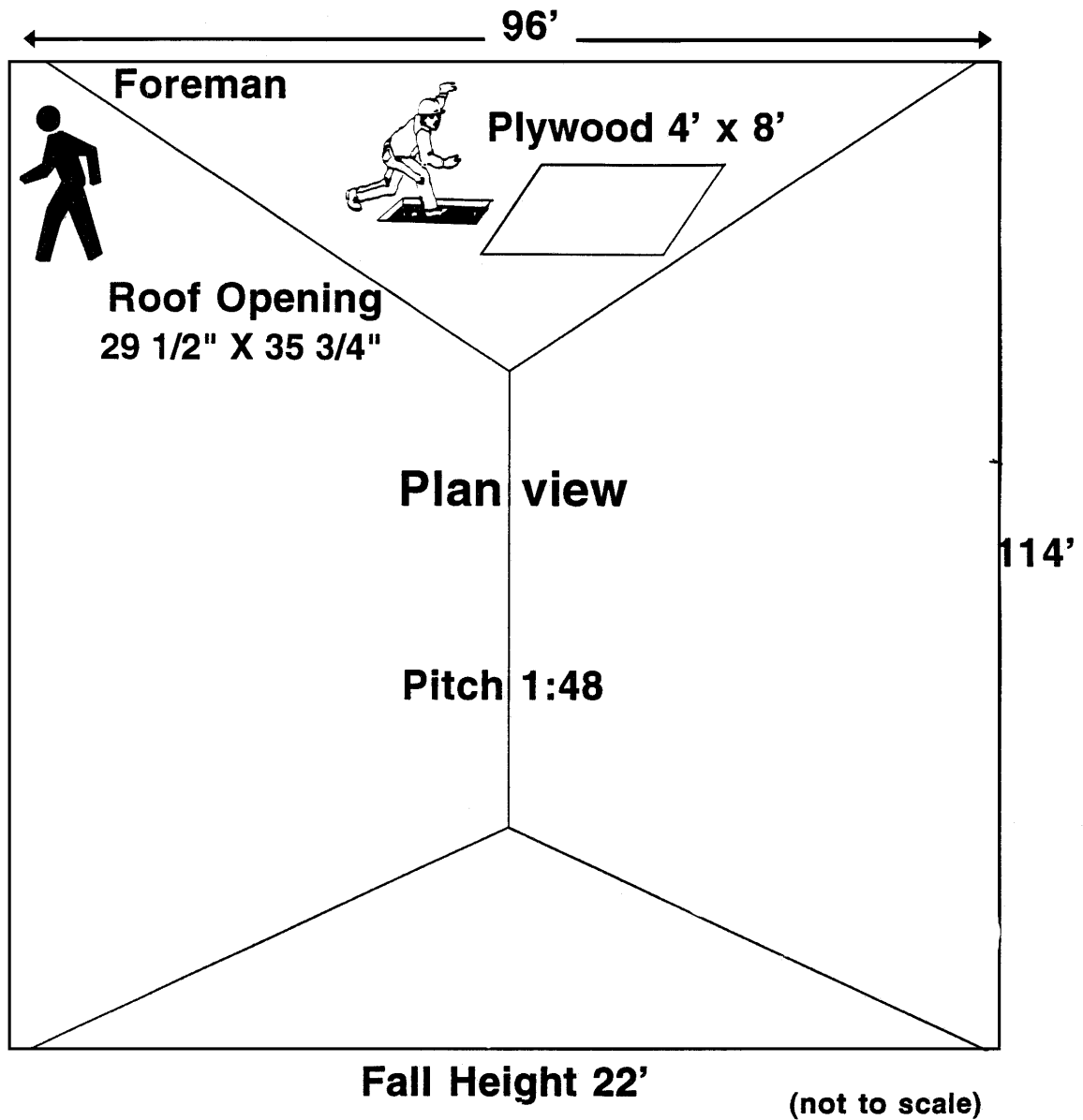


Figure. Roof Opening

FACE 92-04: Steel Connector Dies After Falling 19 Feet From a Bridge Under Construction to the Highway Below in Indiana

SUMMARY

A 28-year-old male steel connector (victim) died of injuries sustained from a 19-foot fall from a bridge under construction. The victim was a member of a crew setting steel beams onto two concrete bridge pillars of a highway overpass. After the steel beams were positioned on the pillars by a crane, the victim and a second steel connector bolted the beams to flange plates incorporated into the design of the bridge pillars. Each connector was working from a platform placed between two beams, on top of the beams' lower flanges. The crew was setting the third beam across the pillars when the incident occurred. As the beam was being lowered, the victim attempted to push it into place. The platform on which the victim was standing gave way, causing the victim to fall to the highway below. The victim was transported to the hospital where he died the next day. NIOSH investigators concluded that, in order to prevent similar occurrences, employers should:

- *require the use of safety belts, lifelines, and lanyards when working from elevations*
- *always secure temporary flooring from displacement during steel erection*
- *develop, implement, and enforce a comprehensive safety program*
- *consider and address worker safety in the planning phase of construction projects*
- *routinely conduct scheduled and unscheduled worksite safety inspections.*

INTRODUCTION

On September 11, 1991, a 28-year-old male steel connector died after having fallen, the previous day, from a bridge under construction. On November 14, 1991, officials of the Indiana Occupational Safety and Health Administration (INOSHA) notified the Division of Safety Research (DSR) of the incident, and requested technical assistance. On December 19, 1991, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with the INOSHA compliance officer, county coroner, medical examiner, and the police. Photographs of the site were obtained during the investigation.

The employer was a steel erection contractor that had been in operation for 3 years. The contractor employed 85 workers and hired additional personnel as necessary from the local union hall. The employer had no safety program or designated safety officer. The victim had worked for the employer for two years.

INVESTIGATION

The employer had been contracted to set steel beams and lay the metal decking for a bridge overpass that would span an existing state highway. The beams were to be set across two concrete pillars, one on each side of the highway. Because of the degree of bank of the overpass, the pillars were stepped so that each beam would be set 6 inches higher than the previous beam.

A 5-man crew consisting of a foreman, a crane operator, a laborer, and two connectors (one of whom was the victim), and an employee of the state department of highways were at the scene.

At the time of the incident, the crew was setting the third beam across the pillars. Each connector was standing on a plywood platform measuring 6-feet 3-inches long by 1-foot wide. Two-inch by 4-inch boards were nailed underneath the entire length of each side of the platforms to serve as braces. The platforms were positioned between two beams, on top of the beams' lower flanges.

The two connectors and the laborer (guiding the beams with a tagline) were working near one pillar, while the supervisor and the state employee were standing in the vicinity of the other pillar. The crane operator was receiving hand signals from the supervisor (Figure).

As the beam was lowered into position, the victim attempted to push it toward the flange plate on the pillar. As he pushed against the beam, the platform on which he was standing kicked out from under him. The victim fell 19 feet to the highway below, striking his head and shoulders on the concrete berm, and his lower back on the 8-inch-high curb at the edge of the highway. Co-workers ran to the victim and found that he was not breathing. Emergency medical service (EMS) personnel passing the scene stopped, initiated cardiopulmonary resuscitation (CPR), and restored the victim's breathing. The victim was transported to the hospital where he died 13 hours after the incident.

Investigation revealed that bolts protruding upward from a flange plate (connecting two sections of beam) on the beam's lower flange limited the platform's bearing surface (overlap) to 2 inches. As the victim pushed against the beam, the platform slid away from him and off the flange, causing the fall.

CAUSE OF DEATH

The medical examiner listed the cause death as closed head trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should require the use of safety belts, lifelines, and lanyards when working from elevations.

Discussion: When working from elevations, employers should provide personal protective equipment (PPE) (i.e., safety belt, lifeline, and lanyard) to employees exposed to fall hazards. Employers should provide and enforce the use of PPE in accordance with 29 CFR 1926.104.

Recommendation #2: Employers should always secure temporary flooring from displacement during steel erection.

Discussion: During bolting, riveting, fitting up, or plumbing up operations, 29 CFR 1926.752 (i) requires that provisions be made to secure temporary flooring from displacement. In this instance, this requirement was not satisfied.

Recommendation #3: Employers should develop, implement, and enforce a comprehensive safety program.

Discussion: Employers should emphasize safety to their employees by developing, implementing, and enforcing a comprehensive safety program. The safety program should include, but not be limited to, training workers in the proper selection and use of PPE, along with the recognition and avoidance of fall hazards.

Recommendation #4: Employers should consider and address worker safety in the planning stages of construction projects.

Discussion: Providing workers with the safest work environment, and with procedures that will allow them to perform tasks in the safest manner, should be a concern addressed during the planning stages of a construction project. Project engineers, design engineers, architects, and safety professionals should evaluate the tasks to be performed by workers, and the types of machinery to be used during the completion of the project. Safe work procedures should be developed for the different tasks to be performed. These procedures should include, but not be limited to, recognition of fall hazards, the use of personal protective or fall arresting equipment, access to the work area, type of work platform to be used, temporary flooring, and methods to secure temporary flooring. In this instance, the temporary flooring was not secured. Elevated work platforms could have been positioned on the concrete berm on the sides of the highway for access to the work areas, or safety nets could have been suspended under the connectors to lessen the exposure to the fall hazard.

Recommendation #5: Employers should routinely conduct scheduled and unscheduled worksite safety inspections.

Discussion: Scheduled and unscheduled safety inspections should be conducted by a qualified safety professional. No matter how comprehensive, a safety program cannot be effective unless implemented in the workplace. Even though these inspections do not guarantee the elimination of occupational injury, they do demonstrate the employer's commitment to the enforcement of the safety program.

REFERENCES

29 CFR 1926.104. Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

29 CFR 1926.752 (i). Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

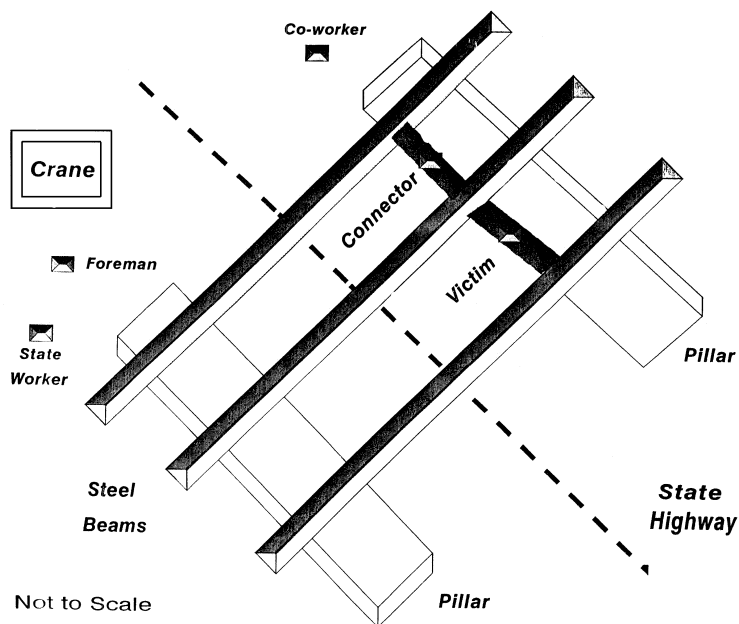


Figure.

FACE 92-05: Painter Dies After 80-Foot Fall From Electrical Transmission Tower In Indiana

SUMMARY

A 31-year-old painter (victim) died from injuries sustained in an 80-foot fall from a 120-foot-high electrical transmission tower. The victim was a member of a four-man crew painting the tower. The crew had painted one side of the tower, from top to bottom, and had begun to paint the other side. The four crew members were working at the same level on the tower and all were wearing safety belts and lanyards. As the victim unhooked his lanyard to reposition himself on the tower, he lost his balance and fell to the ground. NIOSH investigators concluded that, in order to prevent similar occurrences, employers should:

- *ensure that workers continually adhere to the safe work procedures that have been established by the employer*
- *evaluate the feasibility of a redundant fall-arresting system*
- *routinely conduct scheduled and unscheduled worksite safety inspections.*

INTRODUCTION

On September 23, 1991, a 31-year-old painter died from injuries sustained when he fell 80 feet from an electrical transmission tower. On November 14, 1991, officials of the Indiana Occupational Safety and Health Administration (INOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On December 19, 1991, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with the company owner, INOSHA compliance officer, county coroner, police department personnel, and medical examiner.

The employer was a painting contractor that specialized in painting electrical transmission towers and substations. The employer had a written safety program and a written hazard communication program. Material Safety Data Sheets for the paints and solvents used were available in all company trucks. New employees listened to a 30-minute safety presentation when hired and had to read the written safety rules and sign a statement verifying they had read the rules before reporting to a supervisor. The employer supplied new lanyards and safety belts to the painters on a yearly basis and coveralls were available to all painters. The employer maintained four full-time crews and hired additional crews as necessary. The victim and his crew had performed three jobs for the employer, totaling 3 months of employment.

INVESTIGATION

The employer had an ongoing contract with an electric utility to paint cross-country two-sided steel transmission towers and substations. The employer had two four-man crews at the jobsite painting separate towers. The victim's crew was painting their second 120-foot-high tower of the day. It took 22 hours to complete one tower. The crew had painted one side of the tower with solvent-based paint from top to bottom and had begun to paint down the opposite side of the tower. The crew members were wearing safety belts and lanyards and were tying the lanyards off directly to the tower. It was necessary to disconnect the lanyards to change position. The painters would tie off again when they were repositioned. The crew had progressed 40 feet down the side of the tower. The victim disconnected his lanyard and attempted to move when he lost his balance and fell from the tower, 80 feet to the ground. The three remaining crew members

descended the tower and one ran to a nearby farmhouse to tell the owners to call the emergency medical service (EMS). The second crew, two towers away, also ran to the scene. The victim was breathing and conscious but was bleeding from the mouth, nose, and ears. The EMS arrived within 10 minutes and transported the victim to the hospital where he was pronounced dead by the attending physician.

CAUSE OF DEATH

The medical examiner listed massive internal trauma as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that workers continually adhere to the safe work practices established by the employer.

Discussion: Employers should constantly stress the importance of adherence to established safe work procedures when possible. In this instance, established practice required workers to use safety belts and lanyards at all times; however, the victim disconnected the lanyard from the tower to reposition himself. Employers should provide and enforce the use of PPE in accordance with 29 CFR 1926.124. Whenever possible, workers performing tasks on elevated surfaces should not attempt to move without their fall protection being in place.

Recommendation #2: Employers should evaluate the feasibility of a redundant fall-arresting system.

Discussion: In this instance, the victim relied solely on his safety belt and lanyard as the fall arresting system, even though the victim would disconnect the lanyard from the tower to reposition himself. Prior to the start of work on the tower, a rope for each painter could have been attached to the top of the tower to serve as a lifeline. Either a self-retracting lanyard, or a standard lanyard equipped with a "rope grab" attached to the lifeline, would have provided a second suspension point for fall protection.

[A "rope grab"--a friction activated deceleration and locking device--could have been fitted onto the lifeline; this would have slowed and stopped the victim's fall. Several design configurations are available for these devices--inertial locking, cam/lever locking, or both--and each is effective against this type of fall hazard. An alternative safety device would be a self-retracting lanyard. This is another kind of deceleration and locking device, which contains a drum-wound line. The line can be wound and unwound within certain limits to accommodate normal worker movements; however, during a fall, centrifugal force activates locking devices which stop drum rotation and arrests the fall. Either a rope grab or a self-retracting lanyard would have protected the victim when the lanyard was not attached to the tower.]

Recommendation #3: Employers should routinely conduct scheduled and unscheduled worksite safety inspections.

Discussion: Scheduled and unscheduled safety inspections should be conducted by a qualified person to ensure that required personal protective equipment (PPE) is worn whenever possible. No matter how comprehensive, a safety program cannot be effective unless implemented in the workplace. Even though these inspections do not guarantee the elimination of occupational injury, they do demonstrate the employer's commitment to enforcement of the safety program.

REFERENCE

29 CFR 1926.104. Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 92-08: Roofer Dies in 16-Foot Fall From Residential Roof--Alaska

SUMMARY

A 32-year-old male journeyman roofer (the victim) sustained severe head injuries and died as a result of a 16-foot fall from the roof of a two-story single family dwelling. The victim was correcting a cosmetic error in the alignment of the shingle tabs of roofing shingles installed 2 weeks earlier. He fell (unobserved) from the second-story roof of the residence onto a concrete patio. The roof pitch was 4:12 (4 feet vertical rise to 12 feet horizontal width). The victim had a documented history of grand mal epileptic seizures, and had received a prescription for a maintenance dose of Dilantin. Although he presented a medical clearance to his employer allowing him to work (flat roofs only), it remains unclear whether his pre-existing medical condition predisposed him to this incident or affected its outcome. NIOSH and Alaska Department of Health and Social Services (DHSS) investigators concluded that, in order to prevent future similar occurrences, employers should:

- *ensure that workers with medical conditions or physical limitations are not placed in work situations disallowed by medical certifications*
- *comply with existing State regulations regarding fall protection for workers exposed to fall hazards*
- *develop and implement formal safety programs designed to help workers recognize, understand, and control fall hazards and other work hazards.*

INTRODUCTION

On September 13, 1991, a 32-year-old journeyman roofer (the victim) died from severe head injuries sustained after falling 16 feet 3 inches from the pitched roof of a private residence on September 10, 1991. The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), Alaska Activity began monitoring this incident after it was initially reported in local newspapers on September 11, 1991. An investigation conducted by a safety specialist from the DSR Alaska Activity and an injury prevention specialist candidate from the State of Alaska, Division of Public Health, Epidemiology Section began on November 6, 1991. The incident was reviewed with the State of Alaska, Department of Occupational Safety and Health (AKOSH) compliance officer assigned to this case. An interview with the owner of the roofing company was delayed until November 20, 1991, because key company officials were working on a construction project in another state. The incident site was visited, and photographs and reports were subsequently obtained from the police and coroner.

The employer in this incident was a roofing contractor, specializing in residential and commercial roofing, that had been in operation for 30 years, with 16 years under the current management; there were five employees (roofers). The company had a written safety policy including basic rules and procedures with some application to the type of incident that occurred. The employer indicated that on-site safety meetings (tailgate meetings) were always conducted prior to the start of a new job.

The victim had a documented history of grand mal epileptic seizures, and had received a prescription for a maintenance dose of Dilantin. Although he presented a medical clearance to his employer allowing him to work (flat roofs only), it remains unclear whether his pre-existing medical condition predisposed him to this incident or affected its outcome.

INVESTIGATION

The company had been contracted to re-roof a private residence that was currently occupied. The main roofing work had been completed approximately 2 weeks prior to the incident. However, the homeowner complained about a section of the roofing which was misaligned.

The victim returned to the jobsite on September 10, 1991, to correct the cosmetic error in the alignment of shingle tabs observed by the homeowner.

The victim was working alone on the roof, which had a pitch of 4:12 (4 feet of vertical rise to 12 feet of horizontal width). He had realigned all but two shingles, when he fell from the edge of the roof to a concrete patio deck 16 feet, 3 inches below (Figures 1 and 2). The victim was not using any type of fall protection devices or systems.

Although no one saw the victim fall, the estimated time of occurrence was 6:42 p.m. The homeowner reported hearing an unusual sound and looked out a window. She saw the victim lying on the patio; he was unresponsive and bleeding from the back of the head. She called 911 and an emergency medical service (EMS) team arrived at the scene approximately 3 to 4 minutes later. They found the victim traumatized, unresponsive, and in cardiac arrest. The EMS team administered CPR, stabilized the victim, and transported him to a local hospital. He remained in a comatose condition and died 3 days later on September 13, 1991.

CAUSE OF DEATH

The medical examiner listed the cause of death as severe head injury.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that workers with medical conditions or physical limitations are not placed in work situations disallowed by medical certifications.

Discussion: The victim had a medical history of grand mal seizures and had been prescribed a daily dose of Dilantin (Phenytoin Sodium, 100 mg daily). He had received medical clearance for roofing work on flat roofs only. Employers should carefully follow any limitations on work imposed by medical certifications. In this case the employer believed the victim had a general medical clearance, yet limitations were clearly explained in the certification letter.

Recommendation #2: Employers should comply with existing State regulations regarding fall protection for workers exposed to fall hazards.

Discussion: The victim was working on a pitched roof with a ground-to-eave height of 16 feet, 3 inches. The Alaska Department of Labor, Occupational Safety and Health Standard for Construction, CC 05.240(d)(1) states that "during the performance of built-up roofing work on low-pitched roofs with a ground to eave height greater than 16 feet (4.9 meters), employees engaged in such work shall be protected from falling from all unprotected sides and edges of the roof." The Standard requires the use of at least one of three types of fall protection for roofing work: 1) a motion-stopping safety system (MSS System, which includes safety harness/lanyard systems, guardrails, catch platforms, safety nets, etc.); 2) a safety-monitoring system (a safety system in which a competent person monitors the safety of all employees in

a roofing crew, and warns them when it appears that they are unaware of the hazard or are acting in an unsafe manner); or 3) a warning line system (a line of specified strength, height, and location, designed to warn workers when they are near a roof's edge) erected and maintained as specified in the Standard [paragraph (d)(3)]. The unprotected sides and edges of the roof were not fall-protected, and the victim was not wearing fall protection equipment (safety harness/lanyard system).

Recommendation #3: Employers should develop and implement formal safety programs designed to help workers recognize, understand, and control fall hazards and other work hazards.

Discussion: Although the employer indicated that training programs were in place, these were largely informal procedures, such as "tailgate meetings" at the start of new jobs. Written procedural protocols were available, but safety training was not regularly scheduled. Structured training sessions could provide a framework for systematic safety training for specific work procedures, and would also reduce the possibility that training becomes too informal with minimal discussion of actual safety techniques.

REFERENCES

Alaska Department of Labor, Division of Labor Standards and Safety, Occupational Safety and Health Standards for Construction, Section 05.240, Volume II, August 1990.

29 CFR 1926.500(g)(1), 1926.28(a), and 1926.105. Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register, July 1990.

Side View of Roof Plan

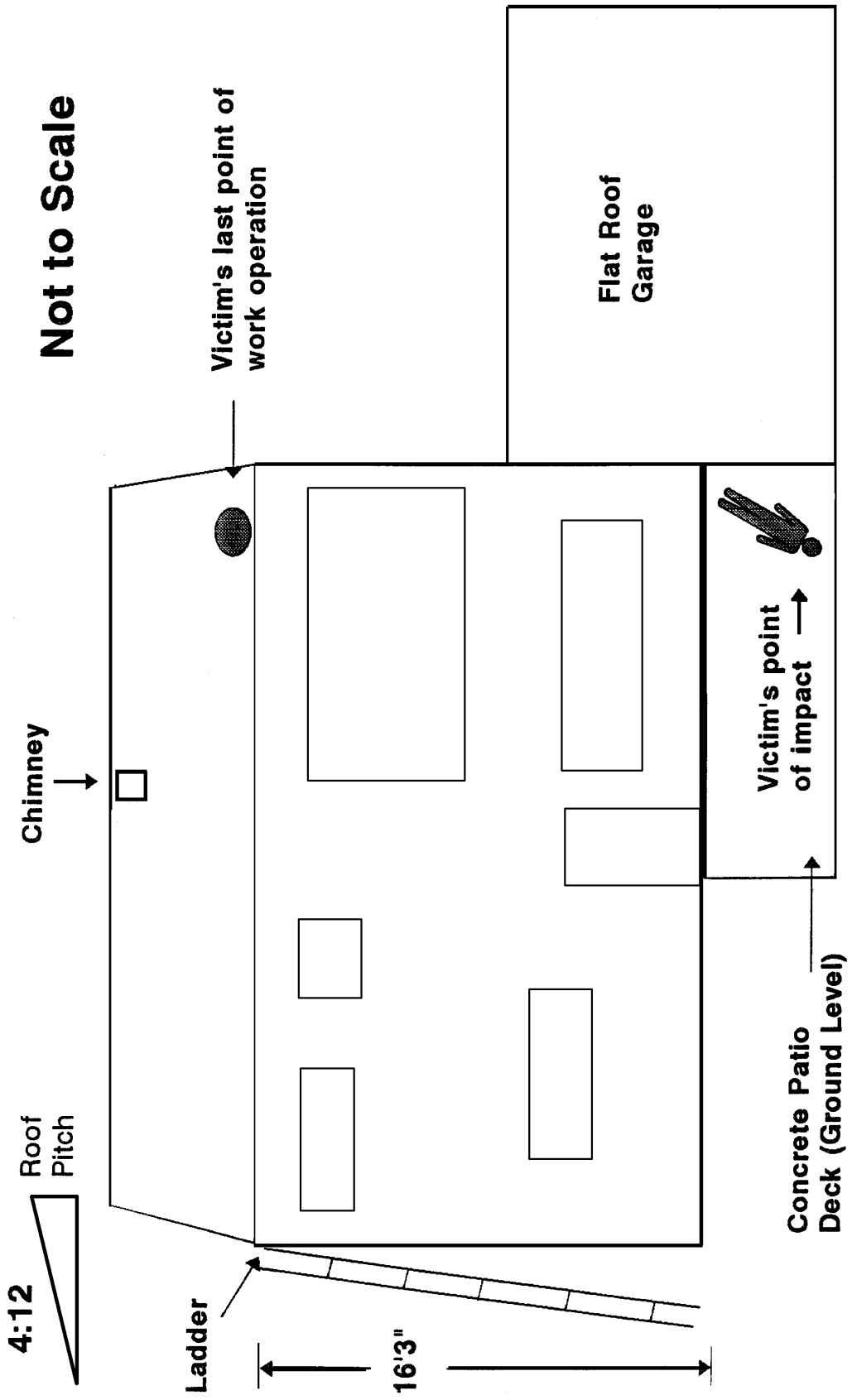


Figure 1.

Top View of Roof Plan

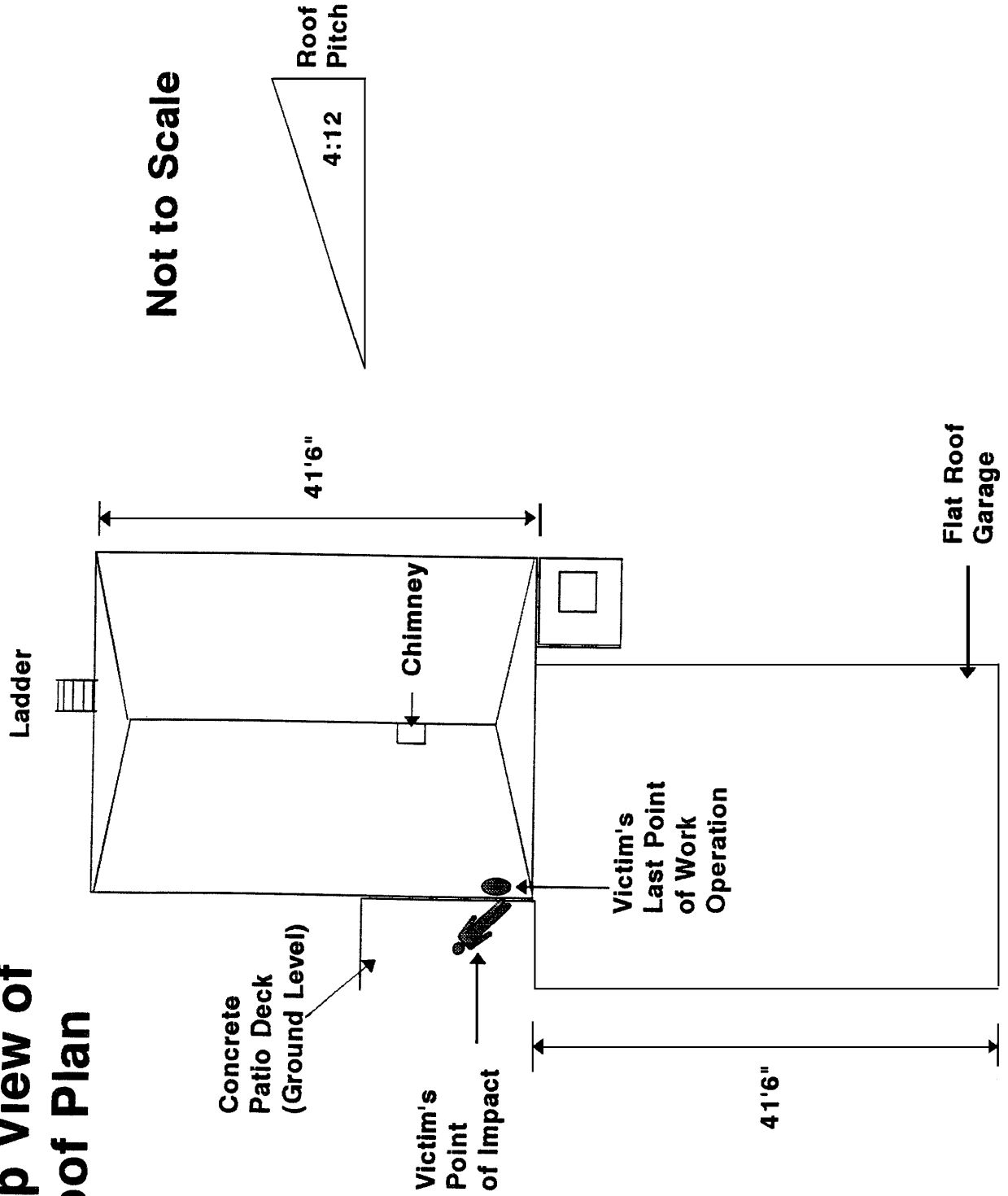


Figure 2.

FACE 92-11: Ironworker Dies Following an 18-foot Fall From Structural Steel Framework-- Alaska

SUMMARY

A 41-year-old male ironworker (the victim) died after falling from a structural steel framework to a concrete floor during the construction of an automobile repair shop. The victim and two other ironworkers (co-workers) were assembling the steel frame "skeleton" (measuring 50 feet wide, 86 feet long and 18 feet high at the roof edge) of the structure. Sway-bracing rods had not been installed between the beams (combination column-roof truss units), the bolts at the base of the beams had not been fully tightened, and two steel beams had not yet been connected at the roof-line apex. As the victim walked on top of a stack of unsecured purlins (steel joists) along one edge of the frame to make a final measurement, the frame began to sway. The victim lost his balance, and fell 18 feet to the concrete floor, receiving fatal injuries. There was no fall protection equipment in place, and the victim was not wearing a helmet. NIOSH investigators concluded that in order to prevent similar occurrences in the future, employers should:

- *ensure that workers follow building plans and procedures for pre-fabricated structures, and comply with existing standards regarding structural steel assembly*
- *ensure that workers comply with existing standards regarding the use of personnel hoists and work platforms*
- *ensure that workers comply with existing standards regarding the use of personal protective equipment*
- *ensure that workers develop and implement a jobsite hazard analysis as an ongoing part of each construction phase.*

INTRODUCTION

On October 20, 1991, a 41-year-old ironworker died from severe head injuries sustained 8 days previously, after falling 18 feet from a structural steel framework. On November 28, 1991, officials of the Alaska Department of Occupational Safety and Health (AKOSH) notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), Alaska Activity of the death. On December 12, 1991, a safety specialist from DSR, Alaska Activity and an injury prevention specialist candidate from the State of Alaska, Department of Health and Social Services, Division of Public Health, Section of Epidemiology traveled to the incident site and conducted an investigation. The incident was reviewed with the AKOSH compliance officer, and the owner of the company. The police report, medical examiner's report, emergency medical service report, and photographs were obtained.

AKOSH determined that the employer in this incident was the owner of an automobile repair shop that had been in business for 12 years. The employer was in the process of constructing a new repair shop, and had contracted with three ironworkers to complete the construction project. The employer did not require any type of safety policy, or established safe work procedures for construction of the repair shop, nor did the contracted ironworkers have any such safety policy or procedures. The victim had 6 years of work experience, in structural steel erection.

INVESTIGATION

The employer contracted with three ironworkers to construct an automobile repair shop which consisted of a pre-fabricated (pre-fab) structural steel building. The pre-fab package for the building came with a set of plans and some basic assembly procedures that the ironworkers did not entirely follow. After 2 weeks of construction, the skeletal steel frame of the shop was nearly complete. The frame consisted of four 8-inch sets of steel beams interconnected with purlins around the perimeter (eaves), with an overall dimension of 50 feet by 86 feet, and a height of 18 feet from the concrete floor to the top of the eave purlins (Figures 1 and 2). Each beam set was to be bolted together at the apex to form the longitudinal cross-section of the building structure. The three workers used a forklift with a pallet laid over the forks as a personnel hoist and work platform for connecting and bolting the steel frame units together.

At approximately 3:30 p.m. on the day of the incident, the construction had progressed to the following stage:

- A temporary guy cable was installed (one end of the cable anchored in the concrete below beam 11, the middle of the cable attached to the apex of beam #2, and the opposite end of the cable anchored to the base of beam #3). This was not in accordance with the building plans and assembly procedures which required 3/4-inch sway-bracing steel rods to be installed (in an "X" configuration between the vertical beams) and kept in place immediately after hoisting the beams into place.
- All the beams had been bolted to the concrete base, but had not been fully wrench-tightened so that final adjustments could be made at a later time.
- All the beams except beam #4 had been bolted (wrench tightened) together at the apex. Beam #4 was being held in place temporarily by a choker cable suspended by the forks of a forklift. The final bolting of this beam was delayed until final measurements could be made for minor adjustments in the structure.
- All the eave purlins had been bolted (wrench tightened) to the steel beams.
- An unsecured stack of purlins was placed on top of one side of the structure between beam #3 and beam #4.

The victim was on top of the unsecured stack of purlins between beams #3 and #4; the two co-workers were working at ground level. The victim walked from beam #4 to beam #3 on top of the stack of purlins to take a measurement. The co-workers observed that the entire structure began to sway beneath him, causing the victim to lose his balance and fall to the concrete floor 18 feet below.

The co-workers hurried to the victim and noted that he was unresponsive and bleeding from the side of the head. One of the co-workers called 911, and an emergency medical service (EMS) team responded, arriving at the scene 3 minutes later. The EMS team noted that the victim was traumatized and unresponsive, yet breathing. They stabilized the victim, and transported him to a local hospital where he remained in a comatose condition. He died 8 days later.

CAUSE OF DEATH

The medical examiner listed the cause of death as blunt force trauma to the head.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that workers follow pre-fab building plans and procedures, and comply with existing standards -regarding structural steel assembly.

Discussion: There were at least five factors in this incident that contributed to the instability or sway effect of the structure, which may have caused the victim to lose his balance and fall. All of these factors were contrary to either the building plans and procedures, the existing standards pertaining to structural steel assembly, or both:

1. Sway bracing rods had not been installed between the beams.
2. The bolts at the base of the beam columns had not been fully tightened.
3. The apex of beam #4 had not been bolted together.

The building plans and procedures specified that 3/4-inch steel sway bracing rods be installed (in an "X" configuration between the beam columns) and kept in place immediately after hoisting the beams into place. Regarding structural steel assembly, AKOSH Standard, CC 05.180(b) requires that during the final placing of structural members, "the load shall not be released from the hoisting line until the members are secured with not less than two bolts, or the equivalent at each connection and drawn up wrench tight."

4. An unsecured stack of purlins had been placed on top of one side of the structure between beams #3 and #4.

The AKOSH Standard states that steel joists (such as purlins) "shall not be placed on any structural steel framework unless such "framework is safely bolted or welded."

5. The victim walked on top of the unsecured stack of purlins between beams #4 and #3.

Walking on top of this unstable structure may have caused it to sway. This task could have been accomplished from a work platform (such as a mobile scaffold or scissors-jack platform) meeting AKOSH and Federal OSHA standards, thus greatly reducing the potential for a fall.

Recommendation #2: Employers should ensure that workers comply with existing standards regarding the use of personnel hoists and work platforms.

Discussion: In this incident, the victim and co-workers used a forklift with a pallet laid over the forks as a personnel hoist and work platform. This does not comply with AKOSH (and Federal OSHA) Standards CC 05.140(c)(3) and CC 05.140(g) (also cited in Federal OSHA Standards 29 CFR 1926.552(c) and 29 CFR 1926.556) which specify acceptable types of personnel hoists and work platforms. The victim in this incident could have worked from a mobile elevating work platform or wheel-mounted scaffolding which

met these standards (instead of from the structural steel beam from which he fell), greatly reducing the likelihood of a fall.

Recommendation #3: Employers should ensure that workers comply with existing standards regarding the use of personal protective equipment.

Discussion: The victim in this incident was not using any type of fall protection equipment and was not wearing a protective helmet. AKOSH Standard, CC 05.030(j) (1) [also USDOL Standard 29 CFR 1926.28(a)] states, "The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions or where this subchapter indicates the need for using such equipment to reduce the hazards to the employees." The use of a traditional safety belt/lanyard (or preferably the safety harness/lanyard) combination as required by AKOSH and USDOL standards CC 05.050(e) and 29 CFR 1926.104 respectively, is sometimes not practical during construction operations, particularly where worker mobility is required. However, in this incident, the use of a perimeter guide, attached to the top of the beams (for anchoring the worker's safety harness/lanyard) could have provided sufficient worker mobility. Additional forms of fall protection, such as safety nets [as specified in CC 05.050(f) and 29 CFR 1926.105], or a catch platform, could also be considered. Safety nets can effectively prevent injury or death when a worker falls. Also, in this situation, wheel-mounted scaffolding might have been placed under the victim to serve as a catch platform. This portable type of catch platform can be moved to a new location as each area is completed. The use of alternative fall protection systems should always be carefully considered when the potential for a serious or fatal fall from elevation exists. Protective helmets are another type of personal protective equipment required by AKOSH and Federal OSHA standards for this type of work: "Employees working in areas where there is a danger of head injury from impact, or from falling or flying objects ... shall be protected by protective helmets." (AKOSH CC 05.050 (a) (1) , and USDOL 29 CFR 1926. 100 (a)] Although such helmets are not specifically designed for head protection in the event of a fall from elevation, protective helmets that- meet ANSI Standard Z89.1-1986 (and if equipped with a chin strap, also worn properly) do provide impact attenuation (including the impact from some types of falls) by limiting the magnitude and concentration of impact forces (Phase I in the Development of Criteria For Industrial and Firefighters' Head Protective Devices, January 1975, and Experimental Program for Industrial Head Protective Devices, Phase II, December 1976, Dayton T. Brown, Inc. under NIOSH contract). Currently, there are industrial protective helmets available that can provide some head protection for falls from elevation.

Recommendation #4: Employers should ensure that workers develop and implement a jobsite hazard analysis as an ongoing part of each construction phase.

Discussion: The employer owned and operated an automobile repair shop, requiring safety procedures specific to that type of operation. However, in this incident the same employer contracted with the victim and two co-workers to construct a building. Therefore, the employer should have required the victim and co-workers to develop and implement safety procedures specific to each construction phase of the building. Before starting each phase of construction, the employer should ensure that the potential hazards have been identified and reviewed with the work crew or contracted employees, including how to implement appropriate safety controls. Federal OSHA Standard 29 CFR 1926.21(b) (2) states, "The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury." AKOSH has a voluntary compliance program which offers safety training to employers and employees on a request basis. Effective safety training in structural steel erection will increase the employees' awareness of the hazards which confront them.

REFERENCES

Construction Code, Volume 1, Occupational Safety and Health Standards, Alaska Department of Labor, Division of Labor Standards and Safety, August 1990.

General Safety Code, Volume 1, Occupational Safety and Health Standards, Alaska Department of Labor, Division of Labor Standards and Safety, September 1990.

29 CFR 1926 Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register, July 1990.

American National Standards Institute, Inc., Z89.1-1986, Personal Protection--Protective Headgear for Industrial Workers-- Requirements, December 1986.

NIOSH Contract, HSM-99-72-86, Phase I in the Development of Criteria For Industrial and Firefighters' Head Protective Devices, Dayton T. Brown Inc., January 1975, pages 23 and 47.

NIOSH Contract, 210-75-0031, Experimental Program for Industrial Head Protective Devices, Phase II, Dayton T. Brown Inc., December 1976, pages 4 and 2-22.

Not to Scale Side View

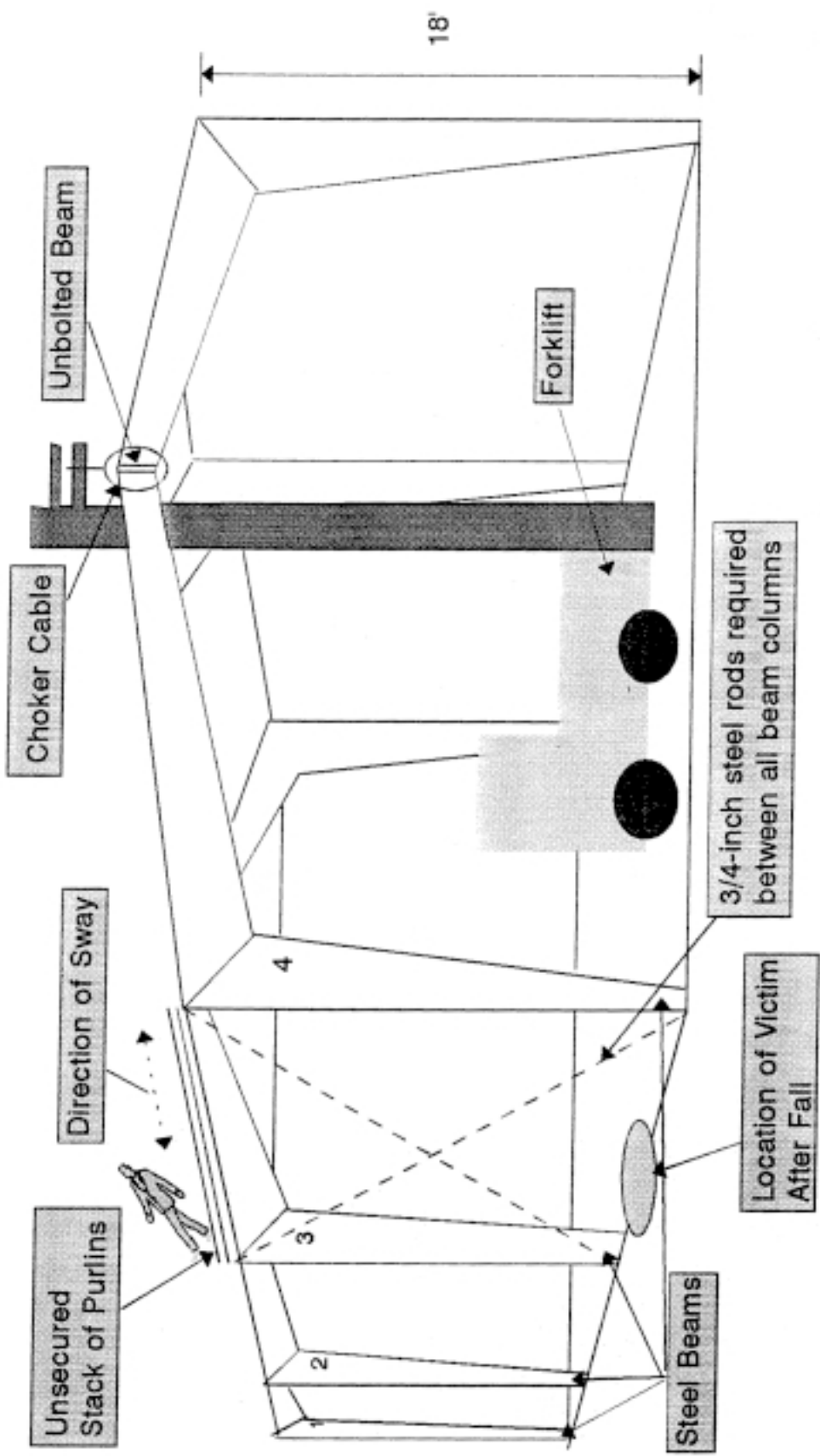


Figure 1.

Not to Scale
Top View

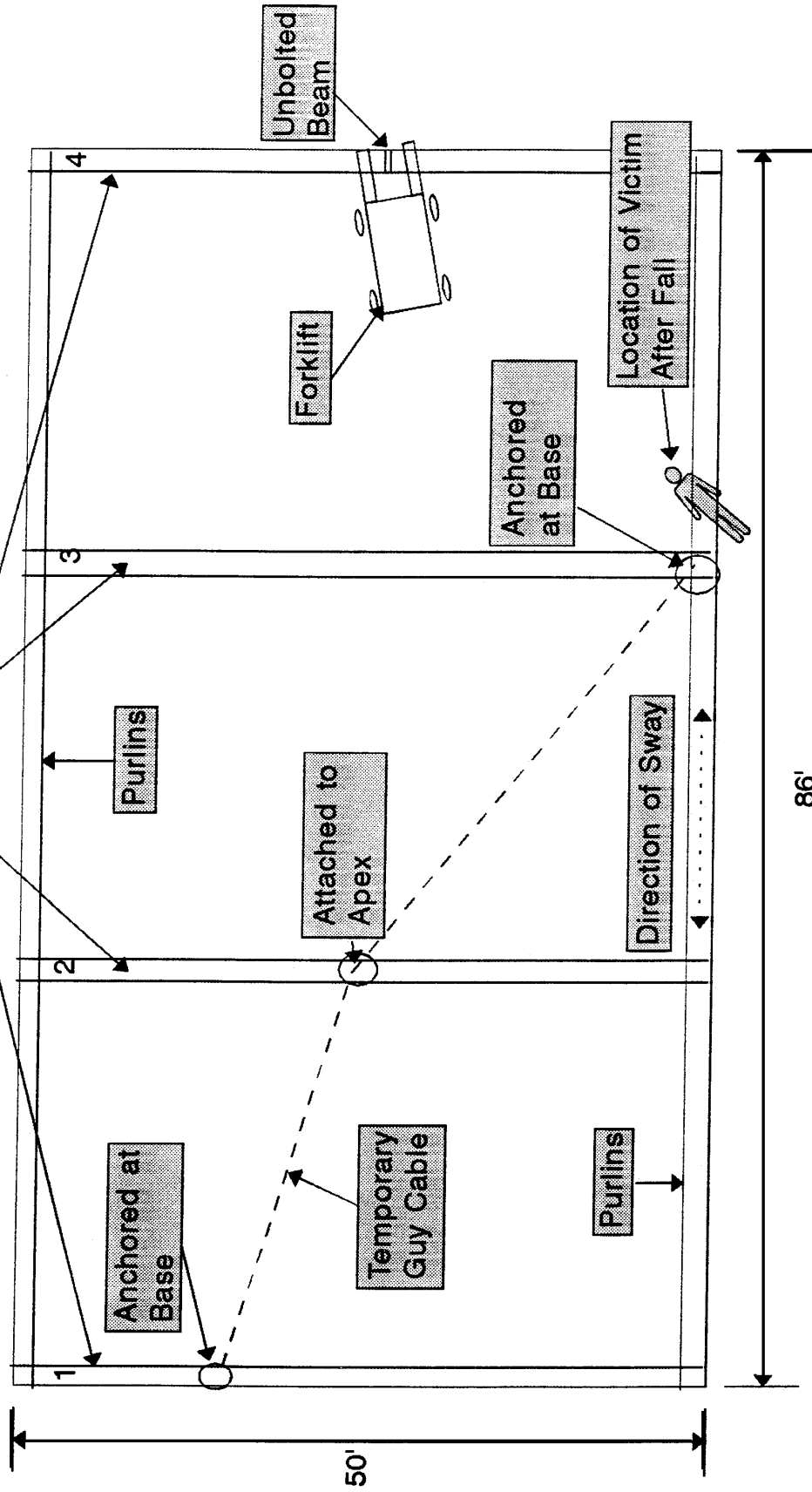


Figure 2.

FACE 92-36: Carpenter's Helper Dies After Falling Through Stairwell Opening--Virginia

SUMMARY

A 35-year-old male carpenter's helper (the victim) died after falling into a stairwell opening. The victim was working with three carpenters to frame a one-story residence with a full basement. Work had progressed to the point that the men were installing 4-foot by 8-foot sheets of plywood on the roof. The victim was standing on the floor handing the plywood up to the men on the roof. A 3-foot-wide by 9-foot-long stairwell opening present in the immediate vicinity of the victim's work area was enclosed on three sides by studded walls and on the fourth side by a closed door. The three workers on the roof did not see the victim fall, but it is believed that, as the victim tried to step between two studs in the stairwell wall, he either tripped or lost his balance and fell toward the stairwell opening. The victim struck his head on the opposite edge of the opening then fell through the opening 8 feet to the concrete basement floor. NIOSH investigators concluded that, to prevent future similar occurrences, employers should:

- *ensure that all floor or roof openings that workers might be exposed to during the performance of their assigned tasks be guarded*
- *train workers to recognize and avoid hazards that they might encounter during the performance of their assigned tasks.*

INTRODUCTION

On September 4, 1992, a 35-year-old male carpenter's helper died from injuries sustained the previous day after falling through a stairwell opening 8 feet to a concrete basement floor. On September 14, 1992, officials of the Virginia Occupational Safety and Health Administration (VAOSHA) notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), of the fatality and requested technical assistance. On September 22, 1992, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with company representatives and the OSHA compliance officer.

The employer in this incident was a construction contractor that specialized in residential, commercial, and multi-unit housing construction. The employer had been in operation for 6 years and employed five workers. The employer had written general safety rules. Each new employee had to read these rules and sign his name as proof that he understood them. New employees worked directly with the owner to demonstrate their proficiency at carpentry work before being allowed to work alone. New employees were not allowed to work above ground on framework until they had been employed for 2 weeks and were considered capable by the owner of performing the work. The victim had worked for the employer for 2 days.

INVESTIGATION

The employer had been subcontracted to frame up a one-story private residence with a full basement at a residential subdivision. The work consisted of laying the framework and 3/4-inch plywood sheeting for the ground floor, installing the 2-inch by 4-inch wall studs as called for by the blueprints, and installing the roof trusses and the 3/8-inch plywood sheeting for the roof. After 2 days at the site, the crew--three carpenters and a carpenter's helper (the victim)--had completed the installation of the floor, the wall studs, and the roof trusses. On the third and final day at the site, crew members were installing the plywood sheeting on top of the roof trusses.

As the crew prepared for work the victim asked the owner if he could work on the roof. The owner instructed the victim to stay on the floor and hand the plywood sheets to the men on the roof. Work progressed in this manner throughout the morning.

A 3-foot by 9-foot stairwell opening was located adjacent to the victim's work area. The opening was enclosed on three sides by the 2-inch by 4-inch stud walls and on the fourth side by a closed door. The studs had been installed on 16-inch centers (a distance of 16 inches from the center of one stud to the center of the next stud in line), leaving 14-inch openings between studs.

Just before noon the victim handed a sheet of plywood to the men on the roof. Shortly thereafter the men heard the victim falling through the stairwell opening. The victim struck his head on the opposite side of the opening, then fell to the concrete basement floor, landing face down. The emergency medical service was summoned by telephone from the construction trailer. The victim was transported to the hospital where he was placed on life support systems. Life support was disconnected the following morning and the victim was pronounced dead.

The men on the roof did not actually see the victim pass between the studs. The victim's size--6 feet, 5 inches tall; 235 pounds--prohibited him from inadvertently falling face forward or sideways through the 14-inch opening between the studs. It is believed that the victim stepped between two studs either to look into or to cross the stairwell opening. The victim then either tripped over the floorboard, or caught his hammer, which was hanging from his tool belt, on one of the studs, and lost his balance and fell into the opening.

CAUSE OF DEATH

The coroner listed the cause of death as accidental death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that all floor or roof openings that workers might be exposed to during the performance of their assigned tasks be guarded.

Discussion: Floor openings should be guarded in accordance with 29 CFR 1926.500 (f)(1), which requires a top rail 42 inches high, an intermediate rail, and a toeboard. Although the stairwell opening in this incident was surrounded on three sides by studs and on the fourth side by a closed door, access to the opening was still possible between the studs. Guarding the opening in the prescribed manner would have prohibited access to the opening. Alternatively, the stud walls around the stairwell opening could have been finished with wallboard or some other material to totally enclose the opening.

Recommendation #2: Employers should train workers to recognize and avoid hazards that they might encounter during the performance of their assigned tasks.

Discussion: In accordance with 29 CFR 1926.21 (b)(2), employers should instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury. Workers should be made aware of the potential hazards presented by stairwell openings and of the control measures which can be used to prevent injuries.

REFERENCES

29 CFR 1926.500 (f)(1). Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

29 CFR 1926.21 (b)(2). Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 93-19: Electrician Apprentice Dies Following a 33-foot Fall Through a Roof--South Carolina

SUMMARY

A 24-year-old male electrician apprentice (the victim) died of injuries received after falling 33 feet through a roof. The victim was part of a five-man crew that was installing conduit and wiring to the top of a dust-collecting silo in the granule plant of a roofing products manufacturer. The victim had just completed pulling electrical wire through a conduit while standing on a steel platform attached to the side of the silo. The platform was equipped with a standard protective railing which consisted of a top rail, mid rail, and toe board. The granule plant roof was directly below the platform, approximately 34 inches from the mid rail. The foreman and another worker were standing on the granule plant roof about 10 feet from the edge of the platform, waiting for the victim to finish his task and break for lunch. His back toward the other workers, the victim climbed over the top rail, and with his feet resting on the mid rail, jumped to the granule plant roof. He broke through the roof of corrugated transite panels and fell 33 feet to the concrete floor. An employee working in the granule plant saw the victim fall and strike the concrete. The employee and the workers from the roof ran to aid the victim, who suffered a severe head injury. The victim was unconscious and was not breathing. Cardiopulmonary resuscitation (CPR) was started and the Emergency Medical Service (EMS) was called. The EMS arrived in less than 15 minutes and pronounced the victim dead at 11:50 a.m. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing and controlling hazards in the workplace. These procedures should include, but not be limited to, conducting hazard evaluations before initiating work at a jobsite and implementing appropriate controls*
- *designate a competent person to conduct scheduled and unscheduled site visits to evaluate field compliance with company safety rules and procedures.*

In addition, plant/facility owners should:

- *identify areas that may be hazardous to all personnel, including contractors, and restrict or prohibit the use of or access to these areas.*

INTRODUCTION

On June 25, 1993, a 24-year-old male electrician apprentice (the victim) died after falling 33 feet through a roof. On June 25, 1993, officials of the South Carolina Occupational Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality and requested technical assistance. On July 28, 1993, a safety specialist from DSR investigated the incident and reviewed the circumstances with a company representative, a witness to the incident, the plant manager, and the SCOSHA compliance officer assigned to the case. Photographs of the incident site were taken, and the medical examiner and police reports were obtained.

The employer in this incident was an electrical contractor that had been in operation for 23 years and employed 27 workers, 7 of whom were electrician apprentices. The employer had a written safety policy and a general safety program which included a hazardous communication program, pre-hiring and random drug testing, and a disciplinary program. Company management personnel were responsible for the

enforcement of the safety program, and the employer provided on-the-job training. Additionally, the roofing manufacturer provided all contractors with a booklet containing safety information and instructions which were to be followed when contractors worked at the plant. This booklet included information on establishment of work boundaries and access to worksites by contract personnel. The victim worked for the company for 2 months as an electrician apprentice, but had approximately 3 year's experience working in this occupation. This was the first fatality the company had experienced.

INVESTIGATION

The employer had been contracted by a roofing products manufacturer to install electrical conduit, wiring, and related components at the dust-collecting silo located in the granule plant. The silo was situated adjacent to and partially above the roof of the 29-year-old granule plant. The plant walls and roof were constructed of corrugated transite panels, a fire-proofing material used in walls and roofs and for lining ovens. The panels were composed of asbestos and cement molded under high pressure, and they had a load rating of 200 pounds per square foot. The panels were set in place on steel girders approximately 30-inches apart. Work on the dust-collecting silo had been in progress for 3 days before the incident.

On the day of the incident, the victim and four co-workers (one foreman, and three other electrician apprentices), arrived at the plant and started work at 7 a.m. The workers had spent the morning installing the necessary conduit and pulling electrical wire through it. At approximately 11:35 a.m., the workers were getting ready to break for lunch. The victim had just completed pulling electrical wire through a conduit while standing on a steel platform attached to the side of the silo. The platform was equipped with a standard protective steel railing which consisted of a top rail, mid rail, and toe board. The granule plant roof was directly below the platform, approximately 34 inches from the mid rail (Figure). The foreman and another worker were standing on the granule plant roof about 10 feet from the edge of the platform, waiting for the victim to finish his task and go to lunch. Plant personnel had seen the workers using the roof as a route of access to the ladder leading to the ground. His back toward the other workers, the victim climbed over the top rail, and with his feet resting on the mid rail, jumped to the granule plant roof. The victim, who weighed 235 pounds, broke through the corrugated transite panels and fell to the concrete floor 33 feet below. An employee working in the granule plant saw the victim fall and strike the concrete floor. The employee and the workers from the roof ran to aid the victim, who suffered a severe head injury. The victim was unconscious and was not breathing. Cardio Pulmonary Resuscitation (CPR) was started and the EMS was called. The Emergency Medical Squad (EMS) arrived in less than 15 minutes and pronounced the victim dead at 11:50 a.m. The medical examiner arrived on the scene shortly thereafter and had the victim transported to the morgue at the local hospital.

CAUSE OF DEATH

The medical examiner reported the cause of death as head trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing and controlling hazards in the workplace. These procedures should include, but not be limited to, conducting hazard evaluations before initiating work at a jobsite, and implementing appropriate controls.

Discussion: The existence of a safety program is only the first step in obtaining a viable safety record. In addition to enforcement, safety programs should be evaluated and training procedures incorporated which emphasize the importance of recognizing and controlling hazards in the workplace, following established safe work procedures, and wearing appropriate personal protective equipment. The hazard of walking or jumping on roofing panels constructed of transite apparently was not recognized by the workers. Additionally, before starting any job at a new worksite, the employer or employer's representative should identify, by observation and by collaboration with the worksite owner, any potential or existing hazards. These hazards should be reviewed with the work crew, and methods to control the hazards and to perform the work safely should be discussed. These discussions should include information on hazards in the immediate work area as well as information on the activities of other work crews on the site that could create additional hazards. In this instance, personnel could have been instructed not to access the roof area.

Recommendation #2: Employers should designate a competent person to conduct scheduled and unscheduled site visits to evaluate field compliance with company safety rules and procedures.

Discussion: Employers should designate a competent person¹ to conduct scheduled and unscheduled safety inspections of worksites to help ensure that employees are performing their assigned tasks according to established company safety rules and procedures. To be effective, a safety program must be enforced at the worksite. Any violations of safety rules should be corrected immediately. Such inspections also demonstrate that the employer is committed to the company safety program and to the prevention of occupational injury.

Recommendation #3: Plant/facility owners should identify areas that may be hazardous to all personnel, including contractors, and restrict or prohibit the use of or access to these areas.

Discussion: Owners of plants/facilities where outside contractors perform jobs should work with contractors to identify areas that may be hazardous. After these areas have been identified, signs and/or barriers, along with verbal communication with the contractors, should be established. Additionally, if work must be performed in one of the identified hazardous areas, appropriate precautions and procedures should be implemented and enforced. [Note: Since this incident, the roofing manufacturer has instituted a safety procedure prohibiting any access to the roofs without the use of a safety belt, lanyard, and lifeline.]

¹Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

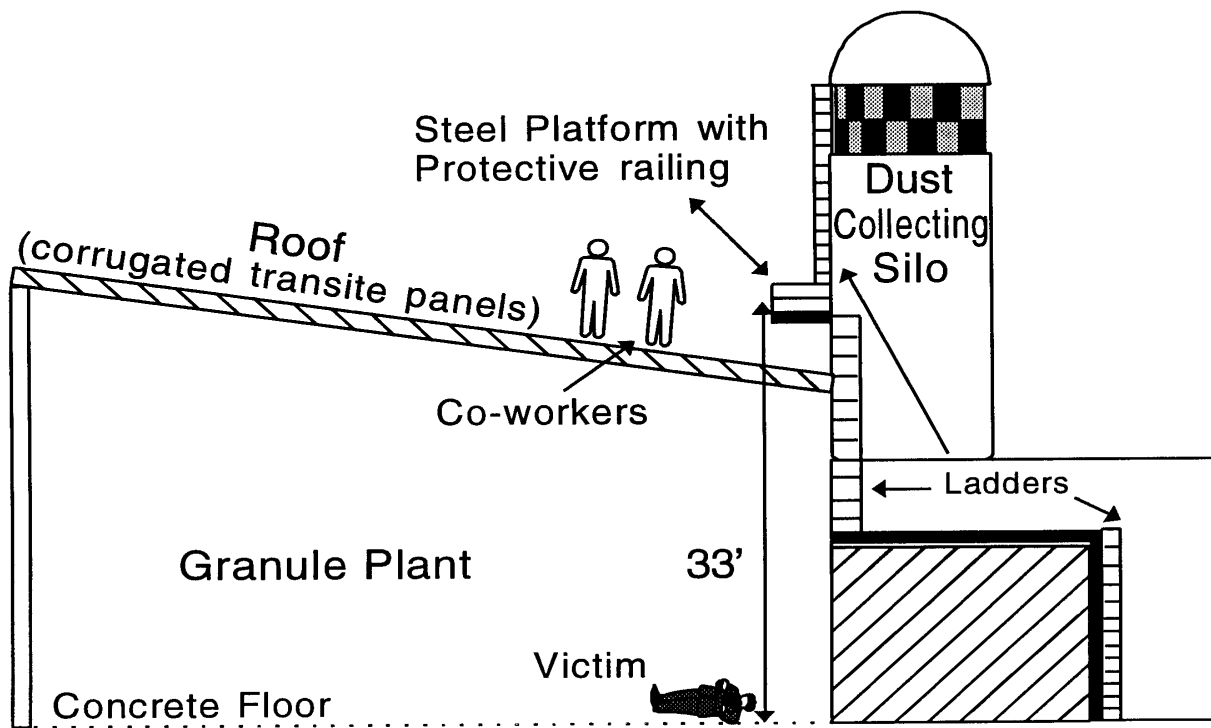


Figure. Dust-Collecting Silo and Granule Plant Roof

FACE 93-21: Cement Finisher Dies After 17-Foot Fall Through Unguarded Floor Opening--North Carolina

SUMMARY

A 38-year-old male cement finisher (the victim) died of injuries he received after stepping backwards and falling through an unguarded floor opening. The victim was one of 13 subcontractor employees pouring cement for a three-story addition to a textile mill. At the time of the incident, one half of the floor of the second story was being poured. The entire floor measured 84 feet wide by 119 feet long and contained eight unguarded openings, each measuring 32 inches wide by 18 feet long. These openings were to be used as vents and ducts for service cables. The floor also contained a 13-foot by 9-foot, 8-inch opening for an elevator shaft; the opening was guarded by a steel rope barrier. The victim and a co-worker (facing away from each other) were working approximately 10 feet apart, finishing the poured concrete with aluminum bullfloats. The victim, who was walking backwards as he worked the bullfloat, stepped into one of the unguarded floor openings. He fell 17 feet to the concrete floor below, striking his head. The co-worker did not see the victim fall, but heard him yell; however, the apprentice superintendent for the prime contractor was on the second story and saw the victim fall through the opening. Textile mill workers on the first floor also saw the victim fall, and ran to his aid. The victim was unconscious but breathing. The emergency medical service (EMS) was summoned and transported the victim to the hospital where he died 12 days later. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *implement 29 CFR 1926.500 (b)(1) and (8), which requires that all floor and platform openings be protected with a standard railing or a floor opening cover secured against displacement*
- *address worker safety issues in the planning phase of construction projects*
- *develop and implement a comprehensive written safety program.*

Additionally, prime contractors should:

- *utilize contract language that requires subcontractors to implement a site-specific safety and health program prior to the initiation of work.*

INTRODUCTION

On July 2, 1993, a 38-year-old male cement finisher (the victim) died of injuries he received on June 21, 1993, when he stepped backwards into an unguarded floor opening and fell 17 feet to the concrete floor below. On July 6, 1993, officials of the North Carolina Occupational Safety and Health Administration (NCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On August 10, 1993, a safety specialist from DSR investigated the incident and reviewed the circumstances with employer representatives and officials of NCOSHA.

The employer in this incident was a temporary employment service which supplied 22 employees to a concrete contractor. At the time of the incident, the concrete contractor was the only client of the temporary service, and both establishments were operated by the same owners. Neither establishment had a written safety program, and training was provided on the job. Tailgate safety meetings were conducted periodically by the crew supervisor, who was also responsible for worker safety at the jobsite. The victim had worked

for the temporary service for 7 years. The service had been in operation for approximately 25 years and had experienced no previous fatalities.

INVESTIGATION

The employer had been subcontracted to do the concrete work for an addition to the spinning area of a textile mill that produced fortrel polyester fiber. The addition was three stories high and measured 84 feet by 119 feet. The employer had a 13-man crew at the site performing various tasks, such as forming areas prior to pouring concrete, laying steel decking on which the concrete would be poured, and working the cement with bullfloats.

On the day of the incident, the job was approximately 80 percent complete and work had progressed to the floor of the second story. The forming of the floor had been completed. One half of the floor was to be poured on the day of the incident and the rest of the concrete was to be poured the following day.

Eight unguarded floor openings, each measuring 32 inches wide by 18 feet long, had been formed into the floor. These openings would be used as vents and ducts for service cables. A ninth floor opening measuring 13 feet long by 9 feet 8 inches wide, marked the location of the elevator shaft and was guarded by a steel rope barrier (Figure).

The crew supervisor approached the apprentice superintendent for the prime contractor 1 week before the pour was to take place and requested that the floor openings be covered. When the openings were not yet covered on the day of the pour, the crew supervisor again approached the apprentice superintendent. The men discussed the issue and decided that each would tell their respective workers to be extremely careful around the openings. Witnesses stated during NIOSH interviews that some of the openings were covered by wooden pallets that measured 40 inches by 48 inches. The pallets were obtained from a second subcontractor doing concrete block work on the addition; however, at the time of the incident, the second subcontractor had removed some of the pallets from the floor openings to return them for a pre-paid deposit. It could not be determined whether or not the floor opening involved in the incident had previously been covered by the pallets, or if any of the floor openings were covered at the time of the incident.

At approximately 11 a.m., the victim and another cement finisher were on the second story floor guiding the pump truck, which was pouring and working down the concrete. When the surface of a section of the poured concrete was relatively smooth and level, workers would further smooth the surface, using aluminum bullfloats. The two men were working approximately 10 feet apart, but were not facing each other. The apprentice superintendent was on the second story in the vicinity of the elevator shaft opening.

As the victim was walking backward floating the concrete, he stepped into the unguarded opening and fell approximately 17 feet to the concrete floor below, striking his head. The co-worker did not see the victim fall, but heard him yell. The apprentice superintendent saw a portion of the victim's body fall through the opening.

Textile mill workers on the first floor also saw the victim fall and ran to aid him. The victim was unconscious but breathing. The EMS was summoned; it arrived within 15 minutes and transported the victim to the hospital, where he remained in a coma until his death 12 days later on July 2, 1993.

CAUSE OF DEATH

The coroner listed the cause of death as closed head trauma-skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.500 (b)(1) and (8), which requires that all floor and platform openings be protected with a standard railing or a floor opening cover secured against displacement.

Discussion: Prior to the start of work, floor openings should be protected with a standard railing, or covered or guarded with materials that are installed so as to prevent displacement. After the incident, the openings were properly fitted with secured plywood covers by the prime contractor.

Recommendation #2: Employers should address worker safety in the planning phase of construction projects.

Discussion: Safety concerns should be addressed and incorporated into all construction projects during the planning phase and throughout the entire project. Such a procedure would allow for the identification of potential hazards prior to the initiation of work so that appropriate intervention strategies could be implemented.

Recommendation #3: Employers should develop and implement a comprehensive written safety program.

Discussion: Employers should develop and implement a comprehensive written safety program which includes, but is not limited to, the proper use of fall protection equipment, the recognition and control of fall hazards, and should include appropriate worker training in the proper methods of covering\guarding floor openings to prevent falls through the openings. Development, implementation, and enforcement of a written safety program and the establishment of standard safety practices will demonstrate to workers the employer's commitment to safety.

Recommendation #4: Prime contractors should utilize contract language that requires subcontractors to implement a site-specific safety and health program prior to the initiation of work.

Discussion: Prime contractors should use contract language that requires all subcontractors to identify how they intend to implement a site-specific safety and health program prior to the initiation of work. Subcontractors' safety programs should be consistent and compatible with the prime contractor's safety program. The contract should contain clear and concise language as to which party is responsible for a given safety or health issue. Any differences should be negotiated before work begins.

Once the provisions for these responsibilities have been established, the respective parties should ensure that the provisions of the contract regarding safety and health are upheld.

REFERENCES

Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926.500(b)(1) and (8), July 1, 1992.

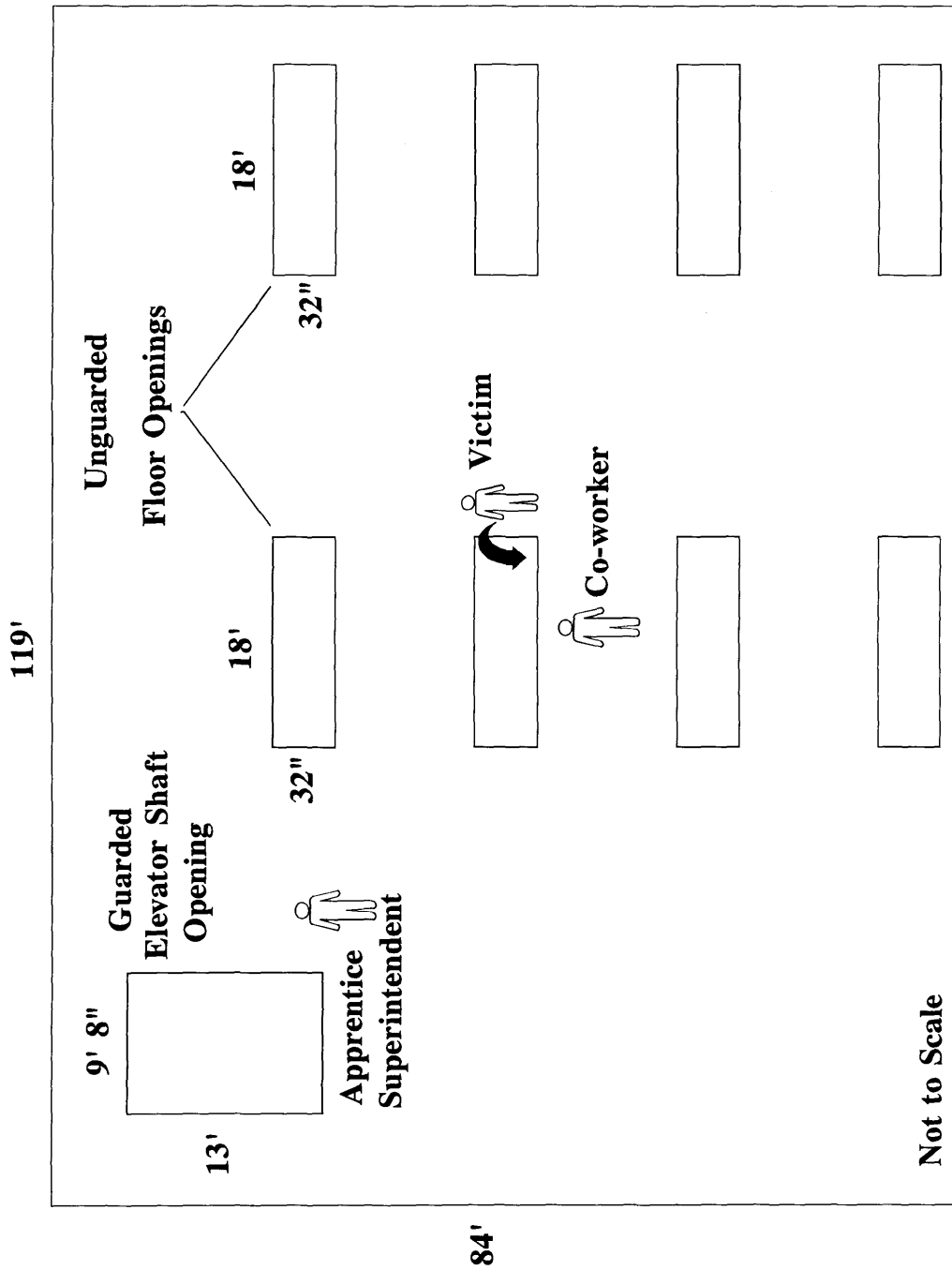


Figure. Second Story Floor Plan

FACE 94-09: Meat Packing Plant Employee Dies After Fall From Platform--South Carolina

SUMMARY

A 41-year-old male meat packing plant employee (the victim) died after falling from a platform during the knocking portion of a beef cattle slaughter operation. Knocking involves stunning beef cattle by an electrical shock before slaughtering them. The victim and two co-workers were working at a point in the operation when beef cattle were chased into a chute, knocked or stunned, then slaughtered. The workers were alternating the jobs of chasing, knocking, and slaughtering the cattle. At the time of the incident, the victim and a co-worker were standing on a platform in the knocking area. The platform was 29 inches high and was accessed by 2 steps. As the victim and co-worker waited for the next animal, they entered into an argument and the victim either had a seizure and fell backward, or was bumped by the co-worker and fell backward down the steps of the platform, striking his head. The second co-worker called to the supervisor for help, then ran with the supervisor to the victim. The victim was lying on his back with his feet still on the steps and his hard hat on his head. He was conscious but incoherent, and was bleeding from a cut on the left side of his head. The emergency medical service (EMS) was summoned and the EMS transferred the victim to the hospital where he died 9 days later. NIOSH investigators concluded that, in order to prevent similar incidents, employers should:

- *consider guarding all sides of elevated work platforms*
- *monitor employees for disruptive, erratic, or impaired behavior*
- *employers should consider offering employee assistance programs to provide help to employees whose job performance becomes impaired due to some medical-behavioral problem, including alcohol-related problems, drug abuse, or mental health problems.*

INTRODUCTION

On February 12, 1994, a 41-year-old male meat packing plant employee (the victim) died after falling backward off a 29-inch-high platform and striking his head on a concrete floor. On February 22, 1994, officials of the Occupational Safety and Health Administration for the State of South Carolina (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On March 23, 1994, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with the SCOSHA compliance officer assigned to the case and the investigating officer from the sheriff's department. Photographs of the site taken immediately following the incident were reviewed during the investigation.

The employer was a wholesale beef processing and packing plant that had been in operation for 50 years and employed 170 workers. The employer had a written safety policy and written safe work procedures. The employer provided hard hats, safety shoes, ear plugs, steel mesh aprons, and rubber, cotton, steel-mesh, and kevlar gloves to workers as necessary. Disciplinary procedures were in place that included verbal and written warnings up to dismissal. Workers were instructed to report hazards to their supervisors, and supervisors checked equipment on an ongoing basis. Forklift operators received structured training and all workers received basic training on hazard communication and confined space safety. Supervisors were responsible to see that safety rules were followed and were instructed that if alcohol abuse by a worker was suspected, or if a worker was observed acting in an impaired fashion, to send that person home and alert management of the situation. This was the first fatality experienced by the employer.

INVESTIGATION

The plant operated on a three-shift basis with slaughtering and butchering processes conducted during the first shift (7 a.m. to 5 p.m.) and plant and machinery cleanup occurring during the remaining two shifts.

Cattle were delivered to the plant in trucks and unloaded into a barn. At the appropriate time, the cattle were chased through chutes to the knocking area where they were held temporarily. A worker standing on the 23 1/2-inch-wide by 71-inch-long by 29-inch-high knocking platform then stunned the animals with an electrical charge (Figure). The platform was accessed by two steps and was guarded by guardrails on all sides but the entry. The cattle were stunned and slaughtered. After being hung on hooks, the carcasses were disemboweled, skinned and split, then taken to coolers where they were later either boned out and cut to order or shipped as hanging sides of beef.

At 3 p.m., the victim and two co-workers were working in the knocking area. The three men were alternating the jobs of chasing the cattle to the knocking area, and knocking and slaughtering the cattle.

The victim and a co-worker, standing on the 29-inch-high knocking platform, entered into an argument. The victim either lost his balance, or was bumped by the co-worker and fell backward off the knocking platform. A third co-worker saw the victim fall and called to a supervisor who was standing nearby at a meat cooler with his back to the knocking platform. The supervisor ran to the platform and found the victim lying on his back on the floor. The victim's feet were resting on the 13-inch high first step and his hard hat was still on his head, although the victim was bleeding from a cut on the left side of his head. The emergency medical service (EMS) was summoned by phone from the plant office and arrived shortly thereafter. The victim was transported to the hospital where he died 9 days later.

Plant records revealed that the victim had a history of seizures. One of the responding emergency medical technicians stated that the victim displayed symptoms that were indicative of a seizure. Toxicology results revealed that the victim had a blood alcohol level of .24. The victim had been terminated in 1992 for carrying alcohol into the plant, but was later rehired.

CAUSE OF DEATH

The medical examiner's report is not yet complete.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should consider guarding all sides of elevated work platforms.

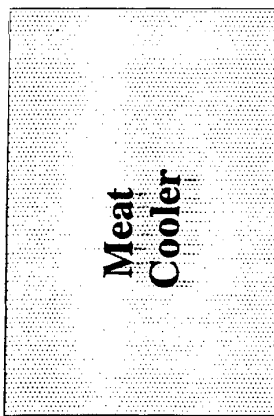
Discussion: Three sides of the elevated knocking platform were protected by guardrails at the perimeter, leaving unguarded the side where the steps were located. A spring-loaded, one-way gate could be installed on this side. The gate would have to be pulled open from inside the perimeter to access the steps, and would lessen the possibility of an inadvertent fall from the platform.

Recommendation #2: Employers should monitor employees for disruptive, erratic, or impaired behavior.

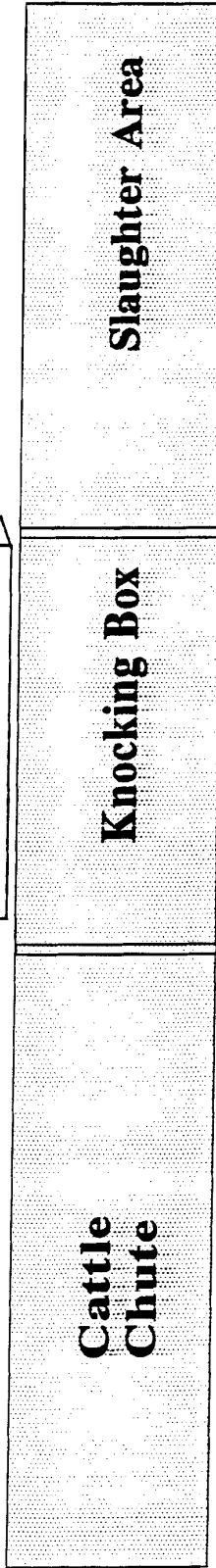
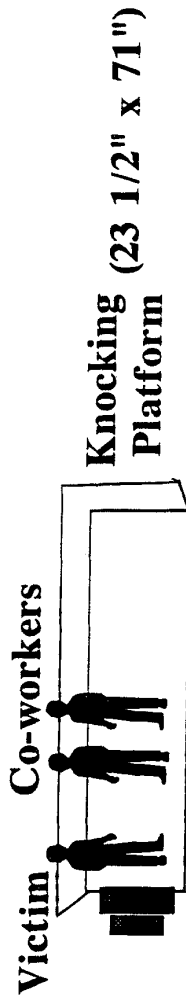
Discussion: Employees should be monitored by employers or supervisors for unusual, erratic, disruptive, or impaired behavior at the jobsite. When this type of behavior is observed, the supervisor should evaluate the situation, and the employee, and take immediate, appropriate action.

Recommendation #3: Employers should consider offering employee assistance programs to provide help to employees whose job performance becomes impaired due to some medical-behavioral problem, including alcohol-related problems, drug abuse, or mental health problems.

Discussion: Although the role of alcohol in this incident is unclear, the victim had an excessive blood alcohol level and had been previously terminated for bringing alcohol into the plant. Employer sponsored assistance programs to help restore employees to optimal performance should be made available to all employees.



Supervisor



3rd Co-worker

Not to Scale

Figure.

FACE 94-13: Drywall Mechanic Dies After 10-Foot Fall From an Open-sided Floor--South Carolina

SUMMARY

A 20-year-old male drywall mechanic (the victim) died after falling about 10 feet from an open-sided second floor landing and striking his head on a concrete floor. The victim was working alone sanding a ceiling constructed of sheetrock. The victim was operating a sander and apparently unaware of his position in relation to the open-sided floor. He was observed by a trim carpenter from another company, stepping/falling off the landing as he sanded the ceiling located over the second floor landing. The victim fell about 10-feet, hitting the concrete floor face first. The carpenter notified his foreman who called 911. The emergency medical service (EMS) arrived in less than 10 minutes and transported the victim to the local hospital, where he died 20 days later. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *provide adequate guarding for open-sided floors, platforms, and runways*
- *develop, implement, and enforce a comprehensive written safety program*
- *routinely conduct scheduled and unscheduled workplace safety inspections*
- *utilize contract language that requires subcontractors to implement a site-specific safety and health program prior to the initiation of work*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On March 14, 1994, a 20-year-old male drywall mechanic (the victim) died of injuries sustained in a 10-foot fall from an open-sided second floor landing on February 22, 1994. On April 21, 1994, officials of the South Carolina Occupational Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On May 18, 1994, a safety specialist from DSR investigated and reviewed the incident with the subcontractor on the job and the SCOSHA compliance officer assigned to the case. The county coroner's report was obtained during the investigation.

The employer had been in business for about 15 years and employed four workers, three of whom were drywall mechanics. The employer had no written safety program or procedures; however, 2 or 3 days prior to the incident the contractor and subcontractor walked through the jobsite (no guardrails were present at that time). Training was provided on the job, and personal protective equipment was not required by the employer. The day of the incident was the victim's first day back on the job after a 6-month layoff. This was the first fatality experienced by the employer.

INVESTIGATION

The jobsite was located at a housing subdivision which consisted of single family homes in various stages of construction. The general contractor had sub-contracted much of the work to various other contractors.

At this particular jobsite, the frame carpenter crew, trim carpenters, and the dry wall suppliers had been sub-contracted. The dry wall supplier had sub-contracted the hanging and finishing of sheetrock to the employer of the victim. Two or 3 days prior to the incident, the employer had conducted a walk through inspection of the house with the drywall supplier. At that time, the second floor landing and hallway were seen not to have any guardrails present. Guardrailing had been installed during the framing phase of construction, but had subsequently been removed to allow the movement of supplies (e.g., doors, windows, sheetrock, etc.), from the ground floor to the second floor level. The crew, with the exception of the victim, had been working at the jobsite for 1 week prior to the incident. This was the victim's first day back to work after a 6-month layoff.

On the day of the incident, the crew arrived at the jobsite around 8 a.m. to finish sanding the sheetrock. Two employees were assigned to work in the garage, and the victim and his co-worker were assigned to sand sheetrock in the house at the second floor level. The co-worker was sanding sheetrock inside a closet, while the victim was sanding the ceiling above the second floor landing. About 10:30 a.m., a trim carpenter who was nailing windows in a different area on the second floor ran out of nails. As he was going down the stairway he saw the victim step/fall off the open-sided area of the second floor landing. Apparently the victim was unaware of his position in relation to the open-sided floor and stepped or fell off the unguarded open-sided floor landing. The victim fell about 10 feet, striking the concrete floor face first. The carpenter ran to inform his foreman as to what had occurred and the foreman called 911. The EMS arrived in less than 10 minutes and stabilized and transported the victim to the local hospital, where he died 20 days later.

CAUSE OF DEATH

The coroner's report listed the cause of death as closed-head injury.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide adequate guarding for open-sided floors, platforms, and runways.

Discussion: The victim was using an electric sander while sanding sheetrock located above an unguarded open-sided second floor landing. In this incident, where several employers were working at the same jobsite, the general contractor has the responsibility of insuring that all open-sided floors are protected at all times. Although initial guardrailing was installed, it was subsequently removed to move supplies to the second floor level. Providing standard guardrailing as required by CFR 1926.500 (d)(1)(i) may have prevented this incident from occurring. **NOTE:** Following the incident, the general contractor had temporary guardrails reinstalled around the open-sided floor areas.

Recommendation #2: Employers should develop, implement and enforce a comprehensive written safety program.

Discussion: The employer did not have a written safety program. The development, implementation, and enforcement of a comprehensive safety program should reduce and/or eliminate worker exposures to hazardous situations. The safety program should include, but not be limited to, protecting open-sided floors with appropriate guardrailing and handrails, the recognition and avoidance of fall hazards, and the use of appropriate safety equipment.

Recommendation #3: Employers should routinely conduct scheduled and unscheduled workplace safety inspections.

Discussion: Although the employer and subcontractor walked through the jobsite and noticed the absence of guardrailing, no action was taken to alleviate the situation. Employers should be cognizant of the hazardous conditions at jobsites and take an active role to eliminate them. Additionally, scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that jobsites are free of hazardous conditions. Regardless of how comprehensive, a safety program cannot be effective unless implemented in the workplace. Even though these inspections do not guarantee the elimination of occupational injury, they do demonstrate the employer's commitment to the enforcement of the safety program and to the prevention of occupational injury.

Recommendation #4: Employers should utilize contract language that requires subcontractors to implement a site specific safety and health program prior to the initiation of work.

Discussion: General and subcontractors should use contract language that requires all subcontractors to identify how they intend to implement a site-specific safety and health program prior to the initiation of work. Subcontractor's safety programs should be consistent and compatible with the general contractor's safety program. The contract should contain clear and concise language as to which party is responsible for a given safety or health issue. Any differences should be negotiated before work begins. Once the provisions for these responsibilities have been established, the respective parties should ensure that the provisions of the contract regarding safety and health are upheld.

Recommendation #5: Employers should encourage workers to actively participate in workplace safety.

Discussion: Employers should encourage all workers to actively participate in workplace safety and should ensure that all workers understand the role they play in the prevention of occupational injury. In this instance, the victim was working in an area without sufficient guarding. Workers and co-workers should look out for one another's safety and remind each other of the proper way to perform their tasks. Employers must instruct workers of their responsibility to participate in making the workplace safer. Increased worker participation will aid in the prevention of occupational injury.

REFERENCES

29 CFR 1926.500 (d)(1)(i) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

¹Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

FACE 95-09: Carpenter Dies After Falling 16 Feet From Roof--North Carolina

SUMMARY

A 46-year-old male carpenter (the victim) died after falling 16 feet from a roof onto a concrete porch floor. The victim was a member of a five-man (foreman and four carpenters) crew laying roofing felt on the gable roof of a newly-constructed, prefabricated church and sacristy. The roof was 48 feet wide by 106 feet long. The crew had completed applying the felt to one half of the roof and were applying the eighth course to the second half of the roof when the incident occurred. The victim was walking backward on the roof unrolling the felt. Approximately 8 feet in front of the victim, a second crew member was temporarily nailing down the felt. A short distance behind the second crew member, the two additional crew members were permanently nailing the felt to the roof sheeting. The foreman was on the roof observing the crew. The men were only unrolling 8 feet of felt at a time because it was a windy day, with gusts up to 25 miles per hour. As the men approached the end of the roof, the foreman was called to the ground to discuss the color of the shingles with the church preacher. The worker temporarily affixing the shingles looked up to see the victim approaching the edge of the roof and yelled for him to "watch out." The victim lost his balance and fell backward off the roof. The victim fell approximately 6 feet, struck a cross brace on the framework of the church's porch, then fell another 10 feet, striking his head on the concrete floor of the porch. The crew members left the roof and ran to the victim, finding him unresponsive, bleeding from the nose and ears. One of the workers ran to the parsonage and had the preacher call the 911 operator. The crew was instructed by the 911 operator to initiate cardiopulmonary resuscitation (CPR). The crew continued CPR until the emergency medical service (EMS) arrived. When EMS personnel could not detect any vital signs they called the county coroner, who pronounced the victim dead at the site. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *ensure that appropriate fall protection equipment is available and correctly used when working where there is a danger of falling*
- *develop, implement, and enforce a comprehensive written safety program*
- *routinely conduct scheduled and unscheduled workplace safety inspections*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On March 7, 1995, a 46-year-old male carpenter (the victim) died from injuries received in a 16-foot fall from a roof. On March 10, 1995, officials from the North Carolina Occupational Safety and Health Administration (NCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On March 22, 1995, a DSR safety specialist conducted an investigation of this incident. The incident was reviewed with the employer, the crew foreman, the NCOSHA compliance officer assigned to the case, and a fall-equipment manufacturer representative. The site was photographed, the police report was reviewed, and the medical examiner's report was requested during the investigation.

The employer in this incident consisted of a parent company that manufactured pre-fabricated homes and employed 15 workers. A subsidiary company included the outside-construction crew on which the victim

worked. Ninety-five percent of the employer's business involved single-dwelling residential housing, though the employer would occasionally construct larger structures, such as the church in this incident. The employer had been in operation for 38 years and had no written safety policy, program or safe work procedures. Training was provided on the job, and monthly safety meetings, attended by all workers, were conducted by the safety director. This was the first fatality experienced by the employer. The victim had worked for the employer for 2 years.

Since the incident, the employer has begun to develop a comprehensive safety program, and has purchased a fall protection system consisting of body harnesses, lanyards, four 50-foot lifelines equipped with rope grabs, and anchorage points to be attached at the crest of the roof, to be used during roofing operations.

INVESTIGATION

The employer had been contracted to pre-fabricate and erect a church and sacristy 48 foot wide by 106 foot long. The fabricated materials were prepared at the parent company's manufacturing plant, then shipped to the jobsite. After a concrete footer, four courses of cement block, and a 12-foot by 24-foot concrete and block porch floor were in place, a 5-man construction crew was dispatched to the site to erect the structure.

In a span of 12 days the crew of 4 carpenters (including the victim) and a foreman had erected the skeletal structure, laid the plywood floor, attached the aspenite outer walls, and applied the plywood sheeting to the roof of the church.

On the day of the incident, the crew was applying the roofing felt to the plywood sheeting on the 5:12-pitched gable roof of the church. The crew had completed half the roof and was applying the eighth course to the second side of the roof. The victim was walking backward on the roof, unrolling the felt approximately 8 feet at a time, because the wind was gusting up to 25 miles per hour. Approximately 8 feet in front of the victim, a co-worker (facing the victim) was temporarily nailing down the felt. A short distance behind that worker, two crew members were permanently nailing the felt to the roof. The foreman was on the roof observing the crew. None of the men were wearing fall protection.

As the men approached the roof's edge the crew foreman, on the roof observing the men, was called to the ground to discuss the color of the shingles with the church's preacher. The worker temporarily affixing the felt looked up to see the victim approaching the edge of the roof and yelled for him to "watch out." The victim lost his balance and fell backward off the roof, striking a temporary brace on the skeletal framework of the church's front porch, 6 feet below the roof's edge. The victim fell an additional 10 feet to the concrete porch floor, striking his head. The crew left the roof and ran to the victim, finding him unresponsive and bleeding from the nose and ears. One of the workers ran to the parsonage and had the preacher call the 911 operator. The crew was instructed by the 911 operator to initiate cardiopulmonary resuscitation (CPR) and to continue until the emergency medical service (EMS) arrived. When EMS personnel arrived and could not detect any vital signs, they summoned the county coroner, who pronounced the victim dead at the scene.

CAUSE OF DEATH

The medical examiner listed the cause of death as skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that appropriate fall protection equipment is available and correctly used when working where there is a danger of falling.

Discussion: 29 CFR 1926.501 (b) (1) states that "each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems." In this incident, there was no fall protection equipment present on the roof; however, on the day of the NIOSH investigation, the employer purchased a fall protection system that was demonstrated by a fall-protection equipment manufacturer representative at the site.

Recommendation #2: Employers should develop, implement, and enforce a comprehensive written safety program.

Discussion: The development, implementation, and enforcement of a comprehensive safety program should identify, and reduce or eliminate worker exposures to hazardous situations. The safety program should include, but not be limited to, employing workday hazard assessments to enable the recognition and avoidance of fall hazards; and providing, and enforcing, the use of appropriate safety equipment such as safety nets, or safety belts and lanyards.

Recommendation #3: Employers should routinely conduct scheduled and unscheduled workplace safety inspections.

Discussion: Employers should be aware of the hazardous conditions at jobsites and should take an active role to eliminate them. Scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that jobsites are free of hazardous conditions. Even though these inspections do not guarantee the prevention of occupational injury, they may identify hazardous conditions and activities that should be rectified. Further, they demonstrate the employer's commitment to the enforcement of the safety program and to the prevention of occupational injury.

Recommendation #4: Employers should encourage workers to actively participate in workplace safety.

Discussion: Employers should encourage all workers to actively participate in workplace safety and should ensure that all workers understand the role they play in the prevention of occupational injury. In this instance, the victim was walking backward on a roof 16 feet above ground without any guarding or safety equipment. Workers and co-workers should look out for their personal safety and the safety of co-workers. When workers observe hazardous conditions or activities, they should, depending on the circumstances, notify management and/or remind co-workers of the proper way to perform their tasks and protect themselves. Employers must instruct workers of their responsibility to participate in making the workplace safer. Increased worker participation will aid in the prevention of occupational injury.

¹Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

REFERENCES

29 CFR 1926.501 (b) (1) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 95-15: Shipping Department Employee Dies After Falling Into Floor Opening on Conveyor Line--Virginia

SUMMARY

On July 12, 1995, a 37-year-old male loader/unloader (the victim) was fatally injured when he fell through a floor opening of a conveyor line at a furniture manufacturing company warehouse. The victim was transferring cardboard cartons containing furniture from one conveyor line to another prior to their being lowered through a floor opening from the third to the second floor of the warehouse. The victim had already removed a furniture carton from the incoming conveyor line, and was attempting to position it on the adjacent line. A co-worker working nearby heard the victim call out, and turned to see his feet disappearing over the edge of the floor opening. The victim fell 11 feet 6 inches to the concrete floor below. A co-worker contacted the local emergency medical service (EMS), which responded in approximately 5 minutes, transporting the victim to a nearby hospital. Later that day, he was transferred to a trauma center in a neighboring state, where he died the following day. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *ensure that floor openings are guarded by standard railings or covers*
- *establish safe work areas to ensure that work activities take place away from floor openings*
- *ensure that warning devices incorporating bilingual and/or symbolic signage where appropriate are displayed in work areas with floor openings*
- *consider installing sensing devices at approaches to floor openings which will activate automatic shutdown of conveyor lines when workers enter danger zones*
- *ensure that workers who are part of a bilingual workforce comprehend instructions in safe work procedures for the tasks to which they are assigned by designating experienced personnel who share the worker's native language to act as interpreters and trainers.*

INTRODUCTION

On July 13, 1995, a 37-year-old male loader/unloader (the victim) died from injuries sustained the previous day when he fell through a floor opening of a furniture warehouse conveyor line. On August 3, 1995, officials of the Virginia Occupational Safety and Health Administration (VAOSHA) notified the Division of Safety Research (DSR) of the incident and requested technical assistance. On September 12, 1995, a safety engineer and a statistician from DSR reviewed the incident with the VAOSHA compliance officer. The corporate safety director, plant manager, and the co-worker who witnessed the incident were interviewed during the site investigation conducted the following day. The incident site was examined and photographs and measurements were taken.

The employer, a furniture manufacturing firm in business at this location since the early 1900s, now employs approximately 8,000 workers at 40 facilities in 14 states. There were 440 employees at the location where the incident occurred. The warehouse and conveyor system had been in operation since the early 1970s. The victim had been employed at the warehouse for 2 weeks and had received on-the-job training in the task being performed at the time of the incident. The corporate safety director is responsible for the

safety program at the site of the incident and oversees the activities of the full-time safety directors employed at each of the company's other facilities. Safety performance is considered in evaluating the overall performance of plant managers. The company instituted an English-Spanish hazard communication program approximately 1 year prior to the incident, and offers English classes for its Spanish-speaking workers. Safety topics are incorporated into monthly meetings for supervisory staff, who are expected to communicate safety information to workers. The company has its own safety inspection program in which fines are levied against facilities where violations of OSHA standards are found. At the end of each year, the money assessed in fines is awarded to the three plants with the fewest violations and lowest workers' compensation costs. The corporate safety director reported that there had been approximately four fatalities company-wide during his 30 years of employment there, and that none had been associated with the task being performed by the victim.

INVESTIGATION

On July 12, 1995, workers at the warehouse began work on the 7 a.m. to 3:30 p.m. shift. The normal work week is 32 to 40 hours, depending on the volume of orders to be filled. Two conveyor lines operate on the third floor of the five-story warehouse (Figure 1), one which moves furniture from an adjacent manufacturing plant into and throughout the warehouse (the incoming line), and the other which moves furniture to the first floor for shipment out of the warehouse (the outgoing line). Furniture is loaded onto "hangers," which are chairlike cars suspended from the powered overhead trolley-type conveyor. The hangers have 3/4-inch plywood covered load platforms, 30" by 31", bolted to the metal frames. The platforms are about 1 foot above the floor and 7 feet below the conveyor trolleys. The backs of the hangers are covered by another sheet of 3/4-inch plywood extending up from the platform about 50 inches. The hangers are spaced approximately 6 feet apart, and travel approximately 42 feet per minute.

The incident occurred at a transfer location where furniture is transferred from the incoming line to the outgoing line before the outgoing line drops through a floor opening to the second floor. The outside edge of the 26 foot 7 inch by 6 foot 6 inch floor opening (the east side) was located 20 inches from the outside wall. A ledge (4 1/4 inches wide and 2 5/8 inches high) was located 1 foot from the opening, and extended the full width of the south side of the opening (Figure 2). A shutoff switch for the incoming conveyor was located about 12 feet from the southwest corner of the floor opening. The outgoing conveyor's shutoff switch was located on the outside building wall 5 feet 2 inches across from the conveyor line and 3 feet 6 inches up the line from the edge of the floor opening.

The victim's duties consisted of removing furniture cartons from hangers of the incoming conveyor line, sliding them across the floor to the adjacent conveyor line, and placing them on hangers on the outgoing line located approximately 8 1/2 feet away. The victim had received on-the-job instruction in his task from the "lead man," whose duties consisted of monitoring the activities of the loader/unloaders and using an electronic bar code scanner to record information about the outgoing shipments. The lead man stated that he had cautioned the victim several times during the morning of the incident about working too close to the floor opening. He also reported that he had advised him to let cartons proceed if he was having any difficulty handling them.

The employer stated that this particular floor opening, one of 13 throughout the facility, was the only opening located near a work area. Fewer furniture cartons than usual were moving through at the time of the incident. Some pieces of furniture, such as the 135-pound dresser the victim was handling, were packed in cardboard cartons that were partially open on one end, leaving the furniture legs or base exposed. The dresser the victim was loading was approximately 20 inches by 30 inches by 49 inches. The surface of the

concrete floor was very smooth, allowing workers to easily slide the cardboard furniture cartons across the floor from one conveyor to the other. The loader/unloaders wore athletic shoes or other rubber-soled shoes to assure safe footing. They also wore rubber-faced gloves provided by the employer to protect their hands and to provide a secure grip on furniture cartons.

Around 1:15 p.m., the time of the incident, there were four workers in the vicinity: the victim, the lead man, and two other loader/unloaders who were working farther up the conveyor line. The lead man was removing a carton from the incoming conveyor line with his back to the victim, and the victim was positioned between the outgoing conveyor and the wall, attempting to place a carton on a hanger. The lead man stated that, before he turned away, he noticed the victim was walking backward attempting to adjust the carton more squarely on the hanger. He heard the victim call out, and turned back and saw the victim's feet disappear as he tripped over the water ledge across the floor opening. The victim fell 11 feet 6 inches, striking his head on the concrete floor below. A co-worker notified the EMS, which responded in approximately 5 minutes. The victim was transported to a hospital in a nearby town, transferred to a trauma center in the neighboring state, and died the following day without regaining consciousness.

CAUSE OF DEATH

The cause of death was determined to be head and chest injuries.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that floor openings are guarded by standard railings or covers.

Discussion: At the time of the incident, the floor opening was partially guarded by standard railings (i.e., 42-inch high top rail, midrail, and toeboard). One railing extended along the full 26 foot 7 inch length of the west edge of the floor opening. Another extended across the 6 1/2-foot width of the north end of the floor opening and continued to the building wall. At the south end of the opening, the standard railing extended from the southwest corner of the floor opening 20 inches to the building wall. Since the incident, the employer has extended the west 26 foot 7 inch standard railing an additional 8 feet beyond the southwest corner of the floor opening, and has added a standard railing the full length of the east edge of the opening. At the time of the incident, the south edge of the floor opening providing conveyor access was not guarded. The employer has since covered the opening with an 800-pound-capacity cargo net which extends about 10 feet from the south edge (Figure 2). This method of covering offers fall protection yet still allows the conveyor to descend unimpeded through the opening. In response to reports that workers commonly sat on standard railings during break periods, the employer has also covered the north end with a second net secured to the top rail.

Recommendation #2: Employers should establish safe work areas to ensure that work activities take place away from floor openings.

Discussion: The conveyor lines ran parallel to each other beginning at the edge of the floor opening and continuing for 30 feet until the incoming conveyor line turned west. At the time of the incident, workers manually transferred furniture from the incoming to the outgoing line within this work area. Apparently the victim, while positioning the carton on the hanger, moved progressively closer to the floor opening, ultimately falling backward over the water ledge. After the incident, the employer extended the standard railing 8 feet beyond the threshold of the opening, effectively moving the available work area away from the opening.

Recommendation #3: Employers should ensure that warning devices incorporating bilingual and/or symbolic signage where appropriate are displayed in work areas with floor openings.

Discussion: There were no warning lines or signs in the vicinity of the floor opening at the time of the incident. Since the incident, the employer has marked a danger zone by painting prominent diagonal yellow warning lines on the floor in the 8 foot long by 6 1/2 foot wide area in front of the floor opening. Warning signs in English and Spanish have been affixed to the new 8-foot section of standard railing along the inside length of the opening. The employer has no educational prerequisites for prospective employees, thus there is no guarantee that employees, Spanish speaking or otherwise, can read the signs in either language. Additional signs using symbols rather than text would illustrate the hazards associated with the floor opening to all workers regardless of their literacy or language skills.

Recommendation #4: Employers should consider locating automatic conveyor shutdown devices at approaches to floor openings near areas where material is manually transferred between conveyors.

Discussion: The victim had about 40 seconds to transfer a piece of furniture from one line to the other. The available work area was about 30 feet, and the conveyors travel at a rate of about 42 feet per minute. If in that amount of time the furniture was not securely positioned on the hanger, unwritten company policy dictated that the worker should allow the furniture to continue on the line without regard for its security. During the transfer of material from one line to the other, the victim's safety depended upon his ability to remain cognizant of his location relative to the floor opening while walking backward with the conveyor line and adjusting the position of the furniture on the hanger. A pressure sensitive mat such as those used to activate automatic doors, placed before the approach to the floor opening, could be used to automatically shut down the conveyor, thereby stopping worker movement toward the opening without relying on the worker's sense of location.

Recommendation #5: Employers should ensure that workers who are part of a bilingual workforce comprehend instructions in safe work procedures for the tasks to which they are assigned by designating experienced personnel who share the worker's native language to act as interpreters and trainers.

Discussion: The lead man assigned to explain the victim's task to him did not speak Spanish, nor did any of the other workers in the area. It is not known to what extent the victim understood English; however, it was not his native language. To safely perform the task assigned to him, the victim needed to understand the importance of avoiding the floor opening, as well as the area available to safely accomplish the transfer of furniture from one conveyor line to the other. The lead man explained the task to him in English, but because of the language difference, had difficulty evaluating the victim's understanding of the work instructions. The lead man indicated that he and the victim had very little conversation during the morning prior to the incident; however, he had told the victim that if he had difficulty placing a piece of furniture on a hanger he should allow the unstabilized furniture to proceed instead of risking getting too close to the floor opening. Since there were no warning signs or symbols in the work area, the lead man could only demonstrate the work task and signal for the victim to move away from the opening if he approached it too closely. A significant portion of the workforce at this location was Hispanic, and the employer had implemented a bilingual hazard communication program; however, bilingual on-the-job, task-specific training was not necessarily provided. It is difficult to evaluate worker comprehension of training when both trainer and worker share a common language, and more so when there is a language barrier, as may have been the case in this incident. Employers could ensure that workers comprehend training and instructions by designating experienced workers to act as interpreters, trainers, and safety representatives.

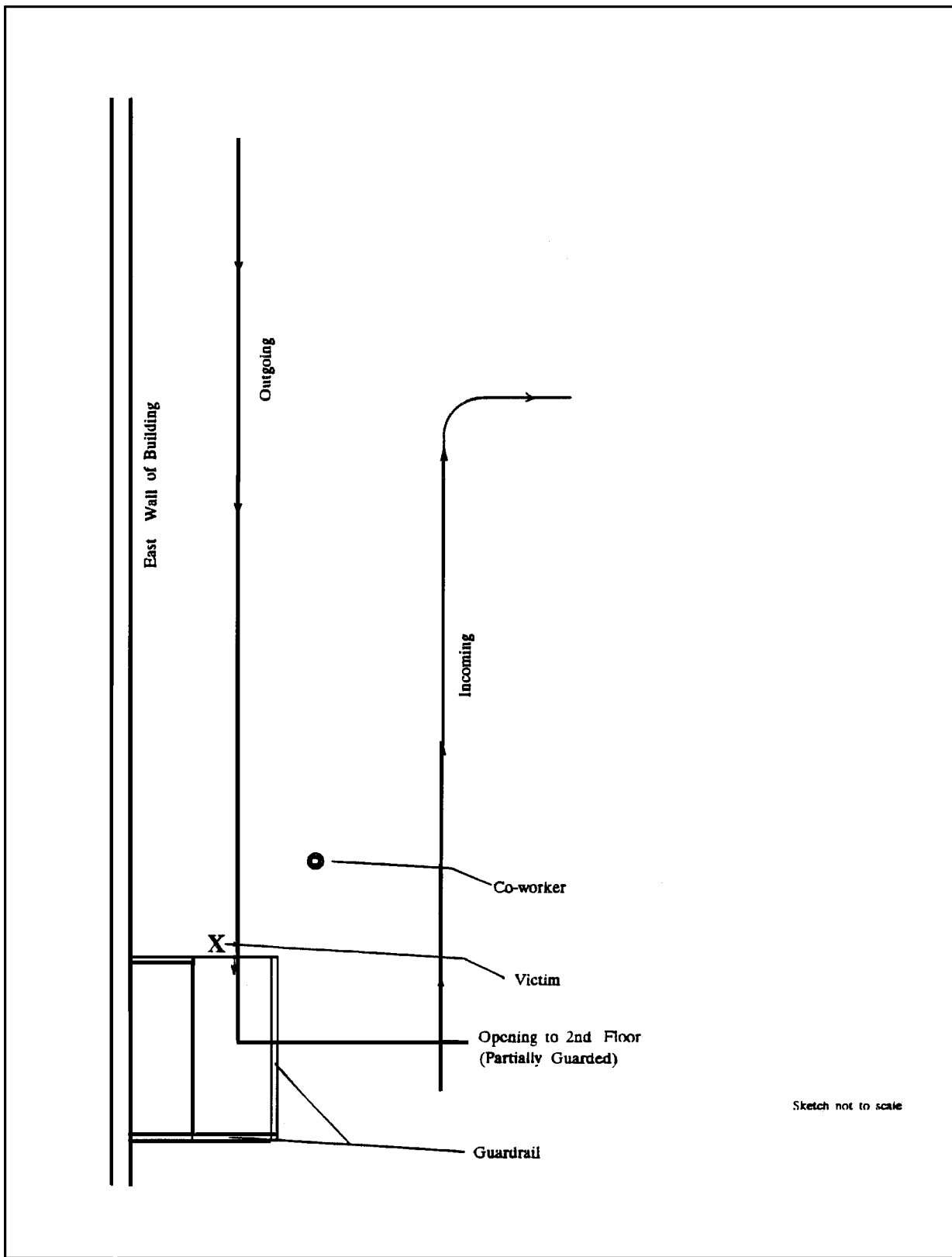


Figure 1. Furniture Warehouse

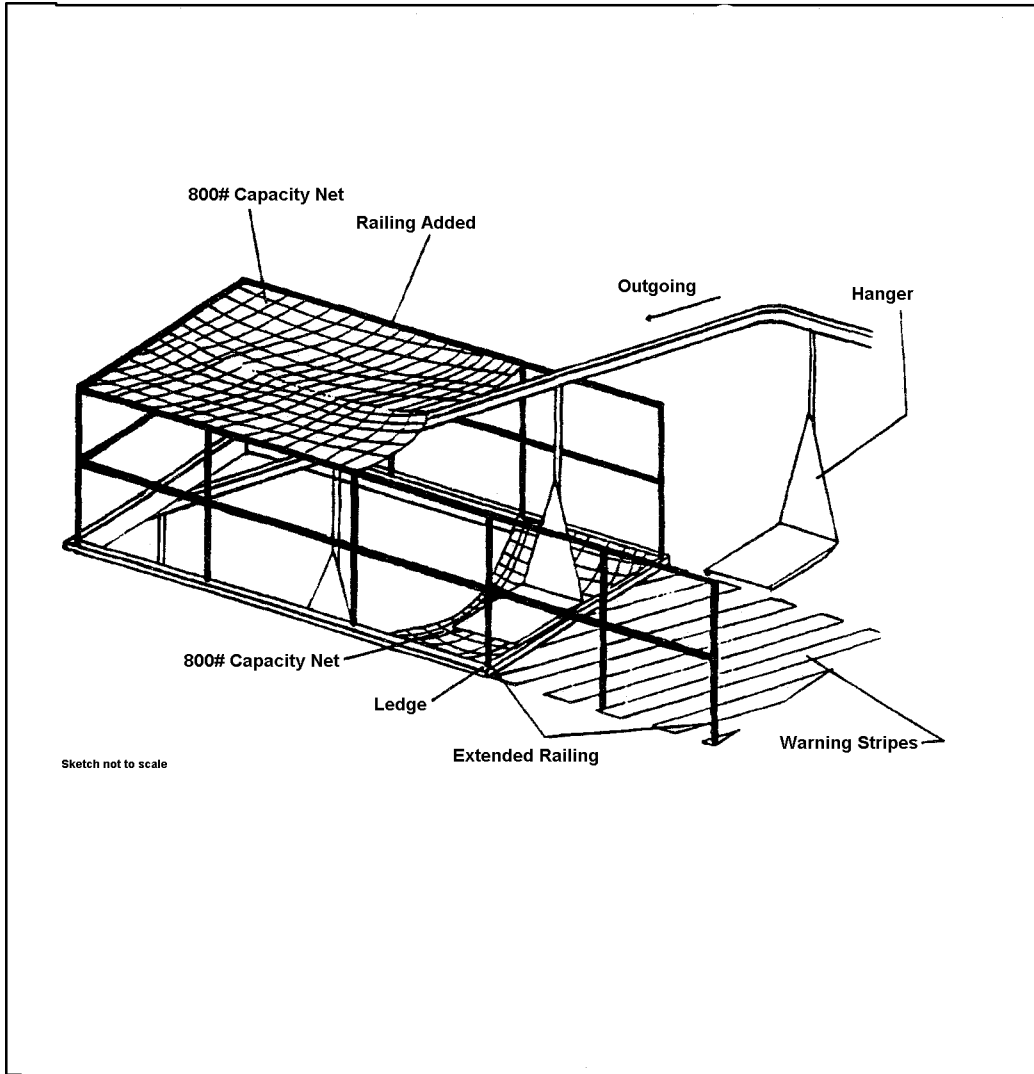


Figure 2. Overhead Conveyor System Floor Opening After Modification by Employer

FACE 95-18: Roofer Falls to Death From Roof--South Carolina

SUMMARY

A 36-year-old male roofer (the victim) died after falling 23 feet from a roof to the ground below, striking his head on a flatbed trailer. The victim, a company co-owner, and a laborer were re-roofing a private residence. The men had stripped the old shingles from the lower roof section and installed the roofing felt and two parallel lines of 2-inch by 4-inch toeboards along most of the length of the roof. The men then began to carry the bundles of shingles to the peak of the roof. The victim climbed the roof to the top line of toeboard and walked the toeboard toward the end of the roof away from the upper roof. As the victim approached the end of the toeboard line, a 6-foot section of the toeboard broke off, causing the victim to tumble and fall off the roof. The victim fell to the ground, striking his head on the flatbed trailer. The men climbed down the ladder to assist the victim, but due to the severity of his injuries, no first aid was administered. The emergency medical service (EMS) was summoned from the residence and responded within 10 minutes, along with the police and coroner. The coroner pronounced the victim dead at the scene. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *provide adequate fall protection to employees that are exposed to fall hazards*
- *develop, implement, and enforce a comprehensive written safety program.*

INTRODUCTION

On August 3, 1995, a 36-year-old male roofer (the victim) died after falling 23 feet from a roof to the ground, striking his head on a flatbed trailer. On September 1, 1995, officials of the South Carolina Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On September 11, 1995, a DSR safety specialist conducted an investigation of the incident. The incident was reviewed with the employer, the coroner, and the SCOSHA compliance officer. Photographs of the incident site immediately following the incident were reviewed and the coroner's report was obtained.

The employer was a roofing contractor that had been in operation for 11 years and employed the 2 owners (including the victim) and a roofer on an as-needed basis. The company had no written safety policy, safety program, safety procedures, or training. This was the first fatality experienced by the employer.

INVESTIGATION

The company had been contracted to re-roof a private residence. A crew consisting of the 2 co-owners (including the victim) and a laborer that worked on an as-needed basis were performing the work. The portion of the roof on which the crew was working was 20-feet long and 35 1/2-feet high, with gabled-ended eaves approximately 12 1/2-feet above the ground. The roof had a 12:12 pitch. The men accessed the work area by means of a 20-foot-long step ladder. A flatbed trailer had been placed at the front side of the house to catch and haul the old shingles.

The men had been at the site for 2 days and had removed the old shingles on the front side of the roof, applied the roofing felt, and had installed two rows of 2-inch by 4-inch toeboards along the 20-foot length of the roof. The first line of toeboard was installed 5 1/2-feet up from the roof eave. The second line of toeboard was installed 6 1/2-feet above the first.

On the morning of the incident, the three men were carrying the bundles of shingles to the peak of the roof. The victim carried a bundle of shingles up the ladder on his shoulder and climbed the roof to the top line of toeboard. He then walked out along the toeboard away from the upper roof. As the victim approached the end of the toeboard, a 6-foot-long section of the toeboard broke off, causing the victim to lose his balance and fall off the roof. The victim fell to the ground, striking his head on the flatbed trailer. The men climbed down the ladder to assist the victim, but due to the severity of the victim's injuries, no first aid was administered. The emergency medical service (EMS) was summoned from the residence and responded within 10 minutes, along with the police department and the coroner. The victim was pronounced dead at the scene by the coroner.

CAUSE OF DEATH

The coroner listed the cause of death as massive head trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide adequate fall protection to employees that are exposed to fall hazards.

Discussion: 29 CFR 1926.501 (b) (1) states that "each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems." In this incident personal fall arrest systems were not available and no form of fall protection was used.

Recommendation #2: Employers should develop, implement, and enforce a comprehensive safety program.

Discussion: The development, implementation, and enforcement of a comprehensive safety program should identify, and reduce or eliminate, worker exposures to hazardous situations. The safety program should include, but not be limited to, employing worksite hazard assessments to enable the recognition and avoidance of fall hazards; and providing, and enforcing, the use of appropriate safety equipment such as safety belts and lanyards, or safety nets.

REFERENCES

29 CFR 1926.501 (b) (1) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 95-19: Sheet Metal Mechanic Dies After Falling 25 Feet Through Roofing Insulation--South Carolina

SUMMARY

A 41-year-old male sheet metal mechanic (the victim) died after stepping backward and falling 25 feet through a roof opening covered only with fiberglass insulation. The victim was a member of a five-man crew that was replacing the old metal roofing panels and insulation on a church roof. The crew would remove three 3-foot by 6-foot metal panels and the underlying insulation, then lay down new insulation and install a new 2-foot by 16-foot panel. The roofer would pull each panel back as the mechanics removed the screws anchoring the panels to the roof. On the second day at the site, the victim had just removed the final two screws on his side of a panel when he stood up and stepped backward. The victim stepped on exposed insulation, lost his balance, and fell between the roof joists to the hardwood church floor below. The foreman went to the parsonage to tell the preacher to call the emergency medical service (EMS), while the other crew members went to aid the victim. The victim was found unconscious, but breathing. The EMS arrived within 10 minutes and transported the victim to the hospital where he was pronounced dead 1 hour later. NIOSH investigators concluded that, to prevent similar incidents, employers should:

- *perform a hazard evaluation at each worksite before any work is initiated*
- *ensure that fall-protection equipment is provided and utilized by employees whenever work is performed from an elevation where the potential for a fall exists*
- *train employees in the recognition of hazards, and methods to control such hazards, including the use of appropriate safety equipment.*

INTRODUCTION

On July 20, 1995, a 41-year-old male sheet metal mechanic (the victim) died after falling 23 feet through roofing insulation and landing on a hardwood floor. On August 22, 1995, officials of the South Carolina Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On September 20, 1995, a DSR safety specialist conducted an investigation of the incident. The incident was reviewed with the employer, the SCOSHA compliance officer, and the county coroner. Photographs of the incident site taken immediately after the incident were viewed during the investigation.

The employer in this incident was a roofing contractor that had been in operation for 22 years and employed 12 workers. The employer had a written safety policy and safety program. General written safety rules were reviewed with all employees upon hire. Training was accomplished on the job. Tailgate safety meetings were conducted by the job foreman when necessary. Safety meetings were held prior to the start of each job to discuss the safety hazards associated with that job. The victim had worked for the employer for 12 years and had 15 years prior experience. This was the first fatality experienced by the employer.

INVESTIGATION

The employer had been contracted to replace the fiberglass insulation and corrugated metal roofing on an 80-foot-wide by 140-foot-long church roof with a 1:12 pitch. A five-man crew (general superintendent,

foreman, roofer, and 2 sheet metal mechanics) was sent to the site to complete the task. The men were to remove a 36-inch width of metal roofing and insulation at a time and replace them with new panels and insulation. This required removing three, 3-foot-wide by 6-foot-long panels and replacing them with the new 20-inch-wide by 16-foot-long panels.

To remove the panels, the roofer would hold the end of the old panels up and pull them back as the sheet metal mechanics removed the screws that attached the panels to the roof joists. Because the men were installing panels smaller in width than those being replaced, open space with exposed insulation existed around the work area.

At 3:00 p.m. on the second day at the site, work had progressed to a point where the men had completed work on an area measuring approximately 25 feet by 115 feet. As the victim finished removing the screws holding the next piece of old roofing, he stood up and stepped backward into an opening approximately 3 feet by 6 feet that was covered only with fiberglass insulation, and fell 23 feet to the hardwood floor inside the church, striking his head. The foreman went to the church parsonage to have the preacher summon the emergency medical service (EMS) while the rest of the crew assisted the victim. The victim was found unconscious but breathing. He was transported to the hospital by the EMS, where he died 1 hour later.

CAUSE OF DEATH

The attending physician listed the cause of death as skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should perform a hazard evaluation at each worksite before any work is initiated.

Discussion: The employer should identify all potential hazards at a worksite. Job hazard analysis consists of analyzing the sequential steps in routine operations to identify potential hazards, and attempting to develop procedures or other control measures which effectively eliminate or reduce the hazards. Each specific job involves hazards particular to that job or working environment. Therefore, employers should conduct a jobsite survey, identify all hazards, and implement appropriate control measures prior to starting a job. A jobsite and/or hazard analysis survey in this instance would have determined that there would be exposed roof openings and a need for some type of fall protection. Both job hazard analysis and pre-job survey techniques can be effectively used to train workers in hazard identification and appropriate control measures.

Recommendation #2: Employers need to ensure that fall-protection equipment is provided and utilized whenever work is performed from an elevation where the potential for a fall exists.

Discussion: The use of a "traditional" safety belt/lanyard combination, as required by 29 CFR 1926.104(d), is sometimes not practical during roofing operations, particularly where worker mobility is required. Use of a retracting lanyard equipped with a locking device and attached to a lifeline, can provide sufficient mobility in some cases. Alternative forms of worker protection, such as safety nets (as specified in 29 CFR 1926.105) or a catch platform, could also be considered.

Recommendation #3: Employers should train employees in the recognition of hazards, and methods to control such hazards, including the use of appropriate safety equipment.

Discussion: Employers are required by 29 CFR 1926.21 (b)(2) to instruct each employee in the recognition and avoidance of unsafe conditions, and to control or eliminate any hazards or other exposures to illness or injury. Employers need to provide training that ensures that employees understand existing hazards and how to properly use personal protective equipment to protect themselves.

REFERENCES

29 CFR 1926.104 (d) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

29 CFR 1926.105 Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

29 CFR 1926.21 (b)(2) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 96-01: Sign Installer Dies After Falling 12 Feet From A Canopy--Tennessee

SUMMARY

A 22-year-old male sign installer (the victim) died after falling from a canopy located above a loading dock, and striking his head on the bed of a truck crane. The victim and a co-worker had been assigned to remove four wooden signs above a loading dock at a food distribution warehouse. The two workers had removed three signs and were in the process of removing the fourth sign when the incident occurred. While attempting to remove the fourth sign, the victim was standing on a canopy which was about 15 feet above the ground and was not using any personal protective equipment (Note: a safety belt and lanyard were available in the truck crane). The co-worker positioned the truck crane beneath the canopy where the sign was located and extended the boom above the sign. The victim attached the crane's load line around one of the metal brackets which secured the sign to the building. He then removed five lag screws which secured the sign to the building. As he removed the fifth screw the sign swung free. At that time the lag screw which attached the metal bracket to the wooden sign frame pulled out of the wood. The sign dropped and struck a diagonal canopy pipe support. The sign then slid down the support and struck the victim, knocking him off the canopy. The victim fell about 12 feet and struck his head on the corner of the truck bed. The co-worker, who witnessed the event, ran to aid the victim. He found the victim unresponsive and bleeding profusely. The co-worker then ran inside the warehouse and contacted the warehouse manager, who returned to the incident scene with the co-worker and performed cardiopulmonary resuscitation (CPR) on the victim. In the interim, a passerby in a vehicle equipped with a cellular telephone saw the incident and called 911. An emergency rescue squad arrived in less than 10 minutes, continued CPR, and transported the victim to the local hospital. The victim was removed from life support the following day and died from injuries sustained in the fall. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *prepare a hazard analysis of each activity involving the installation and/or removal of signs and implement measures to control these hazards*
- *review and revise, where applicable, the existing written safety program*
- *routinely conduct scheduled and unscheduled workplace safety inspections*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On September 11, 1995, a 22-year-old male sign installer (the victim) died from injuries he received in a 12-foot fall from a canopy. On September 13, 1995, officials of the Tennessee Occupational Safety and Health Administration (TOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On October 18, 1995, a DSR safety and occupational health specialist conducted an investigation of this incident. The incident was reviewed with the employer and TOSHA compliance officer assigned to the case. The sheriff's report and photographs of the incident site and equipment were obtained during the investigation.

The employer manufactured, installed, and maintained lighted exterior signs. The employer had been in business for 30 years and employed 14 workers, six of whom were sign installers. The employer had a

written general safety program that addressed safety procedures for manufacturing workers, but no specific written safety procedures for field workers, which included sign installers. Safety meetings were held on an irregular basis. The victim had worked for the employer for 5 months prior to the incident. This was the first fatality experienced by the employer.

INVESTIGATION

The employer had been contracted to remove four wooden signs attached to the exterior of a food distribution warehouse. The signs would eventually be replaced with new lighted signs. The warehouse was multi-storied, constructed of concrete, and had 14 loading docks. The signs were located on the exterior of the warehouse above a metal 3-foot wide canopy, which extended over the loading docks about 15 feet above ground level. The signs were 8 feet wide by 16 feet long by 2 inches thick and constructed on 2 inch by 4 inch wood frames with 4 feet by 8 feet plywood panels. Each sign was estimated to weigh about 250 lbs. The signs were secured to the warehouse with five 1/4-inch by 2 1/2-inch-long lag screws and metal "L" shaped brackets. The screws were screwed through the "L"-shaped metal brackets into the sign's wooden frame and into the warehouse's concrete exterior.

On the day of the incident, the victim and a co-worker arrived at work and were instructed to proceed to a food distribution warehouse to remove four wooden signs and bring the signs back to the shop. The two workers arrived at the jobsite about 8:30 a.m., and commenced work. They removed two signs without incident. In removing the third sign, the sign reportedly broke into pieces, due to wood deterioration, while it was being lowered to the ground via the truck crane. In attempting to remove the fourth sign, the victim positioned himself on a canopy (Figure) above loading dock number 13 and did not use any personal protective equipment. The canopy was 3 feet wide, 2 to 3 feet below the sign, and about 15 feet above ground level. The co-worker moved the truck crane into position below the sign, extended the boom tip above the sign, and lowered the boom cable down to the top of the sign. The victim secured the boom cable around a corner metal AL@ bracket on the sign and the co-worker took up the slack in the boom cable. The victim then removed the five lag screws. When the last screw was removed, the sign swung free of the building. The weight and deteriorated condition of the wooden frame caused the screw to pull out of the wooden sign frame, allowing the sign to drop. As it dropped, the sign struck a metal pipe canopy support which was at a 45-degree angle to the canopy and warehouse wall. The sign then slid down the support and outward toward the victim, striking him and knocking him off the canopy. The victim fell about 12 feet and struck his head on the corner of the truck bed. The co-worker, who witnessed the event, ran to aid the victim. He found the victim unresponsive and bleeding profusely. The co-worker then ran inside the warehouse and contacted the warehouse manager, who returned to the incident scene with the co-worker and performed cardiopulmonary resuscitation on the victim. In the interim, a passerby in a vehicle equipped with a cellular telephone saw the incident and called 911. An emergency rescue squad arrived in less than 10 minutes, continued CPR, and transported the victim to the local hospital. The victim was removed from life support the following day and died from injuries sustained in the fall.

CAUSE OF DEATH

The official cause of death was listed as severe brain stem trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should conduct job hazard analysis of each activity involving the installation and/or removal of signs and implement measures to control these hazards.

Discussion: As sign installation and/or removal tasks vary widely from location to location, a job-hazards analysis and subsequent implementation of control measures should be performed prior to the commencement of any work task. A proper hazard analysis involves three distinct steps: (1) outlining each step of a task or activity, (2) identifying all potential hazards associated with each step, and (3) developing measures for controlling each hazard. If a hazard analysis had been performed, the employer may have identified the dangers associated with working from an elevated work surface and the deteriorated condition of the sign, and could have subsequently taken measures to prevent this incident (e.g., ensure the use of safety belts and lanyards by employees who work from elevated work surfaces).

Recommendation #2: Employers should review and revise, where applicable, the existing written safety program.

Discussion: Although the employer had a written safety program, the program did not address safety procedures regarding work performed by field personnel, which included sign installers. The implementation and enforcement of a written comprehensive safety program should reduce and/or eliminate worker exposures to hazardous situations. The safety program should include, but not be limited to, the recognition and avoidance of fall hazards, and the use of appropriate safety equipment such as safety belts and harnesses. Note: A safety belt and harness was available on the truck crane, but was not used by the victim, possibly due to the unrecognized hazard of falling or being knocked off the canopy. Also, the employer is working with TOSHA to design and implement a comprehensive written safety program that encompasses all employees.

Recommendation #3: Employers should routinely conduct scheduled and unscheduled workplace safety inspections.

Discussion: Employers should be cognizant of the hazardous conditions at jobsites and take an active role to eliminate them. Additionally, scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that jobsites are free of hazardous conditions. Even though these inspections do not guarantee the elimination of occupational injury, they do demonstrate the employer's commitment to the enforcement of the safety program and to the prevention of occupational injury.

Recommendation #4: Employers should encourage workers to actively participate in workplace safety.

Discussion: Employers should encourage all workers to actively participate in workplace safety and ensure that all workers understand the role they play in the prevention of occupational injury. In this instance, the victim was working from an elevated work surface without the use of personal protective equipment. Workers and co-workers should look out for one another's safety and remind each other of the proper way to perform their tasks. Employers must instruct workers of their responsibility to participate in making the workplace safer. Increased worker participation will aid in the prevention of occupational injury.

¹Competent person: One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

Side view

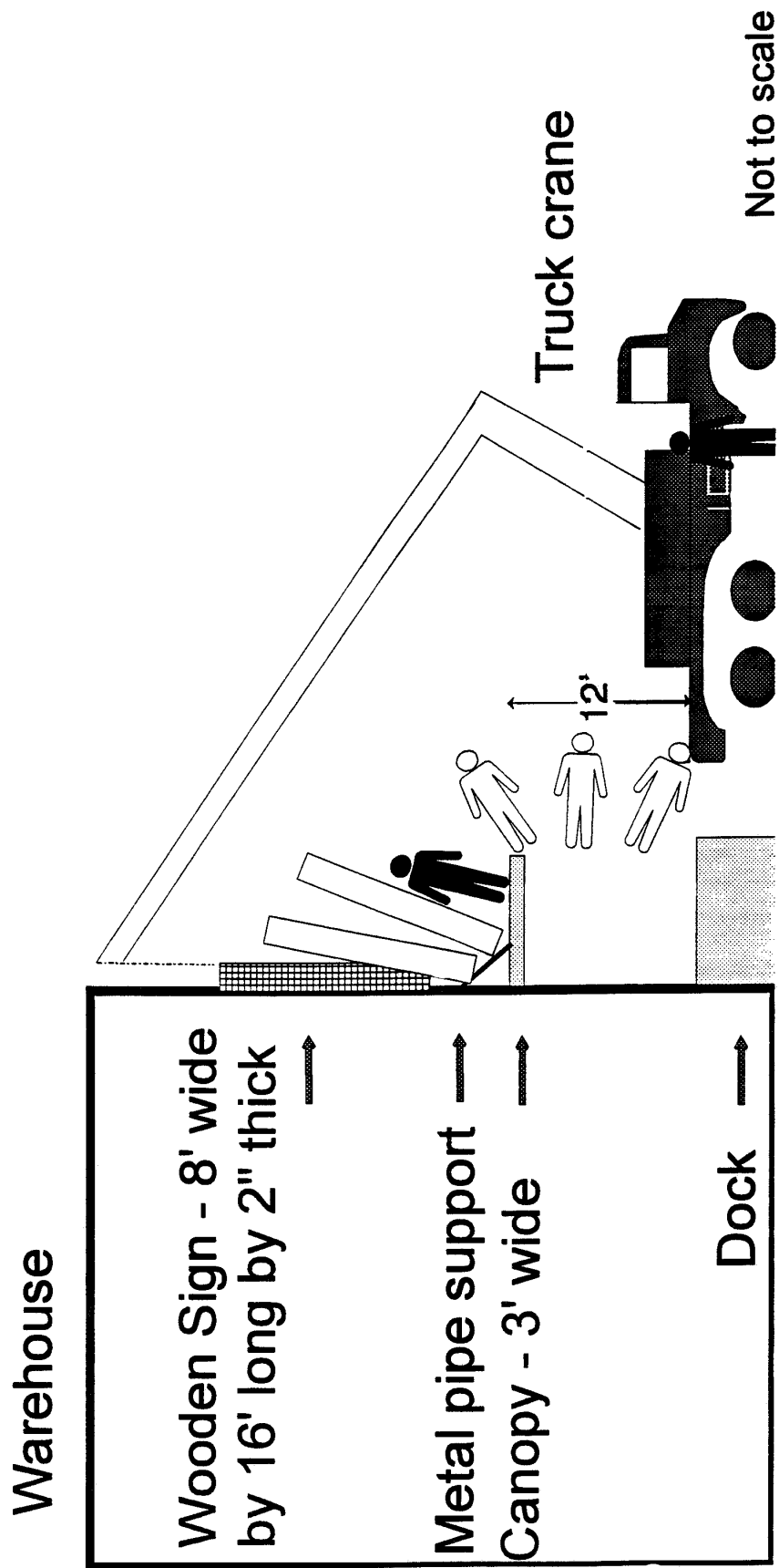


Figure. Victim's Position on Canopy

FACE 96-05: Electrician Dies Following a 60-foot Fall Through a Roof--Virginia

SUMMARY

A 21-year-old male electrician (the victim) died of injuries received after falling 60 feet through a roof. The victim and his apprentice co-worker were dispatched to a locomotive repair building to repair electrical equipment located on the roof of the building. The two workers arrived at the jobsite about 1 p.m. and proceeded to the roof of the locomotive repair building. Once on the roof, the victim reportedly told the co-worker to follow in his foot steps since there were numerous, barely distinguishable fiberglass roof panels located on the roof top. The victim walked down the slightly pitched roof to the ventilator where electrical work was to be performed. The victim then walked around to the opposite side of the ventilator and unintentionally stepped on a corrugated fiberglass roof panel. The roof panel broke, causing the victim to fall through the roof and strike the concrete floor, 60 feet below. Two other employees, who were installing lighting fixtures inside the building, saw the victim fall through the air and strike the concrete floor. One worker rushed to the victim's aid and checked for vital signs while the other worker called 911 for assistance. Cardiopulmonary resuscitation was performed by the worker until paramedics arrived. A medical evacuation helicopter arrived about 15 minutes after being called and transported the critically injured victim to a local hospital. The victim was pronounced brain dead about 43 hours after the incident occurred. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing and avoiding hazards in the workplace. These procedures should include, but not be limited to, conducting hazard evaluations before initiating work at a jobsite and implementing appropriate controls*
- *owners of buildings should evaluate and identify areas that may be hazardous to any personnel, including contractors, and prohibit access to these areas, or eliminate the hazard prior to access.*

INTRODUCTION

On October 25, 1995, a 21-year-old male electrician (the victim) died after falling 60 feet through a roof. On October 30, 1995, officials of the Virginia Occupational Safety and Health Administration (VOSH) notified the Division of Safety Research (DSR) of this fatality and requested technical assistance. On December 14, 1995, a safety specialist from DSR investigated the incident and reviewed the circumstances with the company owner, a manager at the locomotive repair building, and the VOSH compliance officer assigned to the case. Photographs of the incident site were obtained and the medical examiners report was reviewed.

The employer in this incident was an electrical contractor that had been in operation for 22 1/2 years and employed 12 workers, 4 of whom were electricians. The employer had a written general safety program and on-job-training was provided to all employees. Electricians were responsible for the enforcement of the safety program and they also conducted tail-gate safety meetings. The victim worked for the company for 5 years and 2 months prior to the incident. This was the first fatality the company had experienced.

INVESTIGATION

One of the employer's current contracts was to perform various electrical installation and repair services at a locomotive repair building. The contract had been ongoing for several years. The locomotive repair

building was about 700-feet long by 170-feet wide by 80-feet high and was constructed in 1969. The roofing materials consisted mainly of corrugated metal panels with corrugated fiberglass panels interspersed into the roof at irregular intervals. Metal panels have structural integrity to support weight, whereas fiberglass panels do not. The corrugated fiberglass roof panels comprised at least 10 percent of all the roof panels and were faded/bleached from exposure to the weather thus looked similar to the metal panels. Additionally, 24 ventilators equipped with electric motors were located on the roof in a single line at the north end of the building.

On the day of the incident, the victim and his apprentice co-worker were assigned a job at a different location from where the incident occurred. Early in the afternoon the victim and co-worker were dispatched to the locomotive repair building to repair damages to an electric motor and wiring at one of the ventilators. The motor and wiring had been damaged in a fire the previous week. The two workers arrived at the building about 1 p.m. and climbed a fixed ladder on the outside of the building to the roof top. Once on the roof, the victim reportedly told the co-worker to follow in his footsteps, since there were numerous fiberglass roof panels all over the roof top. The two workers proceeded down the roof (pitch about 4:12) toward the damaged ventilator motor. Once at the ventilator the victim proceeded to the opposite side of the ventilator while the co-worker remained stationary. As the victim stepped around the ventilator and out of sight of the co-worker, he unintentionally stepped on a corrugated fiberglass roof panel. The panel broke and the victim fell through the roof to a concrete floor, 60 feet below. Two other company employees, who were installing lighting fixtures inside the building, saw the victim fall through the air and strike the concrete floor. One worker rushed to the victim's aid and checked for vital signs while the other worker called 911 for assistance. Cardiopulmonary resuscitation was performed by one worker until paramedics arrived about 10 minutes after being called. A medical evacuation helicopter was summoned and arrived about 15 minutes later and transported the critically injured victim to a local hospital. The victim was pronounced brain dead about 43 hours after the incident occurred.

CAUSE OF DEATH

The medical examiner's report listed the cause of death as blunt-force head trauma.

RECOMMENDATIONS/DISCUSSION

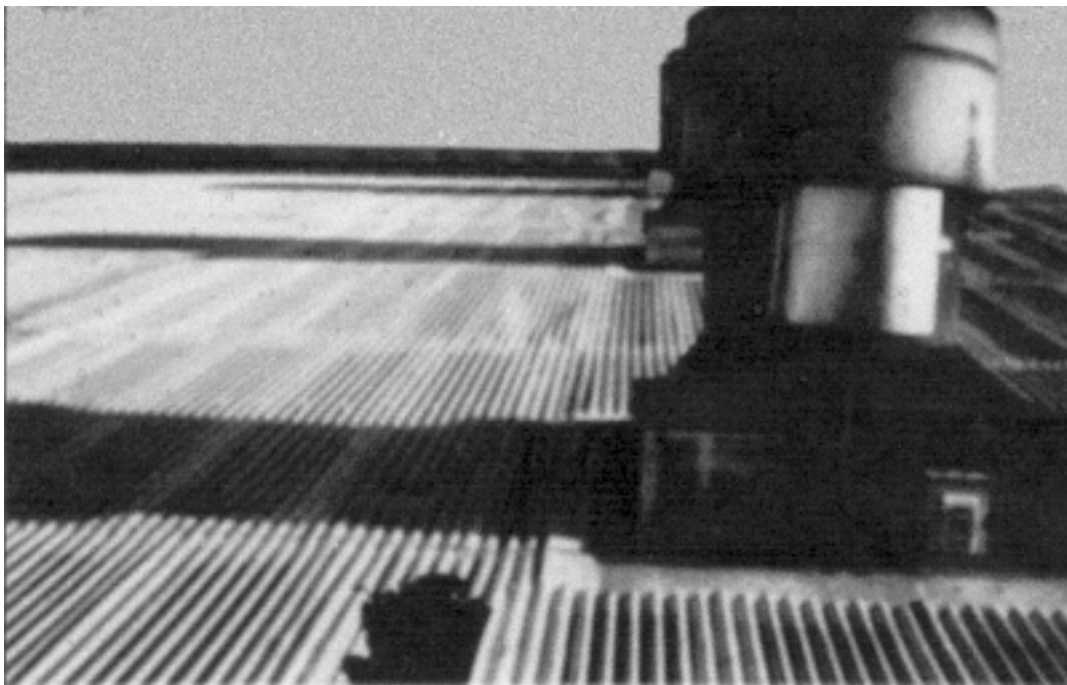
Recommendation #1: Employers should evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing and avoiding hazards in the workplace. These procedures should include, but not be limited to, conducting hazard evaluations before initiating work at a jobsite, and implementing appropriate controls.

Discussion: The existence of a safety program is only the first step in obtaining a viable safety record. In addition to enforcement, safety programs should be evaluated and training procedures incorporated which emphasize the importance of recognizing and avoiding hazards in the workplace, following established safe work procedures, and wearing appropriate personal protective equipment. Before starting any work at a jobsite, the employer or employer's representative should identify, by observation and by collaboration with the jobsite owner, any potential or existing hazards. These hazards should be reviewed with the work crew, and methods to control the hazards and how to perform the work safely should be discussed. In this instance, the numerous irregularly spaced weathered corrugated-fiberglass roof panels could have been identified as a potential hazard because of their minimum load rating, proximity to the working area, and the visual similarity to the corrugated metal roof panels. The hazard of the corrugated fiberglass roof panels,

although recognized by the victim, was not dealt with in an effective manner. Workers could have been instructed not to access the roof area until arrangements for safe access could be provided. Since the ventilators were all located in a single line across one end of the building, a walkway could have been constructed over the panels up to and around the ventilators for maintenance and repair. Alternatively, the corrugated fiberglass roof panels to and around the access area could have been replaced with metal corrugated panels, thus providing a stable walking/working surface, or a designated walkway marked with paint and protected by stanchions and handrails could have been installed.

Recommendation #2: Owners of buildings should evaluate and identify areas (e.g., roofs) that may be hazardous to any personnel, including contractors, and prohibit access to these areas, or eliminate the hazard prior to access.

Discussion: In 1969 metal and fiberglass corrugated roof panels were used in the construction of the roof of the locomotive repair building. Additionally, 26 ventilators equipped with electrical motors were installed on the roof, on one end of the building, to ventilate exhaust fumes from the locomotives. The fiberglass panels accounted for about 10% of all panels and were irregularly spaced among the metal panels. Also, the fiberglass panels were faded, due to weathering, and resembled the metal panels in appearance. These conditions should have been evaluated and appropriate action to mitigate the hazards should have been taken before access to the roof area was permitted.



↑
Broken Fiberglass Panel

Figure. Roof with Metal and Fiberglass Corrugated Panels and Ventilators

FACE 96-21: Temporary Employee Falls Through Coliseum Roof--Virginia

SUMMARY

On June 27, 1996, a 27-year-old laborer (the victim) was fatally injured when he fell through an unguarded roof opening while repairing the rubber roof membrane of a college sports coliseum. The victim and his foreman were repairing the membrane after it had been sliced open to provide access to the underlying roof structure. The victim had been cleaning the existing membrane while his foreman, working behind him, was completing the patch. The victim had progressed to the peak of the arched roof, out of sight of the foreman, and had disconnected his fall protection lanyard from the lifelines. For an unknown reason, the victim stepped on an exposed ceiling tile which gave way, allowing the victim to fall 90 feet to the gym floor. Workers inside the gym saw the victim fall and hit the floor. One of the workers, an EMT, immediately went to the victim and began CPR while another worker notified 911. The campus emergency medical squad (EMS) responded within 8 minutes and transported the victim to a local emergency room, where he was pronounced dead. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *ensure that appropriate fall protection equipment is available and correctly used when working from elevations where there is a danger of falling*
- *consider alternative methods of providing fall protection, such as overhead life line tie-off points.*

INTRODUCTION

On June 27, 1996, a 27-year-old laborer for a roofing company died of injuries sustained when he fell through the roof of a sports coliseum. On July 2, 1996, officials of the Virginia Occupational Safety and Health Administration (VAOSHA) notified the Division of Safety Research (DSR) of the incident and requested technical assistance. On July 30, 1996, a DSR safety engineer and a DSR general engineer reviewed the incident with the VAOSHA compliance officer. On July 31, 1996, the engineers visited the incident site and interviewed the prime contractor's safety director and the roofing contractor's foreman. Photographs of the incident site were taken.

The prime contractor had been in business for about 40 years, employing 75 to 100 employees depending on industry demand. The victim's employer was a roofing company which had been sub-contracted to perform roof maintenance and repair related to the structural modification of the existing coliseum structure. Roof repair work on this jobsite required a crew of two, a foreman and a laborer. The foreman had 11 years experience in the roofing trades. The victim, a temporary employee, had started work the day before the incident. Site safety was controlled by the general contractor who employed a full-time safety coordinator. The general contractor had a written safety policy and written site-specific procedures. These procedures were comprehensive and included fall protection standards. Weekly safety meetings were conducted on site for all workers on the project.

INVESTIGATION

The incident occurred on a college campus where a project was underway to strengthen the roof structure of an arch-shaped sports coliseum 262 feet long, 241 feet wide, and 91 feet high. A construction contractor had been hired by the school to install additional steel purlins to the roof structure. As originally constructed,

purlins had been installed on roughly 8-foot centers. The contractor was adding steel purlins between the existing purlins, essentially reducing the spacing to 4-foot centers. The structure had a "built-up" roof consisting of ceiling tile roughly 2 inches thick, plywood sheets, asbestos insulation, and a rubber membrane. To install the additional purlins, it was necessary to open access holes at each arch location where the purlins were to be secured. Preparatory to this, the rubber membrane was sliced from the eaves of the roof to the peak, and folded back, exposing the built-up roof structure underneath. Just before lowering a purlin through the roof, the ceiling tile was removed. Once this was done, the purlin was lifted by crane, and placed end wise into the structure and lowered to either the floor or bleachers depending on the location. A lifting beam with an air tugger at each end was then attached to the crane's load line. The winch lines from each air tugger were fed through the roof access holes, and the tuggers were used to lift and hold the purlin while it was clamped in place. Once this was done, the roof was replaced, with the final step being the repair of the rubber membrane by gluing a strip of rubber over the slice. The access holes were temporarily covered by sheets of plywood and marked by orange paint on the surface of the roof. Protection was required to be worn by all workers on the roof. All workers on the roof were required to wear full-body harnesses with shock absorbing lanyards and rope grabs. Tie-off points were provided by 3/8 inch wire ropes, strung lengthwise along the surface of the roof, at 40 and 80 feet from the eaves. A third rope was secured around the perimeter of the air-handler ducts mounted at the peak of the roof. Nylon life lines, size-matched to the lanyard's rope grabs, were dropped at various locations for the workers to tie off from.

On the day of the incident, the victim and the roofing foreman had spent the morning patching slices. After lunch, they were preparing to repair another slice. They were working together at the bottom of the slice. The victim was using a roller and solvent to clean the membrane while the foreman was readying the membrane patch and beginning to apply the adhesive. The victim, wearing fall protection, worked his way towards the peak of the roof while the foreman's work kept him occupied near the bottom of the slice. Shortly before 1:30 p.m., the victim had progressed to the peak, between 80 and 90 feet from the eaves, and was out of sight of the foreman. The victim disconnected his lanyard from the lifeline and his harness. At 1:30 p.m., workers inside the coliseum heard a noise near the ceiling, and observed the victim fall and hit the floor. One worker who was a trained EMT immediately went to the victim and began CPR while another worker contacted 911. The campus EMS responded to the scene in 8 minutes and transported the victim to the local emergency room where he was pronounced dead.

CAUSE OF DEATH

The medical examiner's report established the cause of death as head trauma with probable aortic rupture.

RECOMMENDATIONS

Recommendation #1: Employers should ensure that appropriate fall protection equipment is available and correctly used when working from elevations where there is danger of falling.

Discussion: The victim had been provided with appropriate fall protection equipment, a new harness and shock absorbing lanyard with rope grab. Additionally, the prime contractor had provided sufficient life lines to tie off to and the victim had been properly instructed in the use of the equipment. However, once the victim had made his way to the peak of the roof he disconnected from the life line and removed the lanyard from his harness. It could not be determined why he did this. The roof was essentially flat in the area of the incident, he was not near the edge of the roof, and the openings were marked. Although he had

received instruction the day before, he may have not fully comprehended the necessity to use fall protection at all times when on the roof. The proper use of fall protection equipment must be continually emphasized.

Recommendation #2: Employers should consider alternative methods of providing fall protection, such as overhead life line tie-off points.

Discussion: It could not be determined why the victim disconnected his lanyard from the lifeline or why he disconnected the lanyard from the harness. It is possible that once he reached the peak of the roof, he did not feel the need for fall protection, since the peak was essentially level so he disconnected from the lifeline. Also, during discussions with the foreman, it was learned that it was not unusual for employees to disconnect from lifelines after reaching the top of the roof, since the lifelines were rigged on the surface of the roof, and the lanyards dragging around the workers were cumbersome and made it difficult to work. After disconnecting he would have had to carry the lanyard with rope grab attached. To do this, he may have pulled the lanyard through the straps of the harness, allowing the slack to hang down from his waist. Walking with the lanyard in this manner, would have allowed the rope grab to bang against his leg. This may have been enough of an annoyance that he disconnected the lanyard from the harness and laid it on the air handler duct. It may be possible to alleviate the annoyance of dragging lanyards by suspending them from overhead lifelines.

FACE 97-08: Carpenter's Helper Dies After 120-Foot Fall From an Un-protected Floor Edge of an Atrium--South Carolina

SUMMARY

A 22-year-old male carpenter's helper (the victim) died of injuries he received after crawling from an unprotected floor edge onto an unsecured piece of plywood and falling 120 feet to the ground. At the time of the incident, concrete forming work had been completed on 12 floors of a condominium under construction. The victim was part of a crew removing form materials (plywood, etc.) and was assigned to work on the 10th floor. The victim had been on the 12th floor obtaining a safety harness and was en route to the 10th floor via a personnel hoist when he stopped the hoist and exited at the 11th floor. A co-worker from the floor above had yelled down to the victim, asking him to plug in an extension cord that was hanging from the 12th to the 11th floor. He crawled under a red tape warning line at the floor edge of the atrium onto a piece of unsecured plywood. The plywood gave way and the victim fell 120 feet to the ground. The local emergency medical service responded in less than 10 minutes, but the victim was pronounced dead at the scene. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *implement 29 CFR 1926.501(b)(1), which requires that all walking/working surfaces with an unprotected side or edge which is 6 feet or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems*
- *develop and implement a comprehensive written safety program*
- *address worker safety issues in the planning phase of construction projects.*

Additionally, prime contractors should:

- *utilize contract language that requires subcontractors to implement a site-specific safety and health program prior to the initiation of work.*

INTRODUCTION

On March 23, 1997, a 22-year-old male carpenter's helper (the victim) died of injuries he received after falling 120 feet from an unprotected floor edge. On April 14, 1997, officials of the South Carolina Occupational Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On June 10, 1997, a safety specialist from DSR investigated the incident and reviewed the circumstances with the employer and officials of SCOSHA. Photographs of the incident scene and witness statements were also reviewed.

The employer in this incident was a concrete forming company which had been in business for 15 years and had 15 employees. The employer had been contracted to supply the concrete forming work for the construction of a 12-story condominium. The employer did not have a written safety and health program, but bi-weekly safety meetings were held by the employer. Also, the owner was the designated safety officer. The victim had worked for the employer for 9 days. This is the first fatality experienced by the employer.

INVESTIGATION

The employer had been subcontracted to do the concrete forming work for the construction of a 12-story condominium. At the time of the incident, the employer had been at the construction site for 42 months. The concrete pillars and floors had been completed and the employer was in the process of removing the wooden forms. On Sunday, the day of the incident, two crews were directed to work on different levels of the condominium. The crew the victim was assigned to was going to remove forming materials (plywood, 2x4's, 2x6's, etc.) and perform cleanup duties on the 10th floor. Although the crew was assigned to work on the 10th floor, the employees could retrieve safety harnesses from either a box on the ground or from a location on the 12th floor.

At about 7:30 a.m. the employees were reporting to their assigned work locations. The victim traveled to the 12th floor and was observed obtaining a safety harness. He then rode the personnel hoist down to the 11th floor where he exited. A co-worker located on the 12th floor yelled down to the victim to plug in the extension cord that was hanging from the 12th to the 11th floor. The victim was observed crawling under a red warning tape that had been placed around the atrium floor edge on the 11th floor. The cracking of plywood was heard and before the victim could be alerted to the danger, the plywood and victim fell to the ground 120 feet below (see Figure). **Note: A warning line which consisted of red danger tape and manila rope tied to rebar strung along the atrium floor edge was being used in lieu of a guardrail system at the time of the incident.**

CAUSE OF DEATH

The coroner listed the cause of death as closed head trauma-skull fracture.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should implement 29 CFR 1926.501 (b)(1), which requires that all walking/working surfaces with an unprotected side or edge which is 6 feet or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.

Discussion: A warning line which consisted of a red danger tape and manila rope tied to rebar strung along the atrium floor edge was being used in lieu of a guard rail system at the time of the incident. The warning line being used was not adequate in that it had been installed at the floor edge of the atrium. The use of a guardrail system, safety net system, or personal fall arrest system may have prevented this incident.

Recommendation #2: Employers should develop and implement a comprehensive written safety program.

Discussion: Employers should develop and implement a comprehensive written safety program which includes, but is not limited to, the proper use of fall protection equipment, and the recognition and control of fall hazards. Development, implementation, and enforcement of a written safety program and the establishment of standard safety practices will demonstrate to workers the employer's commitment to safety.

Recommendation #3: Employers should address worker safety in the planning phase of construction projects.

Discussion: Safety concerns should be addressed and incorporated into all construction projects during the planning phase and throughout the entire project. Such a procedure would allow for the identification of potential hazards prior to the initiation of work so that appropriate intervention strategies could be implemented.

Recommendation #4: Prime contractors should utilize contract language that requires subcontractors to implement a site-specific safety and health program prior to the initiation of work.

Discussion: Prime contractors should use contract language that requires all subcontractors to identify how they intend to implement a site-specific safety and health program prior to the initiation of work. Subcontractors' safety programs should be consistent and compatible with the prime contractor's safety program. The contract should contain clear and concise language as to which party is responsible for a given safety or health issue. Any differences should be negotiated before work begins. Once the provisions for these responsibilities have been established, the respective parties should ensure that the provisions of the contract regarding safety and health are upheld.

REFERENCES

Office of the Federal Register: Code of Federal Regulations, Labor 29 Part 1926.501 (b)(1), July 1, 1995.

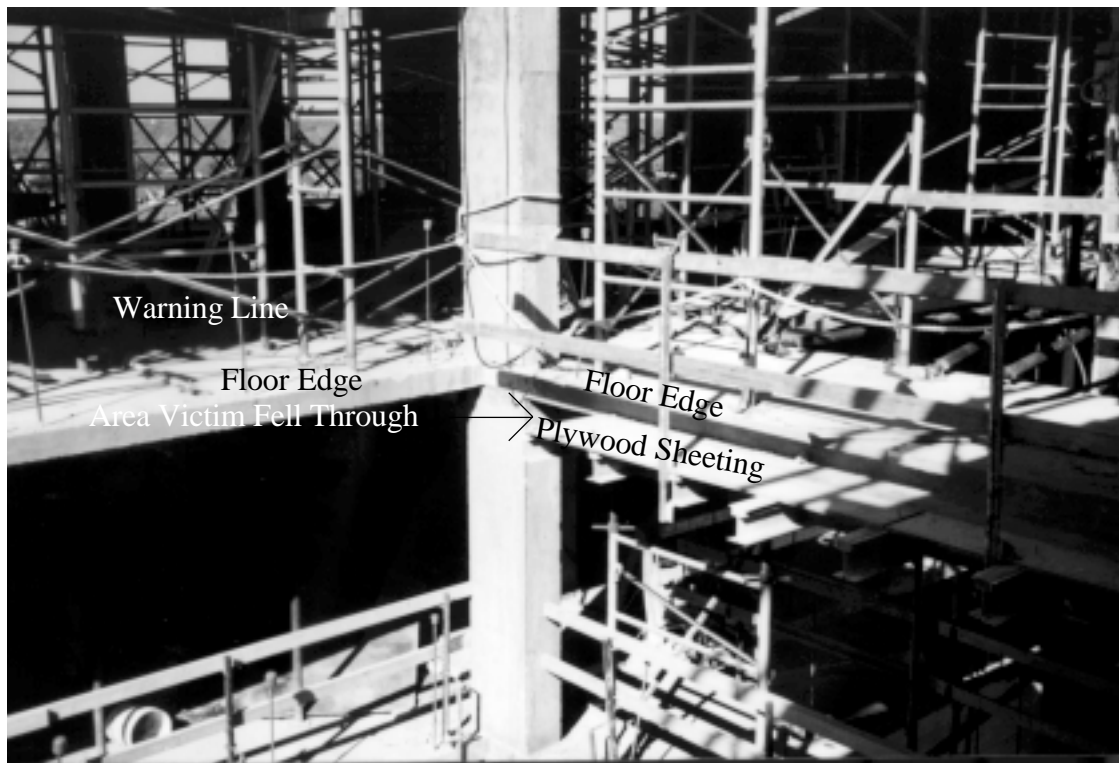


Figure. Atrium Floor Area

FACE 97-10: Tower Erector/Inspector Dies after Falling 200 Feet from a Telecommunications Tower to the Ground -- North Carolina

SUMMARY

On May 15, 1997, a 38-year-old male tower erector/inspector (the victim) died as a result of injuries sustained in a 200-foot fall from a telecommunications tower. The incident occurred while the victim and a co-worker were connecting antenna-support brackets onto a leg of the tower. The victim apparently disconnected or was attempting to re-connect his fall protection and was climbing down the leg of the tower from 220 feet to 200 feet when he fell to the ground. The victim was pronounced dead at the scene by rescue personnel. NIOSH investigators determined that to prevent similar occurrences, employers should:

- *enforce existing safety programs, policies and procedures at all times*
- *thoroughly plan all work and perform a job hazard analysis of the site prior to starting work to ensure employees' knowledge of the use of new tools or new tasks*
- *provide a system or method of fall protection that protects employees at all times when working at elevations*
- *ensure that fall protection equipment is appropriate and maintained in good condition.*

INTRODUCTION

On May 15, 1997, a 38-year-old male tower erector/inspector (the victim) died as a result of injuries sustained in a 200-foot fall from a telecommunications tower. On May 21, 1997, officials of the North Carolina Occupational Safety and Health Administration (NCOSHA) notified the Division of Safety Research (DSR) of this incident, and requested technical assistance. On June 11, 1997, a DSR safety engineer and safety specialist met with the NCOSHA compliance officer and the company owner, and examined equipment similar to that involved in the incident. Additional information was obtained from the NCOSHA file, co-worker witness statements, and the sheriff's report. The site was photographed during the investigation.

The employer was a construction contractor who specialized in tower erection. The company has been in business since 1994 and employed 27 workers, several of whom were "tower hands" who worked aloft regularly. The company had a safety program and written safety procedures. Employee training for climbing and welding appeared to be gained on the job and through tailgate meetings. Safety topics covered at the meetings included rigging safety, climbing safety, and first aid. Although the victim had worked for this company as a tower erector/inspector for only 1 year, he had previously worked as a tower erector for another company. This was the first fatality experienced by the employer.

INVESTIGATION

The victim was a member of a five-man crew, 2 senior tower erector/inspectors, a junior tower erector/inspector, a welder, and a supervisor, erecting a 300-foot communications tower (Figure 1). The crew had been on site for 3 days, and were using a "jin" pole secured on the interior of the three-faced tower, and a winch truck to lift the tower components into place. A "jin" pole is a pulley-oriented lifting device used

to position various equipment into place. Each 20-foot tower section (Figure 1a - enlarged) consisted of 3 legs installed in a triangular configuration. The legs were connected to the preceding 20-foot section using 4 bolts, one in each corner of the overlaying plates. Two cross members were then installed diagonally between the 2 legs on each side to complete the 3 tower faces for that section. The cross members were connected to the legs by a bolt. As each section was completed, the "jin" pole was repositioned higher in the interior of the tower. On the day of the incident, the crew arrived at the site at approximately 8:00 a.m. The victim and a second senior tower erector/inspector (his brother) climbed the tower to the work area. The junior erector/inspector and welder remained on the ground assembling the section faces, hooking up and raising the components into position with the winch truck.

At approximately 10:30 a.m., the tower was complete to the 200-foot level. The workers had installed the legs for the next section and had climbed to the 220-foot level to connect the top of the cross members, which had been hoisted into place, to the tower legs. After the connections were made, the workers began to climb back down to the 200-foot level to connect the cross members to the bottom of the legs. As the men were descending the legs, both the victim's brother and the men on the ground heard a clanging sound. When the brother looked across the tower, he did not see the victim. The workers on the ground looked up and saw someone was falling. A coworker on the ground immediately called 911 and the company owner from a radio in the company truck. The victim was pronounced dead at the scene.

CAUSE OF DEATH

The Medical Examiner listed the cause of death as multiple trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should continually stress to all employees the importance of following established safety rules and procedures at all times.

Discussion: Standard practice calls for testing the connection of the anchorage point prior to releasing a grip on the structure. The company also had a policy of three-point contact at all times if not tied-off. It appears that the victim did not test his connection prior to relying on it to support his full weight or lost one of his three points of contact with the structure. In accordance with the OSHA Act, P.L. 91-596, Section 5(b). "each employee shall comply with occupational safety and health standards and all rules, regulations, and orders... which are applicable to his own actions and conduct." The employer in this incident managed a comprehensive and detailed safety program on the project that addressed the hazards to which his employees could reasonably expect to be exposed. The fact the incident occurred in spite of these policies clearly shows the need for employers to continually remind all employees of the importance of following established safety rules and procedures at all times.

Recommendation #2: Employers should thoroughly plan all work and perform a job hazard analysis of the site prior to starting work, anticipating that employees might have a lack of knowledge about safety at the site, instead of waiting for employees to raise questions.

Discussion: The company states that there is weekly training on climbing safety involving proper personal protective equipment (PPE) (inspection and use) as well as, a hazard assessment of each jobsite. The site supervisor is in charge of weekly training, certification (first aid, life safety, etc.) of employees on site, and hazard assessment of each job. It is recommended that once on site, a job hazard analysis be done by the

employer and workers together. Worker safety issues should be discussed and incorporated into all projects during the planning and throughout the entire project. The planning for and incorporation of safety measures, prior to any work being performed at jobsites, will help to identify potential worker hazards so that preventive measures can be implemented at the site.

Recommendation #3: Employers should provide a system or method of fall protection that protects employees at all times when working at elevations. At a minimum, three-point contact (one foot and two hands or vice versa) should be maintained.

Discussion: In this case, the employee fell from the tower after he apparently disconnected or was reconnecting his fall protection in order to move down the structure. Moving without fall protection is standard procedure with this type of work and requires a minimum of three-point contact at all times; traditional fall protection for this job is more effective when the employee is stationary and tied onto the structure. It is recommended that other methods of fall protection be used that protect employees while they are moving as well as when stationary. For example, a lifeline system or cable safety climb device provides a tie-off point for the employee to hook onto, and provides fall protection coverage at all times. For a tower leg or similar vertical structure, a fall arrester (e.g., rope grab) should be worn by the employee and attached to the lifeline, enabling the worker to move freely without interference until a free fall is detected.

Recommendation #4: Employers should ensure that fall protection equipment is appropriate and maintained in good condition. Employers should periodically inspect fall protection equipment to ensure that all components are in operational order.

Discussion: Connecting clasps on lanyards are equipped with a locking mechanism. Such a mechanism prevents the clasp from opening unintentionally. To prevent unintentional opening, it is recommended that all lanyard clasps be equipped with locking mechanisms. It was observed that some of the other lanyards at the site appeared old and worn. Lanyards and other nylon equipment should also be periodically replaced to prevent equipment failures, as nylon will deteriorate with age and exposure to ultraviolet light from sunlight and welding arcs. It is also recommended that employers and employees periodically inspect all fall protection equipment to ensure that it is in operational order.

REFERENCES

1. Public Law 91-596, December 29, 1970, the "Occupational Safety and Health Act of 1970", Section 5(b).
2. Code of Federal Regulations 29 CFR 1926, 1996 edition. U.S. Government Printing Office, Office of the Federal Register, Washington DC.

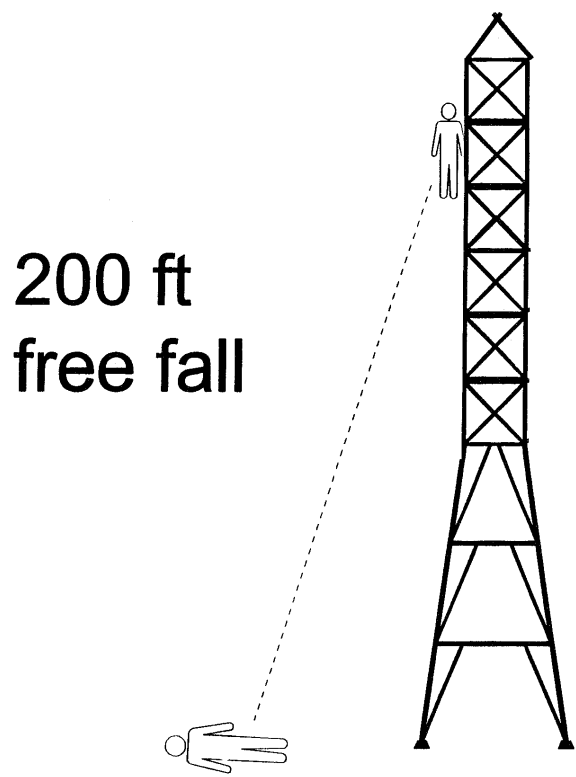


Figure 1. 300 Foot Telecommunications Tower

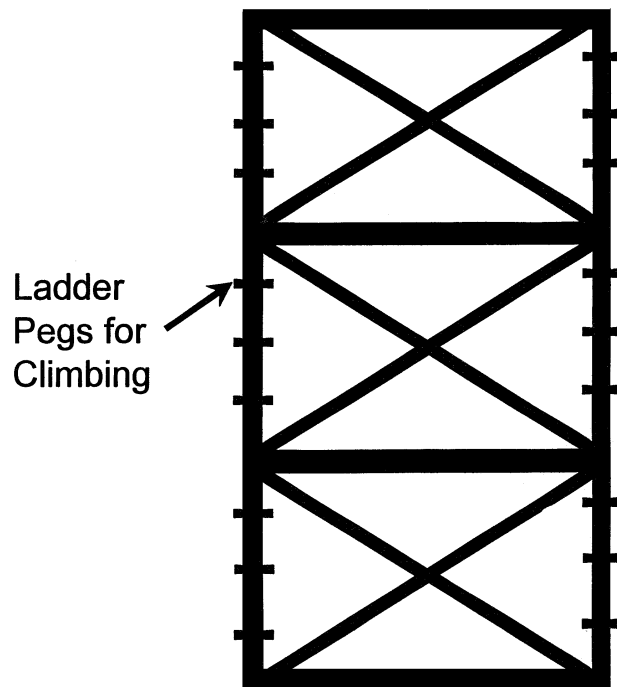


Figure 1a. Enlarged View, Tower Section