

WORKER DEATHS BY FALLS

A Summary of Surveillance Findings and Investigative Case Reports

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

September 2000

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DHHS (NIOSH) PUBLICATION No. 2000-116

FOREWORD

Many American workers, regardless of industry or occupation, are exposed to fall hazards daily during performance of their job tasks. This monograph describes the magnitude of the problem of occupational falls in the U.S., identifies potential risk factors for fatal injury, and provides recommendations for developing effective safety programs to reduce the risk of fatal falls.

This monograph summarizes surveillance data and investigative reports of fatal work-related falls from elevations. The surveillance data were derived from the National Traumatic Occupational Fatalities (NTOF) surveillance system maintained by the National Institute for Occupational Safety and Health (NIOSH). The NTOF data are based on death certificates for workers aged 16 years or older who died from traumatic injuries in the workplace. The fatality investigations were conducted as part of the NIOSH Fatality Assessment and Control Evaluation (FACE) program, a research program for the identification and investigation of fatal occupational injuries. The goal of the FACE program is to collect information on factors that may have contributed to occupational fatalities, using an epidemiologic approach, and to develop and disseminate recommendations for prevention of similar incidents in the future.

Based on the NTOF surveillance data, falls from elevations were the fourth leading cause of occupational fatalities from 1980 through 1994. The 8,102 deaths due to falls from elevations accounted for 10% of all fatalities and an average of 540 deaths per year. Between 1982 and 1997, NIOSH investigated 90 falls incidents which resulted in 91 fatalities.

Part I of this monograph provides an overview of fall hazards in the workplace, a summary of the epidemiology of fatal occupational falls, and recommended elements for an effective safety program for the prevention of falls in the workplace. Part II contains case summaries and prevention recommendations from all 90 FACE fall investigation reports prepared by NIOSH for further information and reference.

This monograph reviews what is known about occupational fatalities due to falls from elevations, identifies common risk factors and exposures, and recommends general approaches to preventing these fatal events. Our hope is that this document will serve as a valuable resource for safety and public health professionals, safety and health trainers, and researchers, prompting further injury prevention efforts to reduce fatal falls in the workplace.

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ACKNOWLEDGMENTS

This document was prepared by Richard W. Braddee, Mathew G. Hause, and Stephanie G. Pratt from the NIOSH Division of Safety Research. The authors are grateful to the following people for their contributions in the development of this Monograph:

Conceptualization of Epidemiologic Analyses

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PUBLIC HEALTH SUMMARY

What are the hazards?

Based on data from the NIOSH National Traumatic Occupational Fatalities (NTOF) surveillance system, falls from elevations were the fourth leading cause of workplace death from 1980 through 1994. The 8,102 deaths due to falls from elevations accounted for 10% of all occupational fatalities during this period and an average of 540 deaths per year.

How can a worker be exposed or put at risk?

Falls from elevation hazards are present at most every jobsite, and many workers are exposed to these hazards daily. Any walking/working surface could be a potential fall hazard. An unprotected side or edge which is 6 feet (1.8m) or more above a lower level should be protected from falling by the use of a guardrail system, safety net system, or personal fall arrest system. These hazardous exposures exist in many forms, and can be as seemingly innocuous as a changing a light bulb from a step ladder to something as high-risk as connecting bolts on high steel at 200 feet in the air.

What recommendations has the federal government made to protect workers' health?

The Occupational Safety and Health Administration (OSHA) sets forth requirements and criteria for fall protection in construction workplaces in Subpart M, Fall Protection, 29 CFR 1926.500 to 1926.503.

Subpart M provides the basic standards for all fall protection systems and for mandatory employee training in fall hazards. It also sets forth the circumstances in which an employer may provide a fall protection plan in place of conventional systems and provides an example of such a plan in one of the five non-mandatory appendices to the section.

Fall protection is also covered in other parts of the construction standards. Requirements for specific operations are covered in Subpart L-Scaffolding; Subpart N-Cranes, Derricks, Hoists, Elevators, and Conveyors; Subpart R-Steel Erection; Subpart S-Underground Construction, Caissons, Cofferdams and Compressed Air; Subpart V-Power Transmission and Distribution; and Subpart X-Stairways and Ladders.

Subpart D of the General Industry Standards, Walking and Working Surfaces, Sections 1910.21 to 1910.32, deals with the basic elements of workplace—floor and wall openings, stairs, ladders, scaffolding, and with one of the most basic safety practices, good housekeeping.

Where can more information be found?

The references included in this document provide a useful inventory of published reports and literature. Additional information from NIOSH can be obtained by calling the following number:

1-800-35-NIOSH (800-356-4674)

PART I

FATAL FALLS FROM ELEVATIONS

OVERVIEW OF POTENTIAL HAZARDS FOR FALLS FROM ELEVATIONS

Falls from elevations occur in all industries, in all occupations, and in a myriad of work settings, from the ironworker connecting steel columns 200 feet in the air, to the laborer washing windows from a suspended scaffold 60 feet from the ground, to the stock clerk retrieving goods from a shelf using a 4-foot stepladder. Fatal falls from elevations are classified by external cause of death codes (E-codes) E880-E888 of the International Classification of Diseases, Ninth Revision, (ICD-9).¹ For the purpose of this monograph, the following categories will be discussed: 1) falls from ladders (E881.0), 2) falls from scaffolding (E881.1), 3) falls from or out of buildings or other structures (E882), 4) other falls from one level to another (e.g., falls from stationary vehicles and falls from trees) (E884.9), and 5) other and unspecified falls (E888). The E-codes E885, E886 (falls on the same level), and E887 (falls resulting in fractures with cause unspecified), were excluded from this monograph since these types of falls were not investigated as part of the FACE program. Figure 1 illustrates examples of common elevated working environments.

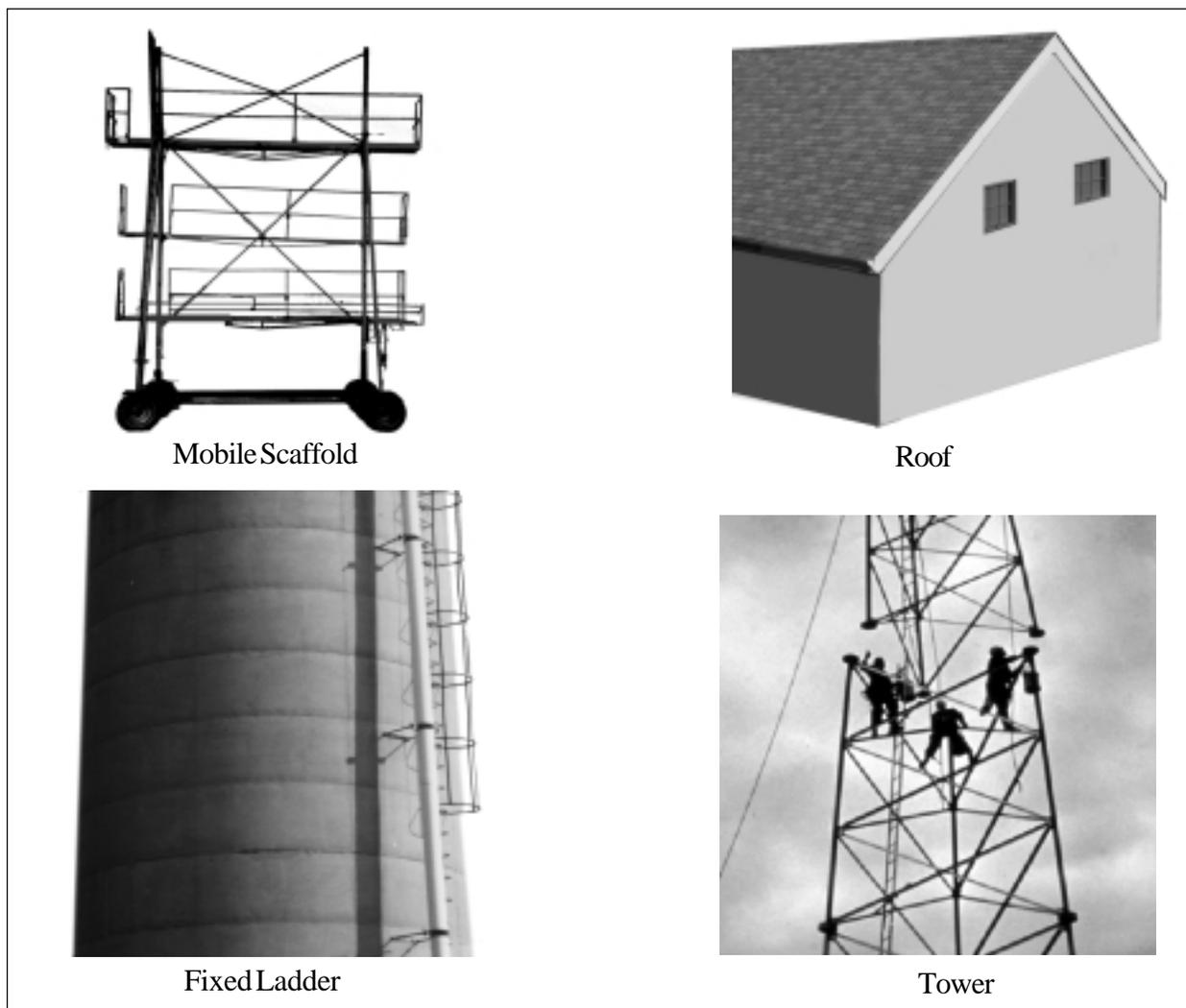


Figure 1. Common Types of Fall Environments

FALL ENVIRONMENTS

Ladders (E881.0)

Ladders are designed and manufactured to be fixed or portable and are intended to provide easy access to various work settings. Ladder configurations vary by length, load rating (e.g., type IA, I, II, or III), and ladder material (e.g., wood, aluminum, or fiberglass). Common types of ladders include straight, step, trestle, extension trestle, platform, combination, mason's, and two- and three-section extension ladders. Ladder sizes range from 2-foot step ladders to 72-foot, three-section extension ladders as well as fixed ladders that can extend hundreds of feet (e.g. providing access to the top of a water tower).

Safety features that have been designed into some ladders, or are available as retrofits, are slip resistant rungs/steps, positioning feet that fully articulate, and top and bottom stabilizers. Fixed ladders typically have a glide-rail system through the middle that is accessed and egressed while using a full body harness with a glide lock attached to a chest D-ring. Other fixed ladders have caging systems which are a less effective tool for fall protection. Some important factors to be considered before using or climbing a ladder are placement, securing or tying down, climbing style, angle of inclination, three-point contact, and tasks to be performed.

Factors that contribute to falls from ladders are ladder slip (top or bottom), overreaching, slipping on rungs/steps, defective equipment, and improper ladder selection for a given task. There are appropriate uses for stepladders and for extension ladders, but the choice of the wrong ladder for a particular job can put the user at increased risk for a fall.

Scaffolds (E881.1)

Scaffolds are defined as temporary elevated platforms and their substructures, that are used for supporting workers or materials or both. Scaffolds vary greatly in type, size, material, and function and are used in a multitude of work settings. Familiar tasks associated with scaffold use include drywall and stucco application, sand blasting and painting, window washing, structural cleaning, caulking, removing asbestos, performing maintenance, installing piping/conduit, laying brick/concrete block, and inspecting. See the glossary for definitions of scaffold types.

Factors associated with falls from scaffolds include improper maintenance or erection/dismantling procedures, incorrect methods for mounting or dismounting, overloading, absence of guardrails, scaffold component failures, defective personal protective equipment (PPE), or absence or improper use of PPE.

Falls from or out of buildings or other structures (E882)

Included in this group are falls from or through roof and floor openings and edges, structural framing, skylight fixtures, utility poles and towers, bridges, tanks, window openings, and platforms.

Regardless of the industry or occupation, a worker may, at some time in his or her working career, be exposed to one or more of the fall-from-elevation environments described above. For example, in the construction industry numerous tasks associated with fall hazards will be performed by workers every day. Tasks such as installing shingles on roofs, erecting skeleton steel for buildings and structures, climbing towers, painting bridges and storage tanks, or installing and maintaining skylight fixtures can and do result

in injuries and death to workers. These tasks represent only a few of the many tasks that can result in injuries and death to workers due to failure to recognize fall hazards, failure to use personal protective equipment, overreaching, loss of balance, tripping, slipping, or equipment failure.

Other falls from one level to another (including falls from embankments, haystacks, stationary vehicles or trees) (E884.9)

Falls from embankments, haystacks, and trees occur in limited work settings and to selected occupational groups, whereas falls from stationary vehicles occur in numerous industries and occupations, since vehicles are used in a wide variety of industrial sectors. Vehicles include automobiles, buses, trucks, vans, construction machinery being used as transport vehicles on public highways, farm and industrial machinery, fire engines, motorcycles, motorized bicycles or scooters, and trolley buses not operating on rails. Primary hazards relating to vehicles include lack of or failure to use seat belts, and slipping/tripping.

Conclusions

One of the serious and oftentimes deadly hazards found in the workplace is falls from elevations. Fall-prevention measures can be general, varied, specific, or elaborate; and the recognition, planning, and implementation of a sound fall-prevention program is the first step in reducing falls in the workplace. When fall hazards are recognized, provisions to abate the hazards can be developed, implemented, and reinforced on a timely basis to prevent deaths and injuries resulting from falls in the workplace.

EPIDEMIOLOGY OF FATAL FALLS FROM ELEVATIONS

INTRODUCTION

Falls were identified as the fourth leading cause of occupational-injury fatality in the United States between 1980 and 1989 by the National Traumatic Occupational Fatalities (NTOF) surveillance system of the National Institute for Occupational Safety and Health (NIOSH), accounting for 10% of all occupational-injury deaths.² NTOF data also showed that workers in the construction, mining (including oil and gas extraction), and agriculture/forestry/fishing industries had the highest fatality rates due to falls during the decade. The Census of Fatal Occupational Injuries (CFOI) of the Bureau of Labor Statistics (BLS) reported that falls to a lower level comprised 9.9% of fatalities in 1996.³ The CFOI data identified roofs, ladders, and scaffolds as the most common fall locations. Other studies have noted falls associated with steel erection,^{4,5} falls from equipment or materials,⁴ and falls through floor openings.^{5,6}

Previous research has identified falls as a leading cause of fatalities in the construction industry. Falls accounted for 25% of the construction deaths identified by NTOF for 1980 through 1989,⁷ 32% reported by the 1996 CFOI,³ and 33% of construction fatalities investigated by the Occupational Safety and Health Administration (OSHA) between 1985 and 1989.⁶ Falls comprised 29% of construction fatalities in Washington State between 1973 and 1983,⁸ and 46% in New Jersey between 1983 and 1989.⁹ Occupational groups identified with high frequencies of fatal falls include roofers, painters, ironworkers, carpenters, construction laborers, and tree trimmers.⁹⁻¹¹

The following analysis combines 15 years of data from the NTOF surveillance system with final reports on 91 fatalities investigated by NIOSH through the Fatality Assessment and Control Evaluation (FACE) program to describe work settings in which fatal falls are likely to occur and the associated risk factors.

METHODS

The NTOF surveillance system is based on death certificates from all 50 states and the District of Columbia meeting the following criteria: age 16 years and older, external (injury) cause of death, and the certifier noted that the injury occurred at work.² The inclusion in NTOF of the injury description, cause of death, occupation, and industry in narrative form provides an opportunity for detailed examination of fall-related fatalities.

Limitations of the use of death certificates in ascertaining work-relatedness and as a source of occupational-fatality data have been described previously.^{2, 12-15} Among the chief limitations are a lack of specific employment information, the customary use of “usual” occupation and industry as they appear on the death certificate as proxies for occupation and industry at the time of injury, and the absence of national guidelines for completion of the “injury at work?” item on the death certificate at the time these NTOF data were collected. Despite these limitations, it has been demonstrated that death certificates identify, on the average, 80% of work-related fatalities nationally, more than any other single source.¹⁴ The frequencies presented here should be viewed as the minimum number of fall-related fatalities occurring during the study period.

This analysis includes NTOF data from 1980 through 1994 for fatal falls from elevations identified by external cause of death codes (E-codes) E880-E884 and E888 of the International Classification of Diseases (ICD-9), Ninth Revision (Table 1).¹

Table 1. ICD-9 External Cause of Death Codes for Falls from Elevations

ICD-9	DESCRIPTION
E880	Falls on or from stairs or steps
E881	Falls on or from ladders or scaffolding
E882	Falls from or out of buildings or other structures
E883	Falls into a hole or other opening in the surface
E884	Other falls from one level to another (e.g., tree, stationary vehicle, haystack, embankment)
E888	Other and unspecified falls

Falls on the same level (E885 and E886) were excluded from this analysis, as were falls resulting in fractures with cause unspecified (E887). Cases assigned these three E-codes comprised less than 3% of the 8,545 total cases for the period 1980-1994. Several other types of fall-related incidents are excluded from the ICD-9 falls rubric, notably falls from machinery in operation, falls from railway trains or in water transport, falls from moving motor vehicles, falls while boarding or alighting from motor vehicles, falls preceded by the collapse of a building or structure, falls from burning buildings or structures, and falls preceded by electrocution. Cases that had fall-related E-codes but whose injury descriptions matched the exclusions described above were also eliminated from the analysis, as were cases with an E-code of E888 whose injury descriptions were consistent with falls on the same level, resulting in a final total of 8,102 fatalities.

In the analysis of fall-related fatalities, E-codes provide insufficient detail to ascertain specific circumstances and hazards, particularly in the instance of E882, falls from buildings or structures. The injury description and cause of death narratives in NTOF were used to obtain more precise information about the location from which the worker fell.

Cases were classified by major industry division according to the 1987 Standard Industrial Classification (SIC) system,¹⁶ and by occupation division according to Bureau of the Census classification schemes.^{17,18} Average annual employment data used to calculate fatality rates by industry division were obtained from the Current Population Survey, a monthly household survey conducted for the Bureau of Labor Statistics by the Bureau of the Census.¹⁹ Because of lack of comparability with earlier classification systems (before 1983), fatality rates by occupation were calculated only for the years 1983 through 1994.

Between 1982 and 1997, the NIOSH FACE program investigated 90 fatal fall incidents in which 91 workers were killed. FACE investigations yield detailed information pertaining to the risk factors and sequence of events leading to fatalities. In addition to site investigations and employer interviews, FACE investigators use police and medical examiner reports, death certificates, OSHA documents, newspaper accounts, and other sources to develop summary reports containing recommendations for prevention of similar incidents. FACE investigations constitute a case series; results of analyses of FACE data may not be generalized to all fatal falls from elevations. FACE data are not directly comparable with sources such as NTOF which seek to enumerate all occupational fatalities. However, FACE data complement NTOF surveillance data by providing greater detail for identifying and describing work situations associated with fatal injury.

RESULTS

Between 1980 and 1994, 8,102 workers in the United States died as a result of falls from elevations. There was an average of 540 deaths per year, comprising 9.6% of work-related fatalities over the 15-year period. The average annual fatality rate was .49 per 100,000 workers. The annual rate declined from .68 in 1980 to .42 in 1994 (Figure 2). This 38% decrease paralleled the overall 41% decrease in rates for all causes of death.

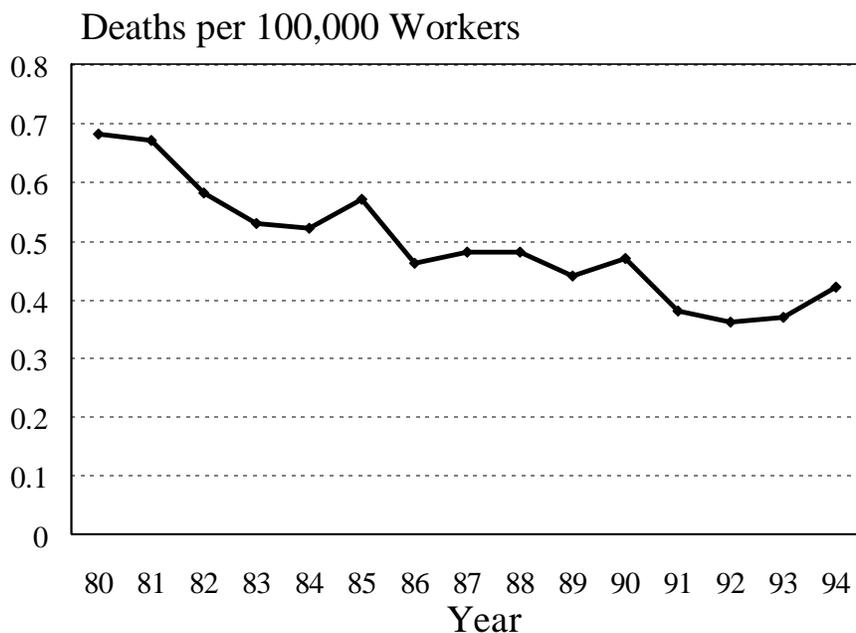


Figure 2. Work-related Fall Fatality Rates, NTOF, United States, 1980-1994 (N=8,102)

Ninety-seven percent of the workers (7,859) were male. Decedents ranged in age from 16 to 96, with a median age of 42. While the greatest number of falls occurred among workers aged 25 to 34 years, the rate of fall fatalities increased with age (Table 2).

Table 2. Number and Rate Per 100,000 Workers of Fatal Falls by Age of Worker, United States, 1980-1994

Age Group (Years)	N	%	RATE
16-19	220	2.7	0.23
20-24	749	9.2	0.38
25-34	1870	23.1	0.40
35-44	1567	19.3	0.39
45-54	1479	18.3	0.54
55-64	1469	18.1	0.86
65+	741	9.1	1.57
Unknown	7	0.1	----
Total	8102	100.0	0.49

Source: National Traumatic Occupational Fatalities (NTOF) Surveillance System

The distribution of workers by race was 86.8% white, 8.9% black, 1.9% other races, and 2.3% of unknown race. Fatality rates due to falls from elevation were .49 deaths per 100,000 workers among whites, .44 among blacks, and .31 among workers of other races.

The greatest numbers of deaths occurred within the construction, manufacturing, and services industry divisions, and the highest rates per 100,000 workers were observed in construction, mining, and agriculture/forestry/fishing (Table 3).

Table 3. Number and Rate Per 100,000 Workers of Fatal Falls by Industry Division, United States, 1980-1994

INDUSTRY DIVISION	N	%	RATE
Agriculture/Forestry/Fishing	507	6.3	0.99
Mining	211	2.6	1.69
Construction	4044	49.9	3.89
Manufacturing	943	11.6	0.30
Transportation/Communications/Public Utilities	518	6.4	0.45
Wholesale Trade	145	1.8	0.22
Retail Trade	250	3.1	0.09
Finance/Insurance/Real Estate	106	1.3	0.10
Services	765	9.4	0.14
Public Administration	181	2.2	0.23
Not Classified	432	5.3	----
Total	8102	100.0	0.49

Source: National Traumatic Occupational Fatalities (NTOF) Surveillance System

NTOF contained detailed SIC codes for fatalities occurring between 1990 and 1994, a total of 2,381 cases. The greatest numbers of deaths were found in construction industry subgroups (Table 4).

Table 4. Detailed SIC Codes with 50 or More Fatalities Due to Falls from Elevations, United States, 1990-1994

SIC CODE	DESCRIPTION	DEATHS
1542	General Contractors — Nonresidential Buildings, Other Than Industrial Buildings and Warehouses	205 *
1611	Highway and Street Construction, Except Elevated Highways	177 **
1761	Roofing, Siding, and Sheet Metal Work	147
1791	Structural Steel Erection	121
1751	Carpentry Work	79
1721	Painting and Paper Hanging	71
1521	General Contractors — Single Family Houses	63
1731	Electrical Work	59
7349	Building Cleaning and Maintenance Services, not elsewhere classified (n.e.c.)	56
783	Ornamental Shrub and Tree Services	56

Source: National Traumatic Occupational Fatalities (NTOF) Surveillance System

* Default category when death certificate specifies building construction

** Default category when death certificate specifies only construction

Analysis of age-specific rates by industry revealed a pattern consistent across most industry divisions. In general, rates increased slowly with age up to age 55, then increased markedly among workers aged 55 to 64 years, and rose even more sharply beginning at age 65 (Figure 3). The only exception to this pattern was the mining industry, where the lowest rate was observed among workers aged 35 to 44 years, and workers below age 25 had fatality rates nearly as high as those seen among the oldest workers. In all other industry divisions, fatality rates among workers aged 65 years and older were five to ten times higher than those among workers below age 25.

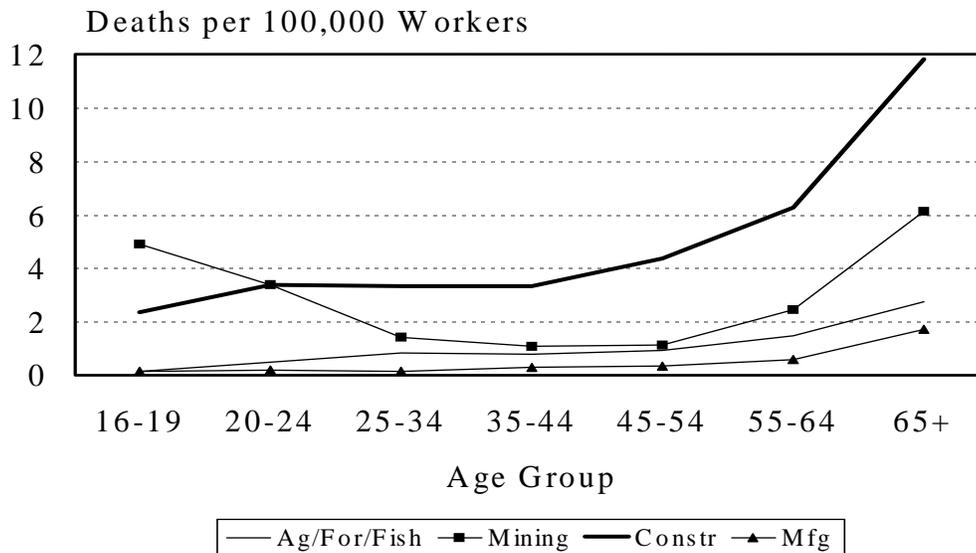


Figure 3. Rates of Work-related Fatal Falls by Age for Selected Industry Divisions, NTOF, United States, 1980-1994

Occupation divisions in which the greatest numbers of fall-related fatalities occurred were precision production, craft, and repair; laborers; executive, administrative, and managerial; and service. Fatality rates were highest among laborers, crafts workers, and workers in farming, forestry, and fishing occupations (Table 5). Detailed occupations with the greatest numbers of deaths between 1990 and 1994 were construction laborers, carpenters, roofers, managers and administrators, n.e.c., structural metal workers, and construction supervisors, n.e.c.

Table 5. Number and Rate Per 100,000 Workers of Fatal Falls by Occupation Division, United States, 1980-1994

OCCUPATION DIVISION	N	%	RATE*
Executive/Administrative/Managerial	513	6.3	0.24
Professional Specialty	260	3.2	0.12
Technicians/Support	74	0.9	0.13
Sales	185	2.3	0.09
Clerical	117	1.4	0.04
Service	508	6.3	0.2
Farmers/Foresters/Fishers	488	6.0	0.91
Precision Production/Craft/Repair	3569	44.1	1.7
Machine Operators	409	5.0	0.32
Transportation/Material Moving	369	4.6	0.5
Laborers	1307	16.1	1.79
Not Classified	303	3.7	----
Total	8102	100.0	----

* 1983-1994

Source: National Traumatic Occupational Fatalities (NTOF) Surveillance System

Location of Fall

Buildings (particularly roofs), ladders, and scaffolds were the most frequently observed locations from which workers fell (Table 6).

Table 6. Work-related Fatal Falls by Location From Which Worker Fell, United States, 1980-1994

LOCATION	N	%
Stairs or steps	207	2.6
Ladder	994	12.3
Scaffolding Scaffold collapse (n=74)	1055	13.0
Building Roof (n=1230) Floor (n=83)	1774	21.9
Specified structures	657	8.1
Unspecified structure/building	381	4.7
Fall into hole or other opening	391	4.8
Other fall from one level to another Tree (n=234) Stationary vehicle/machine (n=177)	1346	16.6
Fall, n.e.c./unspecified	1297	16.0
Total	8102	100.0

Source: National Traumatic Occupational Fatalities (NTOF) Surveillance System

Falls from Ladders

Construction industry workers accounted for a far greater proportion of falls from ladders (46%) than did workers in any other industry. An additional 11% of workers were employed in manufacturing and 11% in service industries. Between 1990 and 1994, the greatest numbers of deaths occurred among General Contractors — Nonresidential, Other Than Industrial Buildings and Warehouses (SIC 1542), and Painting and Paper Hanging (SIC 1721).

Ladders were the leading cause of fatal work-related falls in the retail trade (22%) and finance, insurance, and real estate (21%) industry divisions, and the second leading cause in services (14%) and public administration (18%). They were associated with 20% of fatal falls among sales occupations, more than any other fall-related cause. Ladders accounted for 17% of falls among executive, administrative, and managerial workers and 18% of falls among technician/support and service occupations.

Workers aged 55 years or older were involved in 27% of all fatal falls, but accounted for 42% of falls from ladders. Less than 7% of ladder-related deaths were among workers under the age of 25 years.

Falls from Scaffolds

Construction industry workers accounted for over 70% of falls from scaffolding. Fourteen percent of scaffold-related fatalities between 1990 and 1994 occurred among workers in General Contractors — Nonresidential, Other Than Industrial Buildings and Warehouses (SIC 1542), 11% in Highway and Street Construction, Except Elevated Highways (SIC 1611), and 10% in Masonry, Stone Setting, and Other Stone Work (SIC 1741). Workers in crafts occupations experienced 58% of fatal falls from scaffolding. Detailed occupations with the greatest numbers of fatal falls from scaffolding between 1990 and 1994 were construction laborers, carpenters, and brickmasons and stonemasons.

Falls from Buildings or Structures

Sixty-one percent of fatal falls from buildings and structures occurred within the construction industry, 8% in manufacturing, and 8% in services. Between 1990 and 1994, the specific industries with the greatest proportions of these fatalities were General Contractors — Nonresidential, Other Than Industrial Buildings and Warehouses (SIC 1542); Roofing, Siding, and Sheet Metal Work (SIC 1761); and Highway and Street Construction, Except Elevated Highways (SIC 1611).

More than 50% of workers who died in falls from buildings or structures were employed in the crafts occupation division; 18% were laborers. Between 1990 and 1994, the greatest numbers of these fatalities were seen among construction laborers, roofers, and carpenters.

Of the 1,774 fatal falls from buildings, 1,230 (69%) were falls through or from a roof (Table 7).

Table 7. Circumstances of Fatal Roof-related Falls, United States, 1980-1994

	N	%
Falls through roof		
Through roof opening	43	3.5
Through roof (non-supportive materials)	13	1.1
Through skylight	83	6.7
Through roof, n.e.c./unspecified	103	8.4
Falls from Roof		
From roof structural member	19	1.5
From roof	961	78.1
Roof, n.e.c./unspecified	6	0.50
Total	1230	100.0

Source: National Traumatic Occupational Fatalities (NTOF) Surveillance System

Workers in crafts occupations experienced 56% of fatal falls through or from roofs. Between 1990 and 1994, the greatest numbers of roof-related falls occurred among roofers, carpenters, and construction laborers.

Disproportionately high numbers of falls from specified structures were observed in the mining industry, which includes oil and gas extraction, and in transportation/communications/ public utilities (TCPU). In mining, 36% of all fatal falls were from specified structures, the majority of which were rigs and derricks. Fatal falls in mining were most prevalent within SIC Major Group 13, Oil and Gas Extraction (101 of 144 fatal falls assigned to a major group, or 70%). Fifty-nine (58%) of the 101 were clearly falls from oil rigs, derricks, or towers. An additional 17 mining fatalities not classified to a major group were falls from rigs or derricks. In other mining sectors, the incidence of fatal falls was much lower than in Oil and Gas Extraction: metal (9), coal (11), and nonmetal (23).

In TCPU, 23% of fatal falls were from structures, predominantly poles and towers. This industry contributed only 6% of falls overall, but 18% of falls from structures.

Other Falls from Elevation

Falls from trees (17%) and stationary vehicles (13%) were most prevalent among the 1,346 other falls from elevation. The greatest numbers of falls from stationary vehicles or machinery occurred within manufacturing and TCPU. Within both industries, the majority of these were falls from stationary trucks. Workers in the agriculture/forestry/fishing industry accounted for only 6% of all fatal falls, but suffered 57% of falls from trees. The majority of fatalities in this industry division occurred within agricultural crop production (Major Group 01) and agricultural services (Major Group 07). In crop production, fatal falls were evenly distributed among falls from ladders, roofs, structures such as silos, stationary vehicles, and trees. In contrast, falls from trees comprised over two-thirds of fatal falls in the agricultural services sector.

FACE Investigations

Between 1982 and 1997, the Fatality Assessment and Control Evaluation (FACE) project investigated 90 fatal fall-related incidents resulting in 91 deaths. The fatalities occurred in 13 states. Eighty-eight of the workers (97%) were male. The workers ranged in age from 16 to 70 years, with a median age of 36. The majority (78%) were white and non-Hispanic. Nine percent were black, 8% were Hispanic, and 5% were of other races.

The majority of fatal falls investigated by FACE (82%) occurred in the construction industry. In 51 of the 75 construction cases (68%), the worker was employed by a special trades contractor (SIC Major Group 17). The specific industries noted most frequently in the FACE data were SIC 1761 (Roofing, Siding, and Sheet Metal Work), SIC 1721 (Painting and Paper Hanging), and SIC 1542 (General Contractors — Nonresidential Buildings, Other Than Industrial Buildings and Warehouses). The remainder of FACE fall investigations were in agriculture/forestry/fishing, manufacturing, TCPU, wholesale trade, services, and public administration.

The majority of workers (76%) were employed in crafts occupations; 13% were laborers. The specific occupations observed most frequently were painters, structural metal workers, carpenters, construction supervisors, n.e.c., and roofers.

Eighty-two percent worked for private sector employers; the remainder were self-employed (14%) or government employees (2%). The employment class of one worker was unknown. Company size ranged from one employee to more than 10,000, with a median of 40 (Figure 4). In 36% of the cases, the employer had been in business for 5 to 10 years. In another 28%, the employer had been in business for 11 to 20 years.

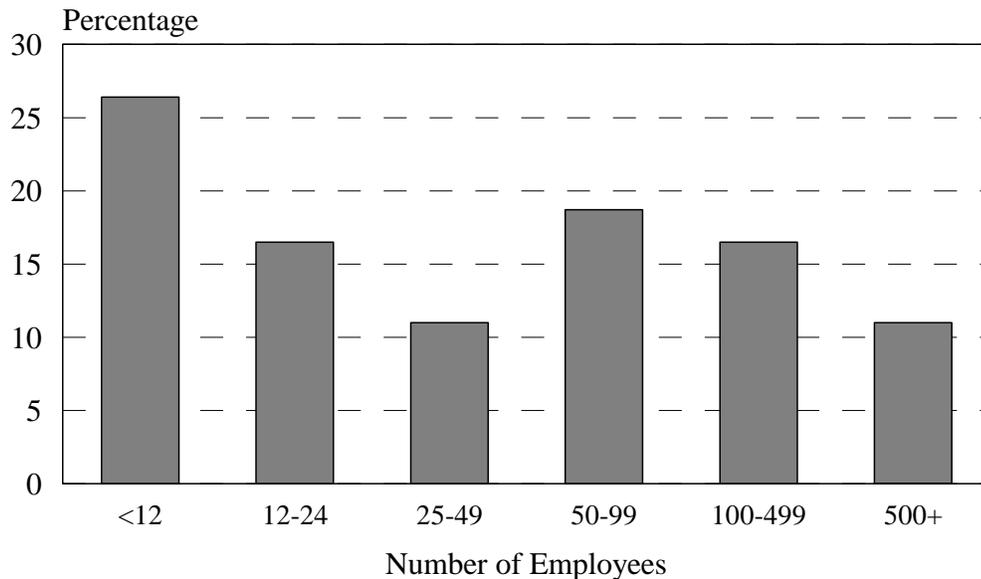


Figure 4. *Distribution of Work-related Fatal Falls by Company Size, FACE Investigations, 1982-1997 (N=91)*

The worker's length of employment with his or her current employer ranged from 1 day to 24 years; 16 of the workers (18%) had been employed by their company for 1 month or less (Figure 5). The median employment period was 18 months. Nearly half (49%) had been working for their current employer for less than 12 months; 83% of these were employed in construction. In many of the fatal falls in construction investigated by FACE, the worker had little additional experience performing the same task for another employer. Only 4 of the 35 construction workers with 12 months or less service with their current employer had more than a year's experience doing the same type of work, and only 3 had more than a year of experience in the specific job task associated with the fatality.

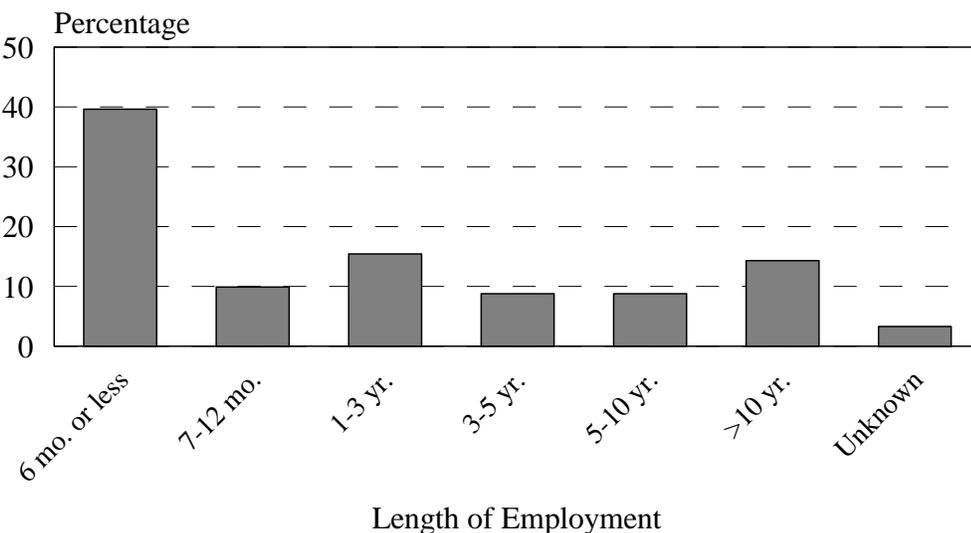


Figure 5. *Distribution of Work-related Fatal Falls by Time with Employer, FACE Investigations, 1982-1997 (N=91)*

Forty-nine percent of the employers had a designated safety officer, and 58% had a written safety program. However, only 37% had written rules covering the task being performed by the worker at the time of the fatal fall. Thirteen percent of employers provided no employee training; 59% provided on-the-job training only. A combination of training methods (on-the-job, classroom, and manuals) was used by 23% of employers, and training status was unknown in 4% of cases.

Availability and use of personal protective equipment (PPE) was ascertained for over three-fourths of the fatalities investigated. Nonuse and incorrect use (n=41) were more frequent than PPE not being available at the worksite (n=18) (Table 8). The kinds of equipment most frequently present at the worksite or used by the worker were safety belts and lanyards, guardrails, and lifelines.

Table 8. Fatal Falls by Availability and Use of PPE, FACE, 1982-1997

PPE STATUS	N	%
PPE not available	18	19.8
PPE available, but not wearing	15	16.5
Wearing PPE, but not using	14	17.6
Using PPE incorrectly	12	13.2
Using PPE, but PPE failed	2	2.2
PPE not applicable	9	9.9
Unknown	21	23.1
Total	91	100.0

The greatest numbers of incidents investigated through FACE were falls from roofs, scaffolding, and ladders (Table 9).

Table 9. Fatal Falls by Location From Which Worker Fell, FACE, 1982-1997

LOCATION	N	%
Stairs or steps	0	0.0
Ladder	8	8.8
Scaffolding Scaffold collapse (n=2)	17	18.7
Building Roof (n=26) Floor (n=10)	40	44.0
Specified structures	7	7.7
Unspecified structure/building	11	12.1
Fall into hole or other opening	0	0.0
Other fall from one level to another Tree (n=1) Stationary vehicle/machine (n=5)	8	8.8
Fall, n.e.c./unspecified	0	0.0
Total	91	100.0

The kinds of ladders involved in fall fatalities investigated by FACE were extension ladders (3), fixed ladders (3), rope ladders (1), and stepladders (1). Four of the eight fatalities occurred inside tanks or towers (three fixed ladders and one rope ladder). Absence of confined space entry procedures or failure to adhere to existing procedures played a role in all four fatalities. In two of these cases that involved fixed ladders, personal protective equipment such as harnesses, safety belts, lifelines, and respirators were required by the employer and available at the site but not used by the worker who fell.

Three of the falls from ladders investigated by FACE occurred while the worker was ascending or descending. In the fatality involving a rope ladder, the worker used an inappropriate climbing procedure, facing the ladder rather than ascending it along the side to minimize swaying. In another instance, the upper section of an extension ladder was used without the bottom section, and the bottom of that section slipped out on the wet concrete work surface.

Six of the scaffolds were suspended scaffolds; one of these events resulted in two fatalities. Six were tubular welded-frame scaffolds; two were mobile scaffolds; and the remaining two were other types. FACE investigations identified several factors associated with falls from scaffolds: improper maintenance or erection procedures (e.g., failure to lock casters, failure to check tightness of bolts, failure to check suspension rope for damage, or failure to secure planking); incorrect methods of mounting and dismounting (e.g., using guardrails or diagonal braces to climb from one level to another); and absence of guardrails.

Of the roof-related falls, nine were through roof openings (four of which were openings cut for skylights); eight were from a roof edge; five were from roof structural members; and two were through skylights. FACE investigations identified several factors associated with roof-related falls including unguarded roof openings, unsecured or unstable materials, and loss of balance. Loss of balance occurred in conjunction with work activities such as carrying metal decking, attempting to free a snagged cable, or unwinding an extension cord. Investigations of the skylight-related fatalities revealed that the employers failed to provide the standard skylight cover or fixed standard railing on all exposed sides as required by OSHA General Industry Standard 29 CFR 1910.23(a)(4).²⁰ These investigations also suggested that workers may have been unaware that the structural integrity of the skylights was insufficient to support their weight.

Overall, the mean height of the fall was 41 feet, and the median was 28. Eight percent of the workers for whom fall height was known fell 10 feet or less; 22% fell more than 50 feet (Figure 6). In four of the six falls from ladders, the worker fell 20 feet or less. The 16 fatalities which were falls of 15 feet or less were evenly distributed among falls from ladders, scaffolds, roofs, floors, and vehicles. Twelve of the 26 falls from roofs (46%) were from heights of 21 to 30 feet. Eight of the 17 falls from scaffolding (47%) were from heights of 46 feet or more.

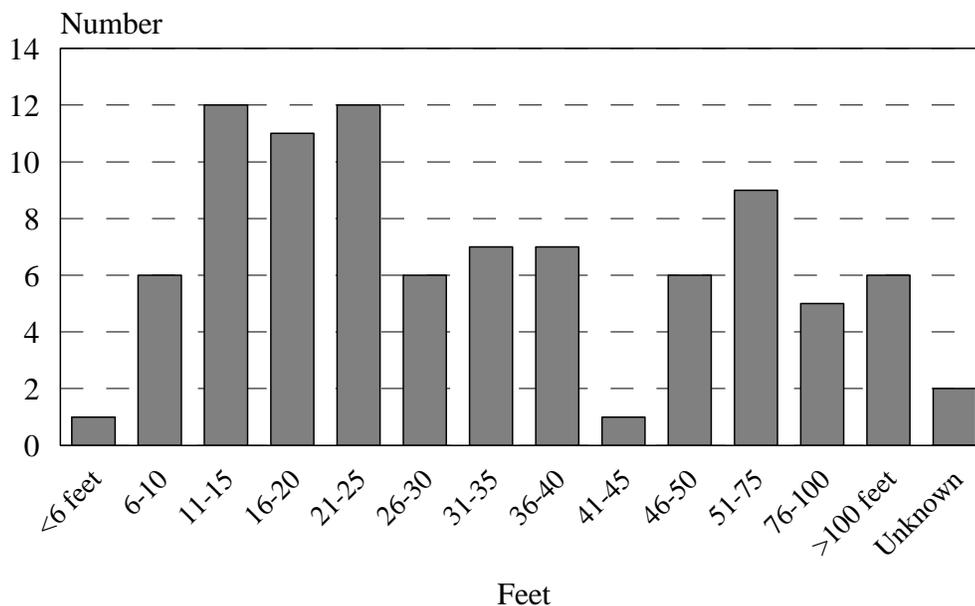


Figure 6. *Distribution of Fatal Falls by Height of Fall, FACE Investigations, 1982-1997 (N=91)*

DISCUSSION

Analysis of NTOF data on fatal work-related falls in the United States identified falls as the fourth leading cause of workplace fatalities. Fifty percent of all fatal falls identified by NTOF occurred in the construction industry, which had both the highest frequency and rate of fatal falls between 1980 and 1994. The industry is characterized by self-employment, small firms, irregular and seasonal employment, temporary and inexperienced workers, intense pressure to meet deadlines, multiple contractors and subcontractors working at the same site, and changing work settings (within a single jobsite or between sites).²¹⁻²³

FACE investigations showed that the above characteristics of the construction industry can contribute to fatal falls. Lack of hazard recognition can result from lack of coordination of work tasks between contractors, rapid physical changes in the work environment, and worker inexperience. Deviation from standard operating procedure and lack of adherence to safety standards (e.g., failing to use PPE and allowing accumulated debris to create fall hazards) may be associated with contract deadlines, the worker's inexperience, the worker's lack of familiarity with the task or the work environment, and the employer's lack of written task-specific work procedures.

For many construction workers, exposure to fall hazards is a nearly constant aspect of employment. Fall prevention challenges facing the construction industry are not necessarily limited to recognition that hazards exist and that means of fall protection are required and available. Also of concern are the difficulties in providing regular, consistent safety training, coordinating work activities among a variety of contractors and subcontractors, and development of safe work practices in a changing workforce amid changing work settings.

The manufacturing and services industry divisions had the second and third highest frequencies of fatal falls. These industries, however, had lower fatality rates, and levels of exposure to fall hazards may be less constant than in construction. Thus, employer and worker recognition of fall hazards may be lower. In addition, because work environments in these industries vary widely no single fall location predominates, and injury prevention programs may have to address various kinds of hazards. This presents diverse challenges to those responsible for protecting workers in these industries from fall hazards.

Following the construction industry, the highest fall-fatality rates were observed in the mining (including oil and gas extraction) and the agriculture/forestry/fishing industries. Fatal falls within mining were concentrated within the oil and gas extraction sector, suggesting that fall prevention programs for the industry should emphasize hazards associated with working from rigs and derricks. The wide variety of fall types seen in agricultural production suggests that fall prevention programs targeted at farmers need to address a wide variety of fall hazards. On the other hand, falls from trees predominated in the agricultural services sector (particularly SIC 0783, Ornamental Shrub and Tree Services), where prevention efforts could most effectively be directed at this specific hazard.

The NTOF analysis corroborated previous research in identifying roofers, carpenters, construction laborers, structural steel workers, painters, and tree trimmers as occupations that experienced high frequencies of fatal falls. NTOF also identified notable numbers of falls among managers, administrators, and construction supervisors, who may have less constant levels of exposure to fall hazards than workers such as roofers and structural steel workers. Emphasis on hazard recognition skills and use of PPE are important not only to managers' personal safety but to demonstrate management commitment to safe work practices.

Ladder-related incidents were the leading cause of fatal falls in retail trade and finance, insurance, and real estate, and the second leading cause in services and public administration. Although these industries had low fall-fatality rates overall, it is nonetheless important to recognize the risk posed by ladders in these work settings and to provide appropriate worker training where ladders are in use.

Workers aged 55 years and older accounted for a disproportionately high share of fatal falls from ladders, 42%. Ladders are generally used with minimal fall protection, with workers relying on balance and coordination to avert falls.²⁴ Even minor declines in balance, coordination, and reaction times associated with the normal aging process may result in increased risk of falls from ladders among older workers.²⁴

The NTOF data also showed that fall fatality rates due to all causes increased with age, particularly after age 65. Compared with younger workers, injuries to older workers tended to result in more complications and prolonged recovery periods and were more likely to result in death.^{25,26} Another source reported that workers aged 55 years or older were at decreased risk for nonfatal injury yet spent greater median days away from work when injured (10 days vs. 6 days for younger workers).²⁷

NTOF and FACE data reveal that the risk and nature of fatal falls vary substantially by factors such as industry, age, work setting, and experience. In some industries a single type of fall or similar group of fall types predominates (falls from rigs and derricks in oil and gas extraction, and falls from trees in agricultural services). For these industries, fall prevention strategies should include intensive training and interventions directed at specific hazards. In other sectors, such as construction, agricultural production, and manufacturing, workers are at risk for a wide variety of fall types. Safety programs for these industries should address risks associated with working from ladders, working from various buildings and structures, and operating and maintaining machinery and vehicles.

PREVENTION: ELEMENTS OF A FALL PROTECTION PROGRAM

Every day at worksites across the nation many workers are required to work at elevations and are exposed to numerous fall hazards. Therefore, it is essential for employers to develop and implement comprehensive, written fall-protection programs where workers are exposed to fall hazards. Fall protection programs should always be applied to all tasks with identified fall hazards—including work involving: aerial-lifts; walking/working surfaces with questionable strength and structural integrity; bridges; demolition; floor-openings; leading edges; low-slope, steep, and built-up roofs; personnel platforms; precast concrete; safety nets; scaffolds; silos/tanks; steel erection; and tree trimming.

Implementation of written fall-protection programs can reduce the number of fall-related injuries. These written programs should describe the appropriate fall-protection systems and equipment to be used for each anticipated fall hazard. Fall-protection systems covered in a written fall-protection program may utilize either passive or active systems. Passive systems, when installed, protect workers without the need for them to take additional action on their own behalf. Examples of passive systems include guardrails, parapet walls, railings, safety nets, and hole covers. Active systems, on the other hand, are protection systems or devices that require each worker to take positive action to protect against/or arrest a fall. An example of an active system is when a worker puts on a full-body harness and connects a lanyard or a self-retracting lifeline to a proper anchorage point. Where possible, passive systems should be used because their effectiveness does not depend on specific actions by the worker being protected.

There are two basic fall-protection systems in use in the construction industry, namely fall-prevention and personal fall-arrest systems. Fall-prevention systems usually involve passive components, such as guardrails and hole covers. However, when passive systems are not feasible, it is possible to prevent falls by having workers tie off to self-retracting lifelines that are short enough to prevent the worker from reaching the fall hazard. Personal fall-arrest systems are designed to limit the distance that a worker can fall, thus limiting the forces acting on the worker's body in the event of a fall. Fall-arrest systems require the use of a full-body harness to distribute fall arrest forces so as to minimize the extent of injury sustained in a fall. Other components of a fall-arrest system may include one or more of the following—rope grabs, shock absorbing lanyards, various types of connection hardware (e.g., snap hooks or carabiners), horizontal or vertical lifelines, and anchorage points sufficient to withstand 5000 pounds or two times the load expected in a fall.

The employer should develop, implement, and enforce a comprehensive, written fall protection program. The program should be in writing and at a minimum meet the requirements of OSHA 29 CFR 1926.502.²⁰ The following elements are recommended as a guide in developing a fall protection program. The program should include, but not be limited to, the following:

1. Addressing all aspects of safety and hazards in the planning phase of projects.
2. Identifying all fall hazards at the worksite.
3. Training employees in the recognition and avoidance of unsafe conditions and the OSHA regulations applicable to their work environment to control or eliminate the hazards. OSHA recommends that fall-protection training include classroom instruction supplemented by hands-on

training with the equipment. Training should commence at the time of hire for new employees exposed to fall hazards, and continue periodically thereafter. Involve workers, when feasible, to help identify which tasks create fall hazards, and what methods could be used to eliminate these hazards. Employee participation and acceptance is crucial to implementing an effective fall protection program.

4. Performing a job hazard analysis for each task to be performed.
5. Providing appropriate fall protection equipment, training workers on the proper use of fall protection equipment and enforcing its use, and daily inspection of equipment.
6. Conducting scheduled and unscheduled safety inspections of the worksite.
7. Addressing:
 - a) environmental conditions,
 - b) multi-language differences,
 - c) alternative methods/equipment to perform assigned tasks,
 - d) establishment of medical and rescue programs.
8. Encouraging workers to actively participate in workplace safety.

Fall protection equipment is very specific in its application, and great care should be taken to choose the correct system for the application intended, in accordance with industry standards or guidelines on specific worker needs. Manufacturer's instructions for correct use and maintenance must be followed explicitly; otherwise, injuries and fatalities can result. Compatibility of a fall-protection system's components is crucial. Employers and employees should realize that not all components (such as lanyards, connectors, lifelines, deceleration devices, and harnesses) are interchangeable. The benefits derived from safely performed work at heights include more organization, more employee cooperation, greater productivity for management, less danger to life on the job and a lower insurance risk for hazardous work in high places.

OSHA regulations under 29 CFR 1926.501 require employers to provide workers who are exposed to fall hazards of over 6 feet with adequate fall protection, which may involve the installation of either fall-prevention systems, or of personal fall-arrest systems. However, the OSHA regulations provide an exception in selected work situations where the employer can demonstrate that it is infeasible, or creates a greater hazard to install these systems. Employers have the option of developing and implementing a fall protection plan in lieu of installing fall protection systems only when they can demonstrate the infeasibility, or greater hazard created by fall protection systems. This exception in the OSHA fall protection regulation is further described below.

Exception: When the employer can demonstrate that it is infeasible or creates a greater hazard to use these systems, the employer shall develop and implement a fall protection plan which meets the requirements of paragraph (k) of 1926.502 (e.g., employers engaged in leading edge work, precast concrete construction work and residential construction).

The fall protection plan shall be prepared by a qualified person and developed specifically for the site where the leading edge work, precast concrete work, or residential construction work is being performed and the plan must be maintained up to date. A "qualified person" is one with a recognized degree or professional certificate and extensive knowledge and experience in the subject field who is capable of design, analysis, evaluation and specifications in the subject work, project, or product. The implementation of the fall protection plan shall be

under the supervision of a competent person. A “competent person” is 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 authorization to take prompt corrective measures to eliminate them. This plan is designed to enable employers and employees to recognize the fall hazards on this job and to establish the procedures that are to be followed in order to prevent falls to lower levels or through holes and openings in walking/working surfaces. Each employee will be trained in these procedures and strictly adhere to them except when doing so would expose the employee to a greater hazard. The fall protection plan shall document the reasons why the use of conventional fall protection systems (guardrail systems, personal fall arrest systems, or safety net systems) are infeasible or why their use would create a greater hazard. The fall protection plan shall include a written discussion of other measures that will be taken to reduce or eliminate the fall hazard for workers who cannot be provided with protection from the conventional fall protection systems. For example, the employer shall discuss the extent to which scaffolds, ladders, or vehicle mounted work platforms can be used to provide a safer working surface and thereby reduce the hazard of falling. Where no other alternative measure has been implemented, the employer shall implement a safety monitoring system.

To help reduce occupational fatalities resulting from falls from elevations, NIOSH recommends the following prevention strategies, in addition to the general recommendations provided on pages 21 - 23, by fall hazard environment (i.e., ladders, scaffolds, buildings or other structures, machinery, and trees). The prevention strategies were derived from worksite incident investigations conducted by NIOSH personnel, requirements contained in the Occupational Safety and Health Administration (OSHA) Standards for General Industry and the Construction Industry, and standards from the American National Standards Institute (ANSI).

Ladders

The following recommendations were based on NIOSH investigative/research experience, and OSHA²⁰ and ANSI²⁸⁻³² safety standards for ladders. Every worker should be knowledgeable of the following when using ladders.

Prior to using a ladder, workers should visually inspect it for:

- structural damage, such as split/bent side rails, broken or missing rungs/steps/cleats
- missing or damaged safety devices, such as rung locks, lock spreaders or safety shoes/feet/spurs/spikes
- grease, dirt, or other contaminants that could cause slips or falls
- paint or stickers (except warning labels) that could hide possible defects.

Damaged ladders should be: Tagged or marked for repair, replacement, or destruction.

Climbing guidelines

- Wear slip-resistant footwear.
- Keep the area around the top and bottom of the ladder clear.

- Wear approved fall protection equipment, if applicable.
- Never carry large objects while ascending or descending the ladder. Use a hoist or pulley mechanism to move large/awkward objects up to working level or down to the ground.
- Keep both hands free for climbing.
- Face the ladder and maintain three-point contact (two hands and one foot or one hand and two feet on the ladder) at all times.
- Do not load ladders beyond the maximum intended load for which they were built, nor beyond their manufacturer's rated capacity.
- Use ladders only for the purpose for which they were designed.

Portable ladders (OSHA §1910.26 and §1926 Subpart X)²⁰

There are two basic classifications of portable ladders, self-supporting (step ladders) and non-self-supporting (straight or extension ladders). Remember to use the proper ladder for the job/task being performed. In choosing between a self-supporting and a non-self-supporting ladder, an important factor to consider is the bottom (working surface) and top support conditions. If unsure of what the proper ladder selection should be, consult the ladder manufacturer or the nearest OSHA office. Proper selection of a ladder is essential for ensuring safety and reducing the potential for injury events.

A portable ladder must:

- be long/tall enough to safely reach the work area
- have a load rating that can support the weight of the user, materials, and tools
- have non-conductive side rails, when used near energized equipment.

When using a non-self-supporting straight or extension ladder, observe the following precautions:

- Use ladders only on stable and level surfaces unless secured to prevent accidental displacement.
- Extend ladder side rails at least 3 feet above the upper landing to which the ladder is used to gain access.
- Set up the ladder so that the height-to-base ratio is 4 feet to 1 foot (e.g., 4 feet away from vertical member for a 16-foot ladder). *A general "rule of thumb" is to place feet at base of ladder; extend arms; hands should just touch side rails.*
- Have another person hold the ladder during ascent or descent, or tie/stake/foot it in place (top and bottom).
- Set ladder so that both rails of the ladder maintain equal contact with the supporting structure.

- Use adjustable feet to level the ladder, if applicable.
- Never lean more than 12 inches beyond either side rail. *Belt-buckle rule: always keep your belt buckle inside the side rails of the ladder.*
- Carry small tools and other work materials in your clothing or attached to a tool belt.
- The third highest rung is the maximum climbing height

When using a self-supporting step ladder:

- Use a step ladder only on a solid, level surface.
- Never try to use a folded step ladder as a straight ladder.
- Fully extend and lock the spreaders.
- Never climb or stand on the leg braces, the top step, or on the service tray.
- Avoid using an unprotected step ladder in a doorway or high-traffic areas.
- When working in a high-traffic area, lock or barricade doors, mark the area off, or have a co-worker monitor the area while work is performed.
- Carry small tools and other work materials in your clothing or attached to a tool belt.
- Maintain three-point contact if it is necessary to carry large objects up or down a ladder.

General Information (ANSI A14 and OSHA §1910.26)²⁰

The duty rating is to be considered the maximum working load, which includes the weight of the user, materials, and tools. The following summarizes the classification of ladders by duty rating:

TYPE	DUTY	DUTY RATING
Type IA	Extra heavy	300 lbs.
Type I	Heavy	250 lbs.
Type II	Medium	225 lbs.
Type III	Light	200 lbs.

Each section of a multi-section ladder, when fully extended, should overlap the adjacent section by at least the number of feet indicated in the table below.

Minimum required overlap (extension ladders)

Normal Length of Ladder		
16 ft - 36 ft	>36 ft - 48 ft	>48 ft - 60 ft
3 feet	4 feet	5 feet

The length of single ladders or individual sections of ladders shall not exceed 30 feet. Two-section ladders shall not exceed 48 feet in length and ladders with more than two sections shall not exceed 60 feet in length.

Maximum lengths for wooden, aluminum, and fiberglass step ladders.

DUTY RATING	LENGTH
Type IA and Type I	20 feet
Type II	12 feet
Type III	6 feet

Stepladders shall not exceed 20 feet in length.

Fixed Ladders (§1926.1053)²⁰

- Fixed ladders shall be used at a pitch no greater than 90 degrees from the horizontal, as measured to the back side of the ladder.
- Each step or rung shall be capable of supporting a single concentrated load of at least 250 pounds (114 kg) applied in the middle of the step or rung.
- The rungs and steps of fixed metal ladders shall be corrugated, knurled, dimpled, coated with skid-resistant material, or otherwise treated to minimize slipping.
- Where the total length of a climb equals or exceeds 24 feet (7.3 m), fixed ladders shall be equipped with one of the following: cages, wells, ladder-safety devices, or self-retracting lifelines.

Scaffolds (§1926.451)²⁰

The following recommendations were based on NIOSH investigative/research experience, and OSHA²⁰ and ANSI²⁸⁻³² safety standards for scaffolds. Every worker should be knowledgeable of the following when using scaffolds.

- The footing or anchorage for scaffolds should be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects, such as barrels, boxes, loose bricks, or concrete blocks, should not be used to support scaffolds or planks.
- No scaffold should be erected, moved, dismantled, or altered except under the supervision of a competent person.
- Guardrails and toeboards should be installed on all open sides and ends of platforms more than 10 feet above the ground or floor, except needle-beam scaffolds and floats.
- Guardrails should be 2 by 4 inches, or the equivalent, approximately 42 inches high, with a midrail, when required. Supports should be at intervals not to exceed 8 feet, and toeboards should be a minimum of 4 inches in height.
- Scaffolds 4 feet to 10 feet in height, having a minimum horizontal dimension in either direction of less than 45 inches, should have standard guardrails installed on all open sides and ends of the platform.

- Scaffolds and their components should be capable of supporting without failure at least 4 times the maximum intended load.
- Any scaffold having accessories such as braces, brackets, trusses, screw legs, ladders, etc. which are damaged or weakened from any cause should be immediately repaired or replaced.
- All scaffold platforms should be tightly planked with scaffold plank grade, or equivalent, as recognized by approved grading rules for the species of wood used.
- After the erection of scaffolding at any project site, the employer should designate a competent person to initially inspect the scaffolding and, at designated intervals, re-inspect the scaffolding. Areas of consideration for inspection should include but not be limited to the following: 1) braces, 2) brackets, 3) footing (anchorage), 4) guardrails and toeboards, 5) ladders, 6) legs, 7) locking pins, 8) overhead protection, 9) planking, 10) poles, 11) securing, 12) slippery conditions, 13) trusses, and 14) uprights.
- Suspension-scaffold rigging should be inspected periodically by a competent person to ensure that all connections are tight and that no damage to the rigging has occurred since its last use.
- Synthetic rope used in suspension scaffolding should be protected from heat-producing sources.
- Employers should ensure that employees are informed of the hazards of using diagonal braces as a means of climbing scaffolds and instruct workers on the proper way to climb scaffolding.

Falls from buildings (§1926.502)²⁰

The following recommendations were based on NIOSH investigative/research experience, and OSHA²⁰ and ANSI²⁸⁻³² safety standards for falls from or out of buildings or other structures.

- Designers of buildings such as multi-tiered steel-framed structures should provide for fall protection anchorage systems as part of the overall design of the structure.
- Designers of tanks should incorporate anchorage points (for securing scaffolds and lifelines) and toe boards into the design of their products; owners of tanks should consult with tank manufacturers to devise means of installing these safety features on existing tanks.
- A competent person should evaluate potential tie-off anchorage points and determine if the available safety equipment can work as designed. If the equipment will not work as designed, contact equipment manufacturers to determine what equipment is available that can do the job properly.
- A competent person should routinely inspect all protective devices (e.g., guardrails, lifelines, etc.) to ensure they operate properly.
- Employers should ensure that workers follow pre-fabrication building plans and procedures and comply with existing standards regarding structural steel assembly.
- Employers should ensure that workers using personnel hoists and work platforms comply with existing standards regarding the use of personnel hoists and work platforms.

- Plant/facility owners/operators should identify areas that may be hazardous to all personnel, including contractors, and restrict or prohibit the use of, or access to, these areas.
- Unused or unsecured construction materials should be stored only in designated areas.
- Lifts or hoists should be used to raise tools and materials to working heights or to lower tools and materials to ground level.

Roof Openings

- Install guarding and/or fall protection on all roof openings.
- Warning signs should be present on all roof openings.
- Employers should consider, when applicable, cutting the roof openings as the last action on the roof to help minimize exposure to this type of hazard.

Floor Openings

- Install guarding in the form of a standard railing and toe boards on all sides of floor openings, or install a cover capable of supporting the maximum intended load and so installed as to prevent accidental displacement.
- Hatchway floor openings should be guarded by hinged-floor-opening covers 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.

Skylights

- Install guarding in the form of standard railing around skylight openings, or install a cover capable of supporting the maximum intended load. Covers over skylight openings should be installed so as to prevent accidental displacement.
- To guard against falls through skylights by maintenance or other personnel who must access the roof once construction is completed, building owners should consider installing permanent railings around skylight perimeters or protective covers over individual skylights.
- Skylight manufacturers and building owners should voluntarily affix warning signs (e.g., “DANGER—skylights have been installed on this building. Stepping or sitting on the skylight may result in severe injury or death.”) on the skylights and at or near points of access (e.g., roof hatches, fixed ladders, stairways, doors, etc.) to areas containing these skylights.
- Designers/manufacturers of skylights should evaluate current designs with a view toward increasing load capacities and/or incorporating safeguards (e.g., protective grillwork).

Leading Edges and Wall Openings

- Provide fall protection measures along unguarded roof perimeters and balconies.
- During steel erection, secure temporary flooring from displacement.
- Work near an open or damaged window should be done from the side rather than from directly in front of the window, whenever possible. This is also true of door and window openings prior to installation of the door and window. Guardrails should be installed across the opening until the door or window is installed.

Stationary Vehicles and Tree Work

The following recommendations were designed for aerial lifts (§1926.556),²⁰ fork lifts (powered industrial trucks)(§1910.178), and tree work,¹¹ and should be followed where applicable.

Aerial lifts can be defined as any vehicle-mounted aerial device used to elevate personnel to jobsites above ground such as extensible boom platforms, aerial ladders, articulating boom platforms, vertical towers, or any combination of these devices.

- A full-body harness should be worn and a lanyard attached to the boom or basket when working from an aerial lift.
- Attaching the lanyard to an adjacent pole, structure, or equipment while working from an aerial lift should not be permitted.
- Employees should always stand firmly on the floor of the basket, and should not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.
- An aerial lift truck should not be moved when the boom is elevated in a working position with personnel in the basket, except for equipment which is specifically designed for this type of operation.
- Climbers should not be worn while performing work from an aerial lift.
- The brakes should be set, and when outriggers are used, they should be positioned on pads or a solid surface. Wheel chocks should be installed before using an aerial lift on an incline, provided they can be safely installed.
- Regular inspection and maintenance should be performed on all tools and equipment prior to use.

Fork lifts

Whenever a truck used for lifting personnel is equipped with vertical controls only, or vertical and horizontal controls elevatable with the lifting carriage or forks, the following precautions should be taken for the protection of the personnel being elevated:

- A safety platform firmly secured to the lifting carriage and/or forks should be used.
- Means should be provided whereby personnel on the platform can remotely shut off power to the truck.
- Protection from falling objects should be provided.

Trees

- Workers should not perform tree trimming or cutting without appropriate safety training.
- Use safe work procedures provided by the employer and/or equipment manufacturer for climbing, felling, topping and pruning trees.
- Use safe work procedures provided by the employer and/or equipment manufacturer to prevent the cutting of climbing ropes, lanyards, and harnesses or straps.
- Ensure that proper fasteners are used at the connectors for all climbing-cradle ropes.
- Inspect trees and limbs for structural weakness and the presence of powerlines before climbing or cutting.
- Inspect all equipment, including fall-protection equipment, before use to ensure that it is not damaged or defective.
- Operate mobile equipment (e.g., aerial lifts) only if properly trained.
- Evaluate the feasibility of a redundant fall-arresting system.

Summary Recommendations

The following is a summary of recommendations that may be applicable to all fall environments. These recommendations are based on the 90 FACE investigations and should be considered as part of an overall fall protection program.

Employers should:

- Coordinate site-specific safety programs between multiple contractors.
- Prime contractors and subcontractors should abide by the Rules of Construction, which state: “The prime contractor and any subcontractors may make their own arrangements with respect to obligations which might be more appropriately treated on a jobsite basis rather than individually.” Thus, for example, the prime contractor and his subcontractors may wish to make an express agreement that the prime contractor or one of the subcontractors will provide all required first-aid or toilet facilities, thus relieving the subcontractors from the actual, but not any legal, responsibility (or, as the case may be, relieving the other subcontractors from this responsibility). In no case shall

the prime contractor be relieved of overall responsibility for compliance with the requirements of this part (1926.16)²⁰ for all work to be performed under the contract.

- Instruct new employees in the proper methods to be used in the performance of assigned tasks and periodically observe the working habits of new employees to ensure that they are performing their assigned tasks in a safe manner.
- Design, develop, and implement a verbal and/or written post-training examination to reinforce and evaluate the effectiveness of the safety training program.
- Recognize and provide for language differences among workers.
- Conduct scheduled and unscheduled safety inspections.
- Consider all environmental conditions prior to the commencement of work activities.
- Provide appropriate signs/placards at areas where fall hazards may exist such as roofs containing skylights or floor openings secured with barriers.
- Use standby persons where work is performed in confined spaces.
- Design, develop, and implement procedures to be followed in the event of a medical emergency, including rescue operations.
- Incorporate safety program requirements in contract language.
- Follow applicable safety rules and standards established by OSHA and ANSI.

Conclusion

The Occupational Safety and Health Act of 1970 was established “to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources.”³³ One means of achieving this goal is by providing for the development and promulgation of occupational safety and health standards. Included in these standards are safety and health regulations applicable to fall protection and guarding which include, but are not limited to, ladders, scaffolds, floor and wall openings, vehicles, tree trimming, and personal protective and life saving equipment. These regulations and other applicable standards from the American National Standards Institute along with NIOSH recommendations, should be followed where the possibility of falls from elevations exists.

Additionally, NIOSH has developed and disseminated the following Alerts as a further means to help reduce the number of fatalities resulting from falls from elevations: *Falls Through Skylights and Roof Openings*,³⁴ *Preventing Falls and Electrocutions During Tree Trimming*,¹¹ and *Preventing Worker Injuries and Deaths Caused by Falls From Suspension Scaffolds*.³⁵

GLOSSARY

The Code of Federal Regulations list the following scaffold types.²⁰

- 1) **Boatswain's chair** -- A seat supported by slings attached to a suspended rope, designed to accommodate one worker in a sitting position.
- 2) **Bricklayer's square** -- A scaffold composed of framed wood squares which support a platform, limited to light and medium duty.
- 3) **Carpenter's bracket** -- A scaffold consisting of wood or metal brackets supporting a platform.
- 4) **Crawling boards or chicken ladders** -- A plank with cleats spaced and secured at equal intervals, for use by a worker on roofs, not designed to carry any material.
- 5) **Float or ship** -- A scaffold hung from overhead supports by means of ropes and consisting of a substantial platform having diagonal bracing underneath, resting upon and securely fastened to two parallel plank bearers at right angles to the span.
- 6) **Horse** -- A scaffold for light or medium duty, composed of horses (i.e., sawhorses or other simple framing) supporting a work platform.
- 7) **Interior hung** -- A scaffold suspended from the ceiling or roof structure.
- 8) **Ladder jack** -- A light duty scaffold supported by brackets attached to ladders.
- 9) **Manually propelled mobile** -- A portable rolling scaffold supported by casters.
- 10) **Mason's adjustable multiple-point suspension** -- A scaffold having a continuous platform supported by bearers suspended by wire rope from overhead supports, so arranged and operated as to permit the raising or lowering of the platform to desired working positions.
- 11) **Needle beam** -- A light-duty scaffold consisting of needle beams (i.e., a horizontal beam or group of beams for carrying the load of a column, wall, or other part of a structure) supporting a platform.
- 12) **Outrigger** -- A scaffold supported by outriggers or thrustouts projecting beyond the wall or face of the building or structure, the inboard ends of which are secured inside of the building or structure.
- 13) **Plasterer's, decorator's, and large area single-pole scaffold** -- Platforms resting on putlogs or cross beams, the outside ends of which are supported on ledgers secured to a single row of posts or uprights, and the inner ends of which are supported on or in a wall.
- 14) **Roofing or bearer bracket** -- A bracket used in slope roof construction, having provisions for fastening to the roof or supported by ropes fastened over the ridge and secured to some suitable object.

- 15) **Single-point adjustable suspension** -- A manually or power-operated unit designed for light-duty use, supported by a single wire rope from an overhead support so arranged and operated as to permit the raising or lowering of a platform to desired working positions.
- 16) **Stone setter's adjustable multiple-point suspension** -- A swinging-type scaffold having a platform supported by hangers suspended at four points so as to permit the raising or lowering of the platform to the desired working position by the use of hoisting machines.
- 17) **Tube and coupler** -- An assembly consisting of tubing which serves as posts, bearers, braces, ties, and runners, a base supporting the posts, and special couplers which serve to connect the uprights and to join the various members.
- 18) **Tubular welded frame** -- A sectional panel or frame-metal scaffold substantially built up of prefabricated welded sections which consists of posts and horizontal bearer with intermediate members.
- 19) **Two-point suspension (Swinging scaffold)** -- A scaffold, the platform of which is supported by hangers (stirrups) at two points, suspended from overhead supports so as to permit the raising or lowering of the platform to the desired working position by tackle or hoisting machines.
- 20) **Window jack** -- A scaffold, the platform of which is supported by a bracket or jack which projects through a window opening.
- 21) **Double pole or independent pole** -- A scaffold supported from the base by a double row of uprights, independent of support from the walls and constructed of uprights, ledgers, horizontal platform bearers, and diagonal bracing.

Additionally, scaffolds are classified into weight-bearing categories which include heavy-duty scaffolds which are designed and constructed to carry a working load not to exceed 75 pounds per square foot. Medium-duty scaffolds are designed and constructed to carry a working load not to exceed 50 pounds per square foot, and light-duty scaffolds are designed and constructed to carry a working load not to exceed 25 pounds per square foot.

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PART II
FATALITY ASSESSMENT AND CONTROL EVALUATION (FACE)
REPORTS, 1982-1997
FALLS FROM ELEVATIONS

The following 90 FACE investigations were conducted between May 1982 and September 1997. The investigations have been divided into four categories according to their E-code classifications as follows:

Number of Investigations	E-code	Description	Beginning Page Number
8	881.0	falls from ladders	39
16	881.1	falls from scaffolds	64
58	882.0	falls from or out of buildings or other structures	120
8	884.9	other falls from one level to another	300

The first two numbers of the FACE report (e.g., 87) denote the year in which the incident was investigated. The last two numbers of the FACE report (e.g., 47) identify a sequential file number for a particular year.

FACE 87-47: Worker Dies Inside Filtration Tank in Michigan

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrical-related and confined space-related fatalities. The purpose of the FACE program is to identify and rank factors that influence the risk of fatal injuries for selected employees.

On May 12, 1987, a city worker died while checking the inside of an empty filtration tank at a sewage treatment plant.

CONTACTS/ACTIVITIES

The Water Pollution Control Federation (WPCF) notified the Division of Safety Research (DSR) of this fatality and requested technical assistance. This case has been included in the FACE Project. On June 15-16, 1987, a DSR research industrial hygienist conducted a site visit, collected incident data, photographed the site, and interviewed representatives of the employer and comparison workers.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this incident is a municipality with a resident population of approximately 160,000. The victim worked at the wastewater treatment plant (in the wastewater treatment department) which has a total of 56 employees, primarily plant operators and plant maintenance personnel. Additionally, there are five lab technicians, three plant foremen, a chemist, a civil engineer, office personnel, and a plant supervisor.

New employees are given a half-day orientation concerning the operating policy of the city. Time off is provided for mandatory reading of safety booklets. All employees are given formal training in hazardous communication, material safety data sheets/"right to know", and the use of self-contained breathing apparatus. Continual on-the-job task training also addresses various hazards encountered on a day-to-day basis. Workplace safety is stressed as a responsibility of each employee. A wastewater treatment plant safety committee which consists of the plant superintendent, two union stewards (a plant maintenance worker and a plant operator), a maintenance foreman, and the civil engineer meets monthly. Accident reports, safety equipment, safety complaints from employees, the implementation of safety directives from management, etc. are discussed at these committee meetings. The two union stewards are given additional time to evaluate employee complaints and safety concerns in the plant. No training is given on confined space entry; however, plant supervisors have necessary testing equipment available to test a confined space atmosphere for oxygen (O₂), hydrogen sulfide (H₂S), and explosive gases. The plant also has several self contained breathing apparatus (SCBA) throughout the plant facility.

SYNOPSIS OF EVENTS

A 55 year-old wastewater treatment plant operator (the victim) with 25 years of experience was inspecting one of twelve open-top concrete filter tanks (used for tertiary wastewater treatment) when this incident occurred. Each filter tank is 15 feet wide x 24 feet long x 12 feet deep and is divided vertically in the middle by a concrete baffle. The bottom of each tank contains a filter bed (several feet of filter media composed of graduated sized stone, covered by approximately 12 inches of wheat-sized anthracite coal). Four trough-

like weirs spaced equally apart span the width of each tank half, three feet above the top of the filter media. A concrete walkway with steel safety rails is located around the top of each tank. Each tank operates with approximately nine feet of wastewater and is backwashed three times per day. During this process, a small amount of the filter media (i.e. coal) is washed away. In order to determine the amount of filter media lost, the victim (or other plant operators, when assigned) periodically drain each tank and measure the depth of the filter media. To do this employees are required to lower an aluminum ladder into the tank, positioning the feet of the ladder inside a weir, climb into the tank with a steel tape, measure the depth of the filter media, climb back out, and place the filter tank back in operation. This process is repeated for all the filter tanks. The victim had been assigned to inspect the depth of the filter media in all of the filter tanks (a task which he had done at least twice before). Four days prior to the day of the accident the victim had inspected six tanks. The acting plant foreman (the victim's supervisor) was not aware of the victim having experienced any ill effects from these tank inspections.

On May 12, 1987, the victim reported to work at 8:00 a.m. and was asked by the plant foreman if he required any assistance in the completion of the remaining six tank inspections. The victim said "no" and completed the inspection of one tank and, although there were no eye witnesses, it is presumed that he was in the process of climbing either into or out of a second tank when he fell from the ladder into the weir. The victim struck his head on a ladder rung or on an edge of the weir.

At approximately 10:55 a.m. the victim's supervisor noticed that the filter tank being inspected had no filter tank valve changes documented on the computer for several minutes. The supervisor left the control room and entered the tertiary filter tank building to check on the victim. The supervisor found the victim lying unconscious inside a weir at the bottom of the tank. The supervisor immediately notified office personnel in the plant, who notified the city fire department emergency rescue squad and then summoned a maintenance worker for help. The supervisor and the maintenance worker entered the filter tank, but did not attempt cardiopulmonary resuscitation (CPR). The rescue squad arrived on the scene approximately two and a half minutes after being called, entered the tank, hoisted the victim out, and began to administer CPR. Resuscitation efforts were unsuccessful. The county medical examiner arrived on the scene at about 1:00 p.m. and pronounced the victim dead at the scene.

CAUSE OF DEATH

An autopsy was conducted and the cause of death listed by the medical examiner was hypertensive and arteriosclerotic heart disease. Also, according to the medical examiner: "Advanced emphysema of the lungs may have contributed to the death. The deceased was considerably overweight . . .", the ". . . laceration of the left side of the head was sustained as a result of the terminal fall.", and "Yellow discoloration of the skull may have been related to diabetes mellitus."

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Workers who are required to enter confined spaces to perform tasks as part of their job responsibilities should receive pre-placement and periodic physical examinations to determine that they are physically capable of performing these duties.

Discussion: Simply entering and exiting the filter bed placed a great deal of stress on the victim's cardiopulmonary system. Because of pre-existing medical problems (emphysema, arteriosclerotic heart disease, obesity, and diabetes), which were apparently unknown to the victim, he was unable to withstand

this stress. This fatality underscores the advisability of pre-placement and periodic physical examinations for any strenuous work, especially in a confined space.

Recommendation #2: The employer should develop a written comprehensive safety program that clearly documents procedures for safe entry into confined spaces.

Discussion: All employees who work in or around confined spaces (wastewater treatment plant employees) should be aware of potential hazards, possible emergencies, and specific procedures to be followed prior to entering a confined space. These procedures should include, but not be limited to:

1. Air quality testing to determine adequate O₂ level.
2. Ventilation of the space to remove air contaminants.
3. Monitoring of the space to determine a safe oxygen level is maintained.
4. Employee training in confined space entry, testing, and use of personal protective equipment (respirators, clothing, etc.).
5. Standby person outside the confined space for communication and visual monitoring.
6. Emergency rescue procedures.

Even though there were no dangerous air contaminants in the confined space and normal oxygen levels were found in air samples taken inside the filter tank by the DSR research industrial hygienist at the time of the on-site evaluation, entry into confined spaces should not be attempted until atmospheric testing of the confined space insures that the atmosphere is safe. This testing requirement applies to all confined spaces, including the inside of open-top tertiary filter tanks. Testing must be done by a qualified person prior to entry. Specific recommendations regarding safe work practices in confined spaces can be found in the NIOSH Publication No. 80-106, "Working in Confined Spaces". This publication also defines and provides recommendations on hot work, isolation, purging, ventilation, communication, entry and rescue, training, posting, safety equipment, clothing, etc.

Recommendation #3: A trained standby person should remain outside of the confined space when a worker enters or works inside. The standby person should visually monitor the tasks being performed inside and should be able to communicate with the worker(s) inside the confined space.

Discussion: A person trained in emergency rescue procedures, assigned to remain on the outside of the confined space for communication and visual monitoring of the person inside is of utmost importance.

Recommendation #4: Employees should be trained in cardiopulmonary resuscitation (CPR).

Discussion: CPR should begin as soon as possible, minimally within 4 minutes (in accordance with American Heart Association guidelines) in order to achieve the best results. To meet this criteria for successful resuscitation, workers should be trained in CPR to support the victim's circulation and ventilation until trained medical personnel arrive. While some employees had apparently received CPR training in the past, employees who arrived at the scene of the accident (prior to the arrival of emergency

medical personnel) did not begin CPR on the victim. Retraining in CPR is necessary, usually on an annual basis.

Recommendation #5: The procedure used to measure the level of filter media present in a tank should be evaluated to determine if the procedure could be modified to eliminate the need to enter the confined space.

Discussion: Prior to entry into a confined space one of the first questions that needs to be addressed is whether entry is necessary. The procedure used to measure the level of filter media present in a tank should be evaluated to determine if it could be modified to eliminate the need for entry into the tank.

FACE 88-14: Labor Foreman Falls to His Death Inside Municipal Water Tank in Indiana

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 21, 1988, a 28-year-old male labor foreman died when he fell 50 feet inside a 700,000-gallon municipal water tank.

CONTACTS/ACTIVITIES

Officials of the Occupational Safety and Health Program for the State of Indiana notified DSR of this fatality and requested technical assistance. A research safety specialist discussed this case with the OSHA compliance officer and on April 4 met with the employer's representatives. On April 5 a meeting was held with municipal officials and with responding ambulance personnel. The incident site was also photographed on this date.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this incident is a multistate corporation specializing in cathodic protection systems which provide a form of protection against electrolytic corrosion. Of the company's 250 employees, 16 perform the same type of work as the victim. The company has a written safety policy which prescribes the use of fall protection where there is potential that a worker may fall in excess of 10 feet. This policy also calls for testing the atmosphere prior to entering any confined space, and for the use of a lifeline, safety harness, and appropriate respirator when working inside a confined space. The victim was employed as a tank department foreman and served as supervisor at various sites where work on cathodic protection systems for water tanks was being performed.

SYNOPSIS OF EVENTS

The victim and a co-worker were assigned routine maintenance work on the cathodic protection system within an elevated municipal water tank. Approximately 2 months prior to this incident, the tank developed a leak and was drained. A small amount of water remained in the tank at a level below the riser which serves as the tank drain. There was ice on the surface of the water.

The cylindrical tank is approximately 40 feet wide by 60 feet high. A ladder on one of the legs supporting the tank provides access from the ground to a catwalk on the tank. The catwalk circles the tank approximately 125 feet above the ground. A second permanently mounted ladder extends from the catwalk to the top of the tank. At the top of the tank, a 2-foot-square door provides entry to the tank.

On the day of the incident, the victim and his co-worker arrived at the jobsite at 11:00 a.m. Prior to climbing the tank, they noticed an entry hatch on the side of the tank bowl at the level of the catwalk. They decided not to use this entry hatch because they weren't sure they could properly seal it at the conclusion of the work.

At approximately 12:15 p.m., the two men climbed to the top of the tank and found the entry door locked. The men descended the tank, obtained a key from city officials, climbed again to the top of the tank, and opened the door. They suspended a rope ladder through the door to provide access to the tank floor.

The maintenance work on the cathodic protection system required that they replace a fitting which was below the level of the water in the tank. The victim used a section of garden hose to begin siphoning the water from the bottom of the tank and routing it down the wet riser at the center of the tank bowl. Because the water would not be removed by the end of their shift, they performed other necessary maintenance work, planning to return the following day to finish the job.

At approximately 5:10 p.m., the co-worker exited the tank and stopped on the catwalk to wait for his supervisor. When the supervisor did not follow after 4 to 5 minutes, the co-worker climbed to the top of the tank in search of him. The co-worker saw the supervisor inside the tank approximately one quarter of the way up the ladder. The supervisor stated that he was tired and that his arms were numb. The supervisor then continued to climb the ladder.

The co-worker noticed that the supervisor "was climbing wrong and had a funny look on his face." (The supervisor was facing the ladder, as opposed to the standard procedure for climbing a rope ladder from the side thereby producing less swaying motion.) The co-worker asked the supervisor if he needed help. Upon receiving a positive response, the co-worker descended the ladder to assist him. The co-worker managed to grasp the supervisor's hand, however the supervisor was unresponsive to the co-worker's repeated calls to grasp the ladder. The co-worker was unable to retain his grip, and the supervisor slipped from the ladder and fell approximately 50 feet to the bottom of the tank. The co-worker descended the ladder to aid the victim and moved him slightly from the facedown position near the water where he landed. He returned to the top of the tank where he cried out for help. He got the attention of several individuals located at a business establishment across the street who, in turn, summoned help.

The local fire department received the report of the accident via telephone at 5:15 p.m. and were on the scene at 5:19 p.m. Two firefighters and an EMT from the local ambulance company entered the tank through the manway located at the catwalk. The victim was found to be bleeding from the mouth and nose, with noticeable deformation of his forearm and right upper leg. No vital signs were detected. The victim was secured to a back board and lowered to the ground. The ambulance departed the scene at 5:54 p.m. and arrived at the local medical center at 6:00 p.m. where the victim was pronounced dead shortly after arrival.

Neither the co-worker nor the responding rescue personnel noted any unusual odors in the tank, nor did they experience any symptoms indicative of possible oxygen deficiency.

CAUSE OF DEATH

The Medical Examiner gave the cause of death as a skull fracture and lacerations of the brain, along with contusions to the lungs.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should periodically re-evaluate company confined space work procedures to ensure that the following areas are addressed:

- *atmospheric testing is performed prior to entry*
- *safe climbing devices are employed where needed*
- *safety harness and lifeline are used in all cases (for rescue as well as fall protection when working at elevations)*
- *an observer outside of the confined space is available to summon help if needed.*
- *communication devices are available to ensure adequate communications between workers in confined spaces and those outside.*

Discussion: The company that employed this foreman has written safety procedures that require the testing of the atmosphere of any confined space prior to entry. In addition, the procedures specify that a lifeline and safety harness are to be worn while working in a confined space, and that an appropriate respirator be worn when indicated by the atmospheric testing. None of these procedures were followed in this case, nor was any provision made for the use of safe climbing devices. In addition no observer was present, nor was any means provided for communication between the tower and anyone on the ground. If an oxygen deficient atmosphere existed within the tank, it could have proved fatal to both workers.

Recommendation #2: Employers should provide periodic refresher training which stresses the hazards that exist within confined spaces to all employees who work in or around confined spaces.

Discussion: Although the victim in this case was a supervisor who had received training in confined space entry procedures, he elected to forego written company safety procedures regarding atmospheric testing and the use of safety harnesses and lifelines. His failure to follow standard written procedures concerning confined space work was an important factor in this incident.

Recommendation #3: Company management (safety) personnel should conduct periodic worksite evaluations to ensure that written procedures are being followed in the field.

Discussion: In this case a foreman apparently chose to ignore company procedures regarding work in confined spaces. Since safety is an inherent function of management, workers cannot be expected to follow safety procedures if their supervisors do not. Periodic inspection of worksites by company safety personnel would serve to show management's interest in the safety program and reinforce within all workers the need to follow company standard operating procedures.

Recommendation #4: An evaluation of the worksite should be performed prior to the start of all operations to determine potential safety and health hazards as well as concerns which would affect the efficiency of the operation.

Discussion: An evaluation of the worksite prior to the start of work would permit safety hazards to be identified and plans for corrective action to be prepared prior to employee exposure. In the above case such an evaluation might have enabled the workers to avoid the initial climb up the tower to unlock the door at the top of the tank. In addition, a thoughtful evaluation might have convinced the supervisor to utilize the

hatch at the catwalk rather than the opening at the top of the tank. Such action may have eliminated the need for the rope ladder and thus prevented the fall.

Recommendation #5: Rescue personnel entering confined spaces should utilize appropriate protective equipment.

Discussion: In the above case, rescue personnel entered a confined space where a victim became ill and had fallen for unknown reasons without either checking the atmosphere first or utilizing self-contained breathing apparatus. In similar situations rescue personnel themselves often become victims. NIOSH investigations of 41 confined space incidents have revealed that 18 (31%) of the 59 victims were would-be rescuers.

FACE 89-05: Painter Dies in a 140-Foot Fall at a Municipal Water Tower

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 September 22, 1988, a 34-year-old male painter died when he apparently inhaled vapors from paint containing xylene, lost consciousness, and fell 140 feet within the vertical water supply pipe of a municipal water tower.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On December 13, 1988, a DSR field team met with the employer, the county coroner, and local emergency services personnel; and visited and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer in this incident is a small contractor specializing in painting water towers. The contractor has been in operation for 7 years and employs seven individuals. The company has no formal safety program and all training is "on the job." The victim had been employed by the company for 3 months, and had worked as a painter for the 2 months prior to the incident.

SYNOPSIS OF EVENTS

The victim was a member of a seven-man crew involved in painting a municipal water tower. The crew consisted of a foreman, four painters and two "groundmen." The crew had worked on this tower for several days prior to the incident.

The tower is a large, elevated water tank supported by seven legs. A 5-foot-diameter riser (vertical water supply pipe) extends from the center of the tank bowl to the ground approximately 145 feet below. Access to the top of the tank is provided by a fixed ladder on one of the tank legs. A hatchway on top of the tank provides access to the interior, with a second fixed ladder leading down to the tank floor. The top of the riser, located in the center of the tank floor, is normally covered with a metal grating; however, this grating had been removed for the painting operation. The interior of the riser contains a fixed ladder leading to the bottom, and a 6-inch-diameter overflow pipe. A 24- by 15-inch port located 5 feet above the bottom of the riser provides access to the interior of the riser from the ground.

Prior to painting the interior of the tower, air lines (for supplied-air respirators) and paint lines (for the paint spray guns) had been run through the bottom port and up the riser to the tank bowl. A 3/8-inch steel lifeline had been run from the top of the riser to the bottom for use during painting of the riser interior. A boatswain's

chair (a seat supported by slings attached to a suspended rope to support one person in a sitting position) was suspended at the top of the riser for the painter's use while working inside the riser.

At the time of the incident the victim was working alone, painting the inside of the riser. On previous days, he had applied two coats of paint to the interior. Three other painters were working on the exterior of the tank, and the two groundmen were handling the paint lines and air lines on the ground.

The previous afternoon the foreman had observed the victim exiting the riser in an apparently intoxicated condition. The victim had not been wearing his issued supplied-air respirator, relying instead on a bandana worn across his mouth and nose. Since the paint being used contained both xylene and methyl ethyl ketone, the victim had probably become intoxicated by breathing vapors containing these chemicals. The foreman reprimanded the victim for not wearing his respirator.

On the morning of the incident, the foreman reminded the victim that he must wear his respirator when painting inside the tank. The victim and one co-worker entered the tank to prepare the equipment for painting the interior of the riser. The victim told the co-worker that he would be painting the riser from the fixed ladder instead of using the boatswain's chair because it was "easier." Once preparations for this work were completed, the co-worker left the interior of the tank.

The victim had been painting for approximately one-half hour when one of the groundmen, who was located outside near the access port at the base of the riser, heard a noise and observed the paint line falling within the riser. Moments later the victim, who had fallen from the ladder, landed at the base of the riser.

The groundman immediately called to his co-workers that a man had fallen within the riser. Members of the local fire department rescue squad who were training in a field adjacent to the tower, immediately arrived at the scene. One paramedic, who entered the riser through the access port, examined the victim and was unable to detect any vital signs. The victim's body was removed through the access port and cardiopulmonary resuscitation (CPR) was begun. CPR was continued while the victim was transported to the local hospital where he was pronounced dead on arrival.

Fire department personnel involved in the rescue attempt reported that the victim was wearing a safety belt when they reached him inside the riser, but that the belt was not connected to the lifeline within the riser. They further reported that the victim was wearing a bandana over his face, and that no respirator was present on the body. A police department detective along with one of the victim's co-workers entered the tank approximately 1 1/2 hours after the incident occurred. The police detective reported that vapor was visible in the tank at this time. (The vapor is also visible in photographs taken by the detective.) The victim's supplied-air respirator was found lying on the floor of the tank. Later inspection revealed that the victim had painted the top 8 to 10 feet of the riser before falling.

An autopsy conducted on the victim revealed 0.2mg% xylene in a sample of blood taken from the victim's heart.

CAUSE OF DEATH

The medical examiner's office gave the cause of death as multiple fractures and internal injuries. The fall which produced these injuries was very likely a direct result of loss of consciousness due to acute xylene toxicity.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that all employees understand hazards associated with their jobs.

Discussion: The employer in this case had provided no formal training, relying instead on on-the-job training to prepare workers for the tasks to which they are assigned. Although the victim had previously been reprimanded for failure to use his respirator, he apparently did not understand that the respirator was essential for his safety during this job and he neglected to wear it, relying instead on a bandana to protect himself from the chemicals in the paint. A training program providing the employee with knowledge of the possible consequences of breathing the vapors from this paint might have increased his understanding of the potential danger involved in painting without a respirator. In addition, the victim failed to use the boatswain's chair and to connect his safety belt to the lifeline provided for fall protection. A comprehensive safety training program which stressed the importance of using the safety equipment provided by the employer, and which increased employee understanding of hazards and how to utilize protective equipment might have prevented the fatal fall.

Recommendation #2: Employers should verify that safety equipment provided is used by their employees.

Discussion: The victim in this case had been reprimanded the previous day for failure to use his respirator, and had again been reminded to wear it the day the fatality occurred. Employers should ensure that employees understand why they need to use their safety equipment at all times. Appropriate disciplinary action or additional training should be provided when employees continually neglect to use this equipment. Periodic spot checks to verify compliance with safety rules might have encouraged the victim to use his equipment and might have prevented this fatality.

Recommendation #3: Rescue considerations should be addressed by employers whenever workers are assigned to areas where the potential for falls or entrapment exist.

Discussion: In this case the victim was working at an elevation within a confined space. Because of this, the potential for falling or being overcome by chemicals within the confined space existed. Despite the hazards involved, no pre-planning for any type of rescue operation had been made. When working in similar locations employers should develop a written rescue procedure to be used in the event an incident should develop. This rescue procedure should include actions to be taken by other employees as well as prior notification of local fire department/rescue personnel.

FACE 90-07: Laborer Dies After Fall From Ladder in South Carolina

SUMMARY

A masonry contractor had been contracted to construct a life center building across the road from a hospital complex. A construction laborer (victim) had been instructed by his foreman to prepare a batch of mortar on the second level of a new construction project, and carry it to the third level. The mortar was carried by pails from the second level via stairs to the third level. For some unknown reason, the victim decided to use the top section of an aluminum extension ladder (without safety feet). He placed one end of the ladder on the wet concrete floor, leaned the other end against a wall, and started to climb. The ladder apparently slipped on the wet floor causing him to fall approximately 12 feet. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers and employees must:

- *ensure that ladders are used in accordance with existing safety standards*
- *instruct workers that upper sections of extension ladders should not be used as single ladders*
- *train employees in the proper use of tools and equipment needed to perform their assigned tasks*
- *designate an individual as the company safety officer to visit the various jobsites, identify potential hazards, and ensure that those hazards are eliminated.*

INTRODUCTION

On September 21, 1989, a 46-year-old male construction laborer fell while climbing a ladder. He died on September 24, 1989, from injuries sustained in the fall.

On October 11, 1989, the South Carolina Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the incident and requested technical assistance.

On October 19, 1989, a DSR safety engineer conducted an investigation. The investigator visited and photographed the incident site, reviewed the case with company officials, talked with employees who were present at the time of the incident, and contacted the county medical examiner's office for information about the incident.

The employer is a masonry contractor who has been in business for 30 years and has 267 employees. Although the company has written safety rules and procedures and company officials conduct regular safety meetings, it has no company safety officer. The company places a safety flier in the weekly pay envelope to try to keep the employees aware of proper safety practices. Safety information is primarily conveyed via on-the-job training. The victim had worked for the employer for about 12 months as a laborer prior to this incident.

INVESTIGATION

A masonry contractor had been contracted to construct a life center building across the road from a hospital complex. At the time of the incident, the victim was preparing a batch of mortar as instructed by the foreman. The victim's duties included mixing mortar and transporting it to the desired location in pails. The rest of the crew,

including the foreman, went up to the third level of the building, which was about 12 feet above the second floor where the victim was working. The workers used a stairway to access the third floor work area.

Although no one saw the victim fall, evidence at the site suggested that the victim took the top portion of an aluminum extension ladder (without safety feet), placed one end on the wet concrete floor, and leaned the other end against a wall to reach the third floor area. Without attempting to tie off the ladder or secure it in any fashion, the victim began to climb the ladder. The bottom of the ladder apparently slipped on the wet floor, causing the victim to fall. There were no indications at the scene that the victim was carrying a pail of mortar when he fell.

The victim was discovered by an employee of another contractor on the site. This individual said that the victim was conscious, but was talking incoherently and bleeding from his ears. By the time the emergency rescue squad arrived 15 minutes after the fall, the victim had lost consciousness. He was transported to the hospital where he died 3 days later.

During the interviews, the employer could offer no reason why the victim used the ladder, which belonged to another contractor, instead of the stairway to access the work area. The general contractor stated that the victim's employer did not have any extension ladders at the jobsite. There was no indication that the victim had used a ladder in this way prior to the incident. The incident occurred on the employer's last day of work at the site.

CAUSE OF DEATH

The medical examiner's report listed multiple traumatic injuries sustained from the fall as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that ladders are used in accordance with requirements of existing Federal safety standards.

Discussion: Occupational Safety and Health Administration (OSHA) construction standards require that the base, or feet, of portable metal ladders be placed on a substantial base (1926.450(a)(6)); that they be set up at a proper angle (1926.450(a)(7)); and that ladders in use be tied, blocked, or otherwise secured to prevent displacement (1926.450(a)(10)). Employers should be familiar with the Federal safety standards that apply to their businesses, including those that relate to the tools and equipment they use.

Recommendation #2: The upper sections of extension ladders should not be used as single ladders.

Discussion: Although referring to wooden sectional ladders, 29 CFR 1910.25(d)(2)(xvii) (which is a General Industry Standard) prohibits the use of top sections of such ladders unless equipped with safety feet. It would be prudent to follow this requirement whether the ladder is wooden or metal. The upper sections of extension ladders are not regularly equipped with safety feet and are not intended to be used as single ladders. Using sections of extension ladders in this manner creates potential hazards that can result in serious injuries or death.

Recommendation #3: Employers should train workers in the proper use of tools and equipment used to perform their assigned tasks.

Discussion: Had the victim been trained in the proper use of ladders, he would have known to use a ladder with safety feet, to place it at a safe angle, and to secure the ladder in compliance with existing standards. The victim placed a ladder without safety feet on a wet surface and did not secure it before starting to climb the ladder. A review of safety procedures involving ladders would be a good topic for a training session at a company safety meeting. Training sessions should be conducted and documented by company officials.

Recommendation #4: The employer should designate an individual as the company safety officer.

Discussion: At present the safety function is not overseen by one individual. Assigning one individual the responsibility for coordinating all of the safety activity of the company would most likely result in a better overall safety program. The company safety officer should be required to routinely visit the various jobsites, identify potential hazards, and ensure that those hazards are eliminated. This person should also discuss pertinent safety issues with the foreman on the jobsite on a regular basis.

REFERENCES

1. 29 CFR 1926.450(a)(6) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register
2. 29 CFR 1926.450(a)(7) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register
3. 29 CFR 1926.450(a)(10) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register
4. 29 CFR 1910.25(d)(2)(xvii) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register

FACE 93-22: Roofer Dies After Fall From Ladder--North Carolina

SUMMARY

A 56-year-old male roofer (the victim) died after falling approximately 15 feet from a ladder he was ascending. The victim was part of a five-man crew that was replacing a 35,000 square-foot office complex roof, which was 27 feet above ground. The workers were using a 40-foot fiberglass extension ladder tied off at roof level to access their work area. They began work at 8:30 a.m. and had only to install the flashing around the roof perimeter to complete the job. Three workers were already on the roof. The victim stopped at the tar kettle and asked the tar kettle attendant for a rag, then began to climb the ladder to the roof. The tar kettle attendant watched the victim climb the ladder approximately half-way up. The attendant turned away from the ladder, then heard something hit the ground behind him. When he turned around, he saw the victim lying face up on the ground. The emergency medical service (EMS) was summoned by phone from the office complex and one co-worker ran up the hill to the local hospital to summon help. The EMS arrived within 5 minutes, administered first aid, and transported the victim to the local hospital where he was pronounced dead by the attending physician. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *stress to all employees the importance of exercising caution when climbing ladders to their workplace*
- *develop and implement a comprehensive written safety program.*

INTRODUCTION

On June 11, 1993, a 56-year-old male roofer (the victim) died after falling approximately 15 feet from a 40-foot extension ladder. On June 14, 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 11, 1993, a safety specialist from DSR investigated the incident and reviewed the circumstances with a company representative, and the NCOSHA compliance officer and supervisor assigned to the case.

The employer in this incident was a roofing contractor that employed 8 workers and had been in operation for 30 years. The employer had a general safety program but no written safety procedures. All workers had received documented training in roofing and ladder safety. The victim had worked for the company as a roofer for 25 years. This was the first fatality the company had experienced.

INVESTIGATION

The company had been contracted to replace a 35,000 square-foot, 27-foot-high built-up roof on an office complex. A five-man crew was performing the work. The workers had been at the site for 1 week and work had progressed to the point that the only task remaining was the installation of the flashing around the perimeter of the roof. The day of the incident was to be the last day at the site.

At 8:30 a.m. on the morning of the incident, the foreman and two of the roofers climbed the ladder to the roof. The 40-foot fiberglass extension ladder had a 300-pound load limit rating.

On his way to the ladder, the victim passed the tar kettle where he asked for, and obtained from the attendant, a rag to use for the day. The attendant watched the victim climb the ladder to a height of approximately 15 feet, then turned away to prepare the tar kettle for transport from the site. The attendant heard something hit the ground behind him and thought the workers on the roof were throwing waste to the ground; however, when he turned, he saw the victim lying on his back on the gravel driveway.

The attendant yelled to the foreman, who, with one of the co-workers, descended the ladder to the ground. The co-worker went into the office complex to have someone summon the emergency medical service (EMS). The co-worker then ran to the hospital, which was located up the hill from the complex, to summon help.

The foreman began cardiopulmonary resuscitation but stopped when he realized the victim had broken ribs. The EMS arrived within 5 minutes and transported the victim to the hospital where he was pronounced dead by the attending physician.

Although the tar kettle attendant saw the victim ascend the ladder to approximately 15 feet above ground level, the event was unwitnessed. It is not known whether the victim slipped or tripped, then fell from the ladder. The steps of the ladder were clean and dry.

The medical examiner stated that there was no evidence of any physical condition that might have contributed to the incident. Blood alcohol and toxicology reports were negative. No citations for non-compliance with occupational safety and health standards were issued by NIOSH for this incident.

CAUSE OF DEATH

The medical examiner listed the cause of death as pericardial tamponade and right ventricle rupture.

RECOMMENDATIONS/ DISCUSSION

Recommendation #1: Employers should stress to all employees the importance of exercising caution when climbing ladders to their workplace.

Discussion: The ladder in this incident was clean and there was no evidence of a foreign substance that might have been a factor in the incident. Additionally, the workers had received training in ladder safety. Employers should constantly stress to employees the importance of exercising caution when climbing or working from ladders.

Recommendation #2: Employers should develop and implement a comprehensive written safety program.

Discussion: The written safety program should include, but not be limited to, ladder safety, the recognition and avoidance of fall hazards, and address appropriate worker training in the proper selection and use of fall protection equipment.

FACE 93-23: Painter Dies After Fall Inside 250,000 Gallon Water Tank--North Carolina

SUMMARY

A 20-year-old male painter (the victim) died after falling from an undetermined height inside a 250,000 gallon municipal water tank. The victim was part of a four-man crew painting the interior and exterior of the tank. Three painters, including the victim, were sandblasting and priming the exterior of the tank and the steel-grate catwalk around the circumference of the tank. The men were working from the catwalk, 112 feet above ground level. The crew foreman was inside the tank at floor level spraying an epoxy primer on the walls. A worker on the outside of the tank would periodically climb 25 feet to the top of the tank, using a permanently fixed side ladder, to check on the foreman through the 24-inch top opening at the crown of the tank. At approximately 3 p.m., the foreman, wearing a supplied-air respirator hood, heard a nearby noise and turned to see the victim lying on the floor of the tank. The victim was semi-conscious and having difficulty breathing. The foreman called to the outside workers for help. The victim was fitted with a body harness and lowered 85 feet to the ground through the 4-foot-diameter tank riser, located at the bottom of the tank body. The victim was then loaded by co-workers into a van and transported to the local hospital. The victim received no first aid at the site, nor was the EMS summoned. The victim arrived at the hospital at 4:18 p.m., was life flighted to a major trauma center at 5 p.m., and was pronounced dead at 9:13 p.m. NIOSH investigators concluded that, to prevent similar incidents, employers should:

- *develop and implement a comprehensive written confined space entry program*
- *develop and implement a comprehensive written safety program*
- *train all workers in the administration of basic first aid*

Additionally, property owners should:

- *require that all contractors have a written safety program specific to the work to be performed.*

INTRODUCTION

On July 2, 1993, a 20-year-old male painter (the victim) died after falling from an undetermined height inside a 250,000 gallon municipal water tank. On July 9, 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 11 and 12, 1993, a safety specialist from DSR conducted an investigation of the incident and reviewed the circumstances of the incident with the NCOSHA district supervisor and health compliance officer assigned to the case, along with employer representatives. NCOSHA photographs of the scene following the incident were reviewed during the investigation.

The employer was a painting contractor that had been in operation for 8 years and employed 6 workers. The contractor specialized in refinishing steel structures such as municipal water tanks. The contractor had a basic confined space entry program; however, workers had not received confined space entry training or training in the proper use of respirators. Workers received training for sandblasting and painting on the job. The victim had worked for the contractor for 2 months. The contractor had experienced no previous fatalities.

INVESTIGATION

The company had been contracted by a local municipality to sandblast, prime, and paint the interior and exterior of a 250,000 gallon water tank that served as a fresh water reservoir for the municipality. The tank was 140 feet high at its summit, and was encircled by a steel-grate catwalk 112 feet above ground. A 4-foot-diameter riser extended from the tank bottom, 85 feet to the ground. The riser had a 24-inch-diameter portal located 30 inches above the ground (Figure). Both the air lines for the supplied-air respirator hood and the sandblaster, and service ropes, ran from the ground through the riser to the interior of the tank. The men climbed up to the interior entrance of the tank through the riser, by means of fixed steel steps.

The crew had been at the jobsite for 3 weeks. The entire interior and exterior of the tank body had been sandblasted. Three painters (including the victim) were working on the catwalk, sandblasting the exterior surface and applying an epoxy primer. The crew foreman, equipped with an air-line respirator hood, was inside the tank spraying the interior walls with primer. No artificial interior lighting or additional ventilation was used.

Approximately every 30 minutes, one of the painters would climb a fixed ladder approximately 25 feet to the top of the tank to look through the 24-inch-diameter opening and check on the foreman. At approximately 3 p.m. the victim, without notifying the other workers, climbed to the top of the tank and entered. The foreman, spraying the epoxy primer, heard a noise and turned to see the victim lying on the tank floor. The foreman went to the victim and found him unconscious and breathing with some difficulty. The foreman yelled to the other workers, who entered the tank to help assist the victim. The men placed a full body harness on the victim, then placed him on the foreman's back. The foreman climbed down the fixed steps in the tank riser, assisted by the two other workers, who lowered the victim with a rope attached to the body harness. When the foreman reached the ground, he pulled the victim through the portal at the base of the riser. When the other workers reached the ground, the victim was loaded into a van. The victim was given no first aid at the site and the emergency medical service (EMS) was not summoned. The three men drove the victim to the hospital, arriving at 4:18 p.m. At 5:00 p.m., the victim was life flighted to a major trauma center where he died at 9:13 p.m.

The event was unwitnessed; however, it is possible that the victim entered the tank and either slipped or tripped and fell from the fixed ladder inside the tank. It is also possible that the victim entered the tank and was affected by epoxy vapors, causing him to become dizzy and fall.

The Material Safety Data Sheet (MSDS) for the epoxy primer warned against inhalation of the vapors, stating that inhalation of vapors would affect the brain or nervous system, causing dizziness. The MSDS also advised the epoxy primer be applied in a well-ventilated area with workers wearing airline respirators. An atmospheric testing meter was on-site; however the oxygen sensor was not functioning.

CAUSE OF DEATH

The coroner listed the cause of death as excessive pooling of blood in the brainstem. The victim had also sustained fractures of the fifth and sixth cervical vertebrae.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should develop and implement a comprehensive written confined space entry program.

Discussion: Employers should develop and implement a written confined space entry program to address all provisions outlined in the following NIOSH publications: Working in Confined Spaces: Criteria for a Recommended Standard [Pub. No. 80-106]; NIOSH Alert, Request for Assistance in Preventing Occupational Fatalities in Confined Spaces [Pub. No. 86-110]; A Guide to Safety in Confined Spaces [Pub. No. 87-113]; and NIOSH Guide to Respiratory Protection [Pub. No. 87-116].

A confined space entry program should contain the following:

- written confined space entry procedures
- evaluation to determine whether entry is necessary
- issuance of a confined space entry permit
- evaluation of the confined space by a qualified person
- testing and monitoring the air quality in the confined space to ensure:
 - oxygen level is at least 19.5 %
 - flammable range is less than 10% of the LFL (lower flammable limit)
 - absence of toxic air contaminants
- training of workers and supervisors in the selection and use of:
 - safe entry procedures
 - respiratory protection
 - environmental test equipment
 - lifelines and retrieval systems
 - protective clothing
- training of employees in safe work procedures in and around confined spaces
- training of employees in confined space rescue procedures
- conducting regular safety meetings to discuss confined space safety
- availability and use of proper ventilation equipment
- monitoring of the air quality while workers are in the confined space.

Recommendation #2: Employers should develop and implement a comprehensive written safety program.

Discussion: The safety program should include, but not be limited to, the recognition and avoidance of fall hazards. When employees are required to work from elevations, employers should provide appropriate fall protection equipment and include appropriate worker training in the proper selection and use of fall protection equipment.

Recommendation #3: Employers should ensure that supervisors and workers are aware of the potential hazards of all substances with which they are required to work.

Employers should ensure that Material Safety Data Sheets (MSDS) are available for all chemicals, paints, solvents and other substances that are used, and that supervisors and workers are aware of their potential hazards and appropriate protective measures. It is unclear whether the workers were familiar with the hazards associated with the epoxy primer that was being sprayed inside the tank.

Recommendation #4: Employers should train all workers in the administration of basic first aid.

Discussion: All workers should be trained in the administration of basic first aid, and instructed to summon the Emergency Medical Service (EMS) prior to moving an injured person if the possibility of serious injury exists.

Recommendation #5: Employers should require that all contractors have a written safety program specific to the work to be performed.

Discussion: Although the contractor had a basic confined space entry program, the contractor was not required to have a written safety program or confined space entry procedures specific to the work being performed in the water tank. The contract language should address specific safety and health requirements for any contractors. Additionally, worker safety and health issues should be included as one of the evaluation criteria for selecting the appropriate contractor.

REFERENCES

National Institute for Occupational Safety and Health, Working in Confined Spaces: Criteria for a Recommended Standard. DHHS (NIOSH) Publication No. 80-106, December 1979.

National Institute for Occupational Safety and Health Alert, Request for Assistance in Preventing Occupational Fatalities in Confined Spaces. DHHS (NIOSH) Publication No. 86-110, January 1986.

National Institute for Occupational Safety and Health, A Guide to Safety in Confined Spaces. DHHS (NIOSH) Publication No. 87-113, July 1987.

National Institute for Occupational Safety and Health, Guide to Respiratory Protection. DHHS (NIOSH) Publication No. 87-116, September 1987.

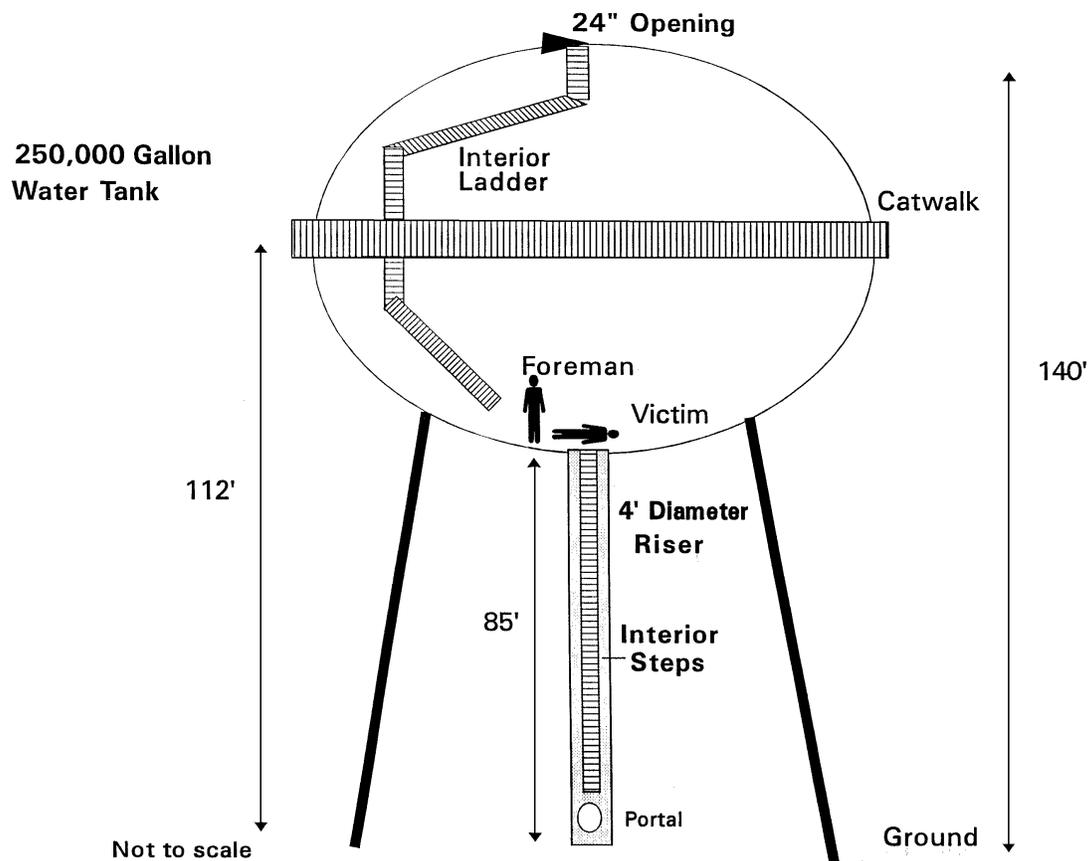


Figure.

FACE 94-01: Hotel Grounds Maintenance Man Dies After 16-Foot Fall From Ladder--South Carolina

SUMMARY

A 53-year-old male hotel grounds maintenance man (the victim) died after falling 16 feet from a ladder and striking his head on a concrete parking lot surface. The victim and a co-worker were trimming palm trees and shrubbery located on a concrete island in the hotel parking lot. The victim was using pruning shears to trim the trees while working from a 32-foot aluminum extension ladder 16 feet above ground. The co-worker was facing away from the victim while trimming shrubs at ground level. The co-worker heard a thud and turned to see the victim lying on his back in the concrete parking lot. The co-worker ran to the victim, who was not breathing, and initiated cardiopulmonary resuscitation (CPR). A worker exiting the hotel office saw the co-worker administering CPR and told management personnel in the office to summon the emergency medical squad (EMS). The victim was transported to the local hospital, then transferred to a major trauma center where he died 4 days later. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *stress to all employees the importance of exercising caution when working from ladders*
- *develop and implement a comprehensive written safety program.*

INTRODUCTION

On October 23, 1993, a 53-year-old hotel grounds maintenance man (the victim) died of injuries sustained in a 16-foot fall from an aluminum extension ladder on October 19, 1993. On October 28, 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 December 20, 1993, a safety specialist from DSR investigated the incident and reviewed the incident with a company representative, and the SCOSHA compliance officer and supervisor assigned to the case.

The victim had been employed at a resort hotel as a grounds maintenance man and painter. The hotel had been in operation for 30 years and employed 40 workers. The employer had no written safety program or procedures; however, training was provided on the job. Maintenance workers were provided with safety glasses and gloves. This was the first fatality experienced by the employer.

INVESTIGATION

The victim and co-worker began work daily at 6 a.m. by hosing down and straightening up the area around the outdoor swimming pool. On the day of the incident, after these tasks were completed, the two men were instructed to trim three 25-foot-high palm trees and the shrubbery located on an island in the hotel parking lot.

At approximately 7:45 a.m., the victim, working from a 32-foot aluminum extension ladder, began to trim the palm trees (using pruning shears), while the co-worker remained at ground level to trim the shrubbery.

Two trees were trimmed without incident. As the co-worker continued trimming the shrubbery, with his back to the victim, he heard the victim positioning the aluminum extension ladder against the third tree. The

co-worker turned to see the victim climb to the 16-foot level, then turned back to his work. He immediately heard a thud, then the sound of the ladder striking the parking lot. He turned to see the victim lying on his back in the concrete parking lot, 10 feet from the base of the tree. The co-worker ran to the victim, who was not breathing, and initiated cardiopulmonary resuscitation (CPR). A worker exiting the hotel office noticed the co-worker administering CPR to the victim and told management personnel to summon the emergency medical service (EMS). The EMS arrived within 5 minutes and transported the victim to the local hospital. The victim was transferred to a major trauma center where he died 4 days later.

CAUSE OF DEATH

The attending physician listed the cause of death as closed-head trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should stress to all employees the importance of exercising caution when working from ladders.

Discussion: The event was unwitnessed but evidence suggests that the ladder and victim fell together away from the tree. The ladder in this incident was clean and there was no evidence of a foreign substance that might have been a factor in the incident. Employers should constantly stress to employees the importance of exercising caution when climbing or working from ladders, and should ensure that employees adhere to 29 CFR 1910.26 (c)(3)(iv), which regulates the proper use of extension ladders. Additionally, a strap or rope cradle could be used to fasten a ladder to an uneven surface, such as the tree in this incident.

Recommendation #2: Employers should develop and implement a comprehensive written safety program.

Discussion: Enforcement of this safety program should reduce and/or eliminate worker exposures to hazardous situations. The safety program should include, but not be limited to, ladder safety, the use of safety equipment, and the recognition and avoidance of fall hazards.

REFERENCES

29 CFR 1910.26 (c)(3)(iv) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 94-12: Carpenter Dies After Falling 10 Feet From A Step Ladder/Porch Floor--South Carolina

SUMMARY

A 37-year-old male carpenter (the victim) died after falling 10 feet and striking his head on a concrete block retaining wall. The victim and two co-workers had been assigned clean-up work at a private residence that was under construction. The victim was working out of sight of co-workers when the incident occurred. The victim was last observed by his co-workers standing on a step ladder affixing blocks of wood to the ceiling rafters of a covered porch. Although the incident was unwitnessed, it can be assumed that the victim either lost his balance and fell from the ladder, or was descending the ladder and stepped backwards off the ladder and off the edge of the porch. The victim struck his head on a concrete block retaining wall, located about 6 feet below the open-sided porch floor. Guardrails around the porch floor perimeter were not present at the time of the incident. When the co-workers found the victim he was unconscious but breathing. One co-worker ran across the lot to another residence that was under construction, and asked the foreman to call for an ambulance. The ambulance arrived in less than 10 minutes, the victim was stabilized and transported to the local hospital. Two days later the victim was pronounced brain dead, all life support systems were removed and consequently he died that day. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *provide adequate guarding for open-sided floors, platforms, and runways*
- *review and revise, where applicable, existing safety programs*
- *routinely conduct scheduled and unscheduled workplace safety inspections*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On March 23, 1994, a 37-year-old male carpenter (the victim) died from injuries received in a 10-foot fall from a step ladder/porch floor on March 21, 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 DSR safety specialist conducted an investigation of this incident. The incident was reviewed with the employer, county coroner, and SCOSHA compliance officer assigned to the case. Photographs of the incident site were taken during the investigation.

The employer was a house-framing contractor that had been in business for 19 years and employed five workers, three of whom were carpenters. The employer had a written safety program, but the program was incomplete regarding specific guardrail requirements. The victim had been employed for 2 days prior to the incident; however, he had worked for the employer for a 2-year period about 1 year previously. He had about 15 years experience as a carpenter. This was the first fatality experienced by the employer.

INVESTIGATION

The employer had been subcontracted to do the framing work for a new residence under construction at a private residential housing community. The house was a three-story wooden structure with a covered

porch located at the second story level. The porch was located about 10 feet above ground level and a 4-foot concrete block retaining wall was located directly below the porch. Work had been in progress for 6 weeks, and the day of the incident was to have been the last day on the job. The workers (the victim and two co-workers), had been assigned clean-up work for the day.

On the day of the incident, the workers started work around 7 a.m. and proceeded to different parts of the house to clean up. The victim was last observed by his co-workers standing part way up an 8-foot-high fiberglass step ladder on the porch floor. The ladder was positioned with the ladder steps facing toward the open side of the porch, about 1-foot from its edge. The ladder was apparently being used by the victim to access the porch ceiling rafters. He had been using a hammer and nails to affix pieces of wood to the porch ceiling rafters in preparation for the hanging of sheetrock. Although the incident was unwitnessed, it is assumed the victim either lost his balance and fell from the ladder, or was descending the ladder, stepped backwards off the edge of the porch, and fell and struck his head on the concrete block retaining wall. The porch floor was located about 6 feet above the top of the concrete block retaining wall, and guardrails around the porch floor perimeter were not present at the time of the incident.

The co-workers found the victim unconscious but breathing about 10:30 a.m. One co-worker ran across the lot to another residence that was under construction, and asked the foreman to call for an ambulance. The ambulance arrived in less than 10 minutes, the victim was stabilized and transported to the local hospital. Two days later the victim was pronounced brain dead and all life support systems were removed.

CAUSE OF DEATH

The coroner's report listed the cause of death as subdural hemorrhage.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide adequate guarding for open-sided floors, platforms, and runways.

Discussion: The victim was using a stepladder positioned on the floor of a porch about 1 foot from its edge. The floor was open-sided and unguarded. Also, the porch was 10 feet above ground level; a 4-foot-high concrete block retaining wall had been erected directly below the porch area where the victim was working. Guarding of the open-sided porch floor with a standard railing as required by CFR 1926.500 (d)(1)(i) was not present. **NOTE:** Since the incident, the employer has revised the safety program to require the guarding of all open-sided floors, platforms, and runways prior to the commencement of any work being performed.

Recommendation #2: Employers should review and revise, where applicable, existing safety programs.

Discussion: Although the employer had a written safety program, there was no procedure regarding the protecting of open-sided floors with guardrails and handrails. Safety programs should be periodically reviewed and revised, as necessary, to 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, ladder safety, the use of safety equipment, and the recognition and avoidance of fall hazards.

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

Discussion: Scheduled and unscheduled safety inspections should be conducted by a competent¹ person to ensure that worksites are free of hazardous conditions. Regardless of how comprehensive, a safety program cannot be effective unless implemented in the workplace. These inspections may not guarantee the elimination of occupational hazards, but 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 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 82-02: Fall from a Scaffold Involving a Construction Foreman

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) Division of Safety Research (DSR) is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Study. By scientifically collecting data from a sample of similar fatal incidents, this study will identify and rank factors which increase the risk of fatal injury for selected employees.

On August 16, 1982, a 29-year-old male foreman fell from the platform of a 16' welded tubular scaffold and landed head first on the 6" concrete slab. The foreman died approximately 24 hours later in the intensive care unit of a local hospital. The attending medical examiner notified DSR on August 20, 1982.

CONTACTS/ACTIVITIES

Subsequent to receiving notification, DSR sent a research team, consisting of an epidemiologist, safety researcher, civil engineer, safety engineer and safety specialist, to visit the company on August 26, 1982 and the incident site on August 26 and 31, 1982. Interviews were held with the co-owner of the company, new construction foreman and co-workers. Information obtained from these interviews pertained to company history and processes, policies and procedures, incident scenario, safety and training programs, employee evaluations, injury records, and relevant work practices. The incident site was surveyed in the presence of the witnesses who were able to describe the appearance of the site at the time of the incident. The scaffold and truss involved in the incident were still at the site and were observed. During the survey, the locations of the victim, scaffold and truss were identified and 35mm pictures were taken.

SYNOPSIS OF EVENTS

This construction company had been established for approximately 12 years and had erected numerous commercial metal buildings. According to the co-owner, the company had no prior history of occupational fatalities nor disabling injuries.

The construction activity consisted of the erection of a commercial metal building designed to be a retail tire store. The design consisted of 35 metal trusses (each of which was approximately 60' long, 11' high at the apex, and 300 lbs. in weight) set 40" apart and attached to 18' sidewalls (masonry block and metal columns) built upon a 6" concrete slab. The building was approximately 60' wide and 110' long with two garage doors on each side with showroom windows and a main entrance door at the front.

At the time of the incident, the slab with the block and metal sidewall framing (without exterior panels) were complete and (31 of 35) of the 35 trusses had been set and secured in place. The erected trusses had been raised with either a hydraulic, telescoping boom crane or a backhoe with extension attachment. Wooden spacers constructed from 2 x 4's were used to align the truss at a proper distance from a previously placed truss and to minimize its lateral movement until secured. The trusses were secured to the sidewalls by two metal screws at each end and to the proximal trusses by two metal roof purlings which would be attached to the truss by screws.

The working foreman (the victim) and three other employees were involved in the activity of raising, setting and securing the metal trusses on the afternoon of August 16, 1982. There were four trusses left to be

installed, and the workers hoped to finish those that afternoon. The victim and another employee were on the 16' scaffold's 8' x 4' platform which did not have guardrails. The other employee was using a 6' wooden stepladder to reach and remove the hoist chain attached to the truss which had just been raised into place and aligned with a wooden spacer. In the process of removing the chain, the truss began to rotate on its base, in a downward direction. The foreman and other employee grabbed the truss in an attempt to prevent its movement and subsequent damage. The foreman and other employee were not able to maintain the truss. The other employee had to let go while the victim continued to hold on. The truss then continued to rotate on its ends downward and knocked over the scaffold and ladder. It is not clear whether the victim fell before or after the truss hit the scaffold. The other employee was able to hold onto a previously secured truss and this prevented him from falling.

A resident of a nearby home was a trained EMT and was able to provide quick emergency care for the victim. This care consisted of fitting the victim with a cervical collar and keeping him warm. An ambulance arrived approximately 40 minutes after the incident occurred and transported the victim to a nearby hospital.

MEDICAL FINDINGS

While in the hospital, neurosurgery was attempted to relieve cerebral pressure caused by a massive subdural hematoma. The damage was irreversible and the victim died approximately 24 hours after being admitted. Toxicologic tests of blood for alcohol and urine for basic neutral and narcotic drugs were all negative.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

Several factors contributed to this fatal incident. The truss' involved in the incident apparently began to move due to the slippage or shearing of the wood spacer. Spacers observed at the incident site were open-ended and cracked. These conditions diminish their ability to adequately hold an unsecured truss. When the truss began to fall, the victim not only grabbed it but also apparently refused to let go in apparent disregard for his own safety. Also, although less contributory since the entire scaffold was knocked over, the victim and other employees were working from a platform which had no guardrails.

It is recommended that future efforts be made to utilize a more suitable type of temporary spacer. A spacer made of metal and with clasps to fasten it in place would be less likely to be dislodged. Safety training should stress that workers should not grab onto large objects in motion. Future efforts should stress the importance of and strictly enforce the proper use of guardrails around scaffold platforms.

The courtesy and cooperation of the company officials and employees are gratefully acknowledged.

FACE 88-27: Dry Wall Finisher Dies in Fall from Ladder on Scaffold

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 23, 1988, a 55-year-old male dry wall finisher was fatally injured when he fell 22 feet from a portable wooden stepladder that was on top of a 17-foot-high mobile scaffold.

CONTACTS/ACTIVITIES

On June 27, 1988, a state Occupational Safety and Health official notified DSR of this fatality and requested technical assistance. On July 12, 1988, NIOSH met with a company representative, discussed the incident with the OSHA compliance officer, photographed the site, interviewed a co-worker who witnessed the incident, and obtained a report from the local fire department's emergency medical service (EMS) rescue squad that responded.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was a dry wall finisher working for a general contracting construction company. The company has been in business for approximately 4 years and currently employs 90 employees, including 4 dry wall finishers. The company uses written safety rules and procedures and provides on-the-job training to employees. The construction jobsite superintendent is responsible for administering the safety program which includes conducting weekly jobsite safety meetings with all the employees. The victim had almost 4 years' experience as a dry wall finisher. He had never received a reprimand for violating safety rules or procedures.

SYNOPSIS OF EVENTS

The construction company had been contracted to build a multilevel brick high school. Construction started in October 1986, with completion scheduled for September 1988. At the time of the incident, most of the exterior work had been completed and the interior finishing work was in progress.

On June 23, 1988, two dry wall finishers were putting filler compound over the heads of the screws that secured sheetrock panels to the interior walls. They were working in the same room from separate scaffolds. The scaffolds were mobile metal scaffolds, 17 feet high, 7 feet long, and 5 feet wide, which were equipped with 8-inch rubber tires with locking casters. The victim's work platform was made up of two 2-inch by 10-inch, 7-foot-long wooden boards and one 2-foot-wide by 7-foot-long standard aluminum plank mounted across the top railing of the scaffold. Additionally, the victim placed an 8-foot wooden stepladder on top of the work platform to reach the upper sections of the wall, which was 25 feet high.

Prior to the incident a co-worker told the victim that the casters on the scaffold were not locked. The victim replied, "I want them that way." The victim positioned the stepladder on the scaffold platform and leaned the top of the ladder against the wall. When the victim climbed the ladder, the force exerted at the ladder's foot caused the scaffold to roll. The victim fell headfirst onto a concrete floor 22 feet below.

The construction superintendent, who was in an adjacent room, heard a disturbance and ran to the incident site. He immediately called the local EMS squad using a two-way walky-talky. An ambulance arrived 4 minutes later, and EMS personnel provided advanced life support. The victim was transported to a local hospital where he was pronounced dead on arrival.

CAUSE OF DEATH

The coroner reported the cause of death as traumatic injuries to the head and chest.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that all employees required to work from elevated work platforms understand the potential danger of a fall, and the proper methods of erecting, placing, securing, and using scaffolds and ladders.

Discussion: Occupational Safety and Health Administration (OSHA) Safety and Health Standard 29 CFR 1926.451(e)(8) states that, "Scaffolds in use by any persons shall rest upon a suitable footing and shall stand plumb, also the casters or wheels be locked to prevent any movement." The employer should ensure that all employees understand the danger of working on scaffolding; this includes the necessity of locking casters or wheels. Employers should also instruct all employees to report all unsafe working conditions (e.g., the unlocked casters observed by the co-worker) to the supervisor. If the victim had locked the casters or the co-worker had reported this unsafe working condition, this fatality may have been prevented.

Recommendation #2: Employers should ensure that appropriate guardrails and toeboards are installed on mobile scaffolding used for work at levels exceeding 10 feet above the ground or floor.

Discussion: OSHA Safety and Health Standard 29 CFR 1926.451(a)(4) requires that guardrails and toeboards be installed on all open sides and ends of platforms more than 10 feet above the ground or floor. The work platform of the mobile scaffolding was 17 feet above the floor, and all four sides surrounding the platform were open. The employer should have equipped the mobile scaffolding with guardrails and toeboards before the platform was used.

Recommendation #3: Employers should ensure that mobile scaffolding platforms are tightly planked.

Discussion: OSHA Safety and Health Standard 29 CFR 1926.451(e)(4) requires that mobile scaffolding platforms be tightly planked for the full width of the scaffold. In addition to the hazard created by leaning an 8-foot wooden stepladder against the wall, the platform was only partially planked, creating an opening approximately 17 inches wide by 7 feet long. The employer should regularly inspect to ensure that all scaffolding meets the requirements established by the OSHA Safety and Health Standards (e.g., locked casters, installed guardrails, and tightly planked platforms, etc.).

Recommendation #4: In the event an employee is injured on the job, the employer should review, and revise if necessary, the safety rules and procedures, inspect the worksite for unsafe working conditions, and initiate actions to ensure safe working conditions before work activities continue.

Discussion: This fall is one of four falls experienced by employees of the contractor or sub-contractor at this specific jobsite (initiated October, 1986). Although the previous three falls did not result in death, the workers involved received severe injuries including fractures and lacerations. One of these workers is permanently paralyzed as a result of a fall. It is evident that safety conditions are poor at this specific worksite; the employer should initiate immediate action to correct these unsafe working conditions.

FACE 88-29: Painter Falls to his Death from a Scaffold

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 24, 1988, a 30-year-old male painter died and a co-worker was injured when they fell from a scaffold to the street and sidewalk 52 feet below.

CONTACTS/ACTIVITIES

State officials of the Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. On July 28, 1988, a DSR research industrial hygienist conducted a site visit, photographed the incident site, and met with representatives of various companies and local police and fire departments who were involved in the incident.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a small painting and decorating contractor which employs six workers. The company has no safety program, no safety training, and does not conduct safety meetings with employees. Most of the work the company does is commercial painting and decorating. The victim had worked as a painter for the company intermittently for the past 10 years.

SYNOPSIS OF EVENTS

The employer had been contracted to paint the outside trim on a seven-story office building. The victim and a co-worker were painting from a 12-foot-long scaffold which was 52 feet above the sidewalk. The employer had provided safety belts and lanyards, but did not require the workers to use them. Also, the workers had been offered a bonus to complete the job before a time deadline. These factors may have influenced their decision not to use fall protection equipment.

The scaffold was suspended by two 5/8-inch-diameter steel cables that were attached with large steel hooks to a ledge near the top of the building. The cables ran vertically to a hand-operated hoist winch on each end of the scaffold that allowed workers to raise or lower the scaffold to the desired height. The suspension cables above the scaffold lay across a horizontal metal gutter that was attached to the side of the building. The slack portion of each cable dangled free under the ends of the scaffold.

On March 24, 1988 (16 days after the job began), the victim and co-worker were within a day of completing the job. They were painting at a level approximately 20 feet above and 4 feet horizontally from a utility pole that held a 3-phase, 7200-volt power line. One of the cables dangling under the scaffold was less than a foot from the power line nearest the building.

At the time of the incident the wind was blowing at 15 to 20 miles per hour. As the victim attempted to crank the hoist, the dangling cable nearest the power line contacted the energized wire nearest the building. The scaffold's two suspension cables grounded out and burned in half where they crossed against the metal gutter, causing the scaffold to fall. The scaffold struck the top of the utility pole, breaking off the cross arm and power lines. The victim and co-worker were thrown from the scaffold. The victim landed on the sidewalk below. The co-worker landed on a bank sign, breaking off the brackets where it was attached to the side of the building. He then jumped the remaining vertical distance (approximately 10 feet) to the street below. The scaffold remained across the top of the utility pole with the downed power lines in the street.

The local emergency rescue squad was immediately summoned and arrived at the scene in 2 minutes. The victim and co-worker were treated at the scene and enroute to the hospital. The victim was pronounced dead at the hospital 1 hour and 44 minutes after the incident occurred. The co-worker survived with multiple fractures.

CAUSE OF DEATH

The medical examiner reported that death resulted from multiple traumatic injuries to the head, chest, and abdomen resulting from the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation# 1: Where the potential for a fall from an elevation exists, employers should ensure that fall protection equipment is provided and used by workers.

Discussion: The use of a safety belt/lanyard combination is required by 29 CFR 1926.104. Use of the safety belt or body harness/lanyard with a rope grab device is appropriate for persons working from scaffolds at varying heights. Properly used, this type of fall protection would have prevented the workers in this incident from falling.

Recommendation #2: To ensure proper protection when working near electrical power lines, employers should request that the electrical utility company de-energize the lines or cover them with insulating line hoses or blankets.

Discussion: Energized power lines in proximity to a work area are hazardous and extra caution must be used when working near these power lines. A safe distance between power lines and scaffolds, ladders, or tools should be maintained at all times; at least one state requires that a 6-foot minimum clearance be maintained. The power line in this instance was only 4 feet from the side of the building. Due to the scaffold location, one of the dangling scaffold cables was less than 1 foot from the power line. In this situation, the power lines should have been de-energized or covered with insulating hoses or blankets before work was begun.

Recommendation #3: The employer should develop and implement a safety program designed to help workers recognize and avoid hazards.

Discussion: The dangers associated with working from scaffolds in the proximity of power lines are obvious. OSHA Standard 1926.21(b)(2) states that "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 company in this incident did not provide any training in safe work procedures and did not have written safety rules. Even though it is a small company, the employer should evaluate the tasks performed by workers and identify all potential hazards. A safety program addressing these hazards should be developed and implemented on the job.

Recommendation #4: Employers should perform job hazard analyses to identify the hazards encountered by their employees, and develop measures for controlling each hazard.

Discussion: A job hazard analysis is one method of identifying the hazards associated with a specific task. 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. For example, a thorough inspection by the employer would have disclosed the hazard associated with working at this elevation with equipment in such close proximity to a power line. Noting this, injury prevention measures (Recommendations #1 and #2) could have been taken. Failure to adequately identify and control these hazards increases the risk of injury to employees.

Recommendation #5: Employers should use the job hazard analysis when training employees on the hazards associated with specific jobs and on the countermeasures to control these hazards.

Discussion: General training on company safety procedures should be supplemented by training on specific hazards associated with specific jobs. Such training can make employees aware of the hazards to which they are exposed. At the same time, countermeasures can be explained.

FACE 89-07: Foreman and Painter Die in 48-Foot Fall When Scaffold Collapses

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 15, 1988, a 53-year-old male foreman and a 28-year-old male painter died when the scaffold from which they were working collapsed, causing them to fall 48 feet to the ground below.

CONTACTS/ACTIVITIES

State officials of the Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. On December 15, 1988, a DSR research industrial hygienist met with the state OSHA official who investigated the incident and representatives of various companies and local police and fire departments that were involved in the incident, and photographed the site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a painting company with 50 employees. The company consists of a painting division with 29 painters and a small construction division. Most of the company business involves painting buildings and other outdoor structures. The company's Hazard Communication Program consists of a brief verbal orientation to new employees concerning the potential hazards of various chemicals contained in paint. The company also has Material Safety Data Sheets (MSDS) available. However, the company has no written safety program, and did not have any safety meetings or training specifically addressing fall prevention or fall protection.

The foreman involved in this incident had a total of 20 years of experience as a painter, including 15 years with the company as a painter foreman. The other painter had 2 years of experience with the company as a painter.

It should be noted that two painters with the same company died in separate, previous work-related incidents. In 1987, a painter fell to his death from an aerial bucket, and in 1972, a painter suspended in a boatswain's chair came in contact with a power line and was electrocuted.

SYNOPSIS OF EVENTS

The company was hired to paint the outside of several tanks at a petrochemical storage plant. The storage tanks are 48 feet high and 56 feet in diameter. Stairs that wind around the tanks provide access to the top. The top of the tanks are smooth and have a slight downward slope that extends from the center to the outside edge.

The two workers began painting the tanks from the bucket compartment of an aerial bucket truck without wearing any type of fall protection equipment. The painters used this painting method for several days and had completed one tank and were nearing completion of a second tank. However, gaining access to the

unpainted side of the tank by using the bucket truck was not possible because other tanks were too close and some above-ground piping was in the way. Therefore, the foreman decided to finish painting the second tank using a two-point suspension scaffold.

The two workers arrived at the site in the morning on November 15, 1988 and set up the scaffold. The scaffold consisted of a worker platform of tubular steel, measuring 2 feet wide by 17 feet long, with two outside guardrails 24 inches and 48 inches above the platform. The platform was suspended by two wire suspension cables, each of which was 5/16th of an inch in diameter. The cables hung vertically from two tubular steel outriggers placed on top of the tank with the outboard ends extending 24 inches beyond the edge of the tank. The cables ran through an electrically-operated hoist on each end of the scaffold platform. This allowed the workers to raise or lower the scaffold platform to the desired height.

Although there were no eyewitnesses of the incident, physical and circumstantial evidence suggests the following:

1. The scaffold outriggers had been installed on top of the tank with only 200 pounds of counterweight. There were two 50-pound steel bars on each of the two outriggers. The outriggers had been set up to keep the suspension cables at a horizontal distance of 24 inches from the side of the tank. In order to maintain this horizontal distance, the scaffold manufacturer required a minimum of 600 pounds of counterweight for this type of scaffold (300 pounds on each outrigger) to counterbalance the work load.
2. The outriggers were not tied off to prevent them from slipping.
3. One end of a lifeline had been tied to a large vent pipe on the top center of the tank and the other end looped around the side of the scaffold guardrail.
4. Two buckets, each containing approximately 4 gallons of paint, were placed on the scaffold platform.
5. The two workers climbed onto the scaffold platform, raised the scaffold platform all the way to the top, got off on top of the tank, climbed down the tank stairs, and went to lunch.
6. Presumably, some time during the afternoon while the workers were on the scaffold platform, the outriggers slid off the top edge of the tank and the entire scaffold along with the two workers fell approximately 48 feet to a hard-packed gravel surface below.

The two workers were not discovered until 4:56 p.m. At that time a truck driver at the petrochemical storage plant was on his way to lock up the plant premises when he noticed the bodies and scaffold wreckage. The truck driver immediately notified the local fire department emergency medical service. Paramedics arrived at the scene in approximately 5 minutes and upon examining the victims, could not detect any signs of life. The county coroner subsequently arrived and pronounced the two workers dead at the scene.

CAUSE OF DEATH

The medical examiner reported the cause of death for both workers as multiple blunt force trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that all employees required to work from elevated work platforms understand the potential danger of a fall, and the proper methods of erecting, placing, securing, and using scaffolds.

Discussion: occupational Safety and Health Administration (OSHA) Safety and Health Standard 29 CFR 1926.451(g)(3) requires that the outriggers of this type of scaffold be securely anchored and that properly designed scaffolds, "... shall be constructed and erected in accordance with such design." For this type of scaffold and the way it was being used, the scaffold manufacturer recommends: (1) a minimum of 600 pounds of counterweight on the inboard end of the outrigger beams (300 pounds on each outrigger), and (2) that the outriggers also be securely tied back.

The fact that the workers only used 200 pounds of counterweight (100 pounds on each side) and that they did not tie back the outriggers indicates they did not fully understand the proper methods of erecting and securing this type of scaffold. The employer should ensure that all employees understand the danger of working on scaffolding. This includes the necessity of properly securing scaffold suspension points. Properly set up, the type of scaffold and anchoring system used in this incident would not have fallen.

Recommendation #2: Where the potential for a fall from an elevation exists, employers should ensure that fall protection equipment is provided and used by workers.

Discussion: Although a safety line had been tied to the top of the tank and the workers had safety belts with rope-grab devices at the site (and possibly on the scaffold) during the incident, they were not being worn by the workers. The use of a safety belt/lanyard combination is required by 29 CFR 1926.451(i)(8) for use on two-point suspension scaffolds. The use of the safety belt or body harness/lanyard with a rope grab device is appropriate for persons working from scaffolds at varying heights. Properly used, this type of fall protection would have prevented the workers in this incident from falling even when the scaffolding fell.

Recommendation #3: Scaffolds should be erected under the supervision of persons who are competent in the use of scaffolds.

Discussion: OSHA Standard 1926.451(a)(3) states: "No scaffold shall be erected, moved, dismantled, or altered except under the supervision of competent persons. " The fact that the workers in this incident did not set up the scaffold according to the manufacturer's specifications points out that the workers did not understand the correct way to erect the scaffold under those circumstances. The scaffold erection should have been supervised by a worker experienced in erecting this type of scaffold.

Recommendation #4: When workers are assigned hazardous tasks, or must work at hazardous workstations (such as elevated scaffolds), a standby person should be assigned to continually observe, give assistance, and ensure timely response in the event of an emergency. Additionally, close supervisory contact should be maintained periodically throughout the duration of the work.

Discussion: On the day of the fatal incident, the two victims apparently worked alone, unobserved. They were not discovered until 4:56 p.m. when a truck driver was locking up the plant. No one was assigned to observe the work from the ground; additionally, the workers were apparently unsupervised from the time they installed the scaffold until the scaffold collapsed and they fell to the ground. Had the scaffold collapse

and resultant fall been observed by someone standing by on the ground, help might have been summoned and emergency medical care administered promptly to the victims improving their chances of surviving the traumatic injuries they received. In any workplace situation which involves the potential for traumatic injury, a "buddy system" and close, periodic supervision are essential to protect the lives of exposed workers.

Recommendation #5: The designers/owners of tanks of this type should design and install appropriate tank anchorage points for maintenance purposes.

Discussion: Permanent structures of this type are known to require extensive maintenance when they are designed. It is essential that designers/owners of these facilities incorporate anchorage points on tank roofs to which workers can adequately secure scaffolds and lifelines. Omission of designed anchor points causes workers to improvise anchors or not use them at all. This increases the possibility that a scaffold will be erected incorrectly. If scaffold anchor points had been available on the tank involved in this incident, the scaffold may not have been incorrectly erected, resulting in its failure. Also, if anchor points had been available, it's likely that the workers in this situation may have been tied off, thus preventing their fall when the scaffold fell.

Recommendation #6: All employers should develop and implement a safety program designed to help workers recognize, understand, and control hazards.

Discussion: Company management must ensure that employees are trained to recognize and avoid hazardous work conditions and that the work environment is safe. Employers should develop and implement a safety program to protect workers as required by OSHA Standard 1926.20. Additionally, OSHA Standard 1926.21(b)(2) requires employers to "...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 company had no formal safety program, and there were no standard operating procedures for any of the tasks performed. Even after having two previous worker fatalities, the employer failed to provide written safety rules and training in safe work procedures. Although a relatively small company, the employer should immediately evaluate the tasks performed by workers, identify all potential hazards, and then develop and implement a safety program addressing these hazards. Prior to starting any job, the employer should conduct a jobsite survey, identify all hazards, and implement appropriate control measures.

FACE 89-21: Cement Finisher Dies After 160-Foot Fall from Scaffold

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 19, 1988, a 27-year-old male cement finisher was dismantling suspended scaffolding inside a 172-foot-high circular concrete silo when he lost his balance and fell from the scaffolding. His safety lanyard broke and he fell 160 feet to the concrete floor of the silo.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On February 13, 1989, a DSR research team conducted a site visit, interviewed company representatives, photographed the site of the incident, and discussed the incident with the OSHA compliance officer and state medical examiner personnel.

OVERVIEW OF THE EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 3 years by a construction company that specializes in slip form construction. The company had 28 workers on site. Concrete forms of different dimensions are erected, set into place and then concrete is pumped into the forms. The company has been in operation since 1928 and employs a corporate safety director. The job superintendent is responsible for safety at the jobsite. Safety meetings are conducted each Monday morning prior to the start of work. Each employee is issued a company safety manual upon hire and training is provided on the job.

SYNOPSIS OF EVENTS

The company had been contracted to construct a holding facility for cement. This included constructing three interconnected concrete silos and installing equipment inside these silos. The silos were 172 feet high and 40 feet in diameter, with 10-inch-thick walls. The project began in October 1988, and by the day of the incident the silos had been constructed and the interior walls had been finished on two of the silos. On the day of the incident the victim and a co-worker were completing the interior finish of the third silo. The two men were working at a height of 160 feet from a suspended scaffold. The scaffold, which was shaped to fit the curvature of the interior wall of the tank, was erected around half the inside diameter of the tank and was suspended from ropes anchored at the top of the silo. As the men finished the inside surface of one half of the tank, they disassembled the scaffold from each end toward the center where a door would provide access to the outside of the silo. The scaffolding, dropped to the floor piece-by-piece as it was disassembled, was then erected around the other half of the tank. The interior walls of all three silos were finished using these procedures.

At the time of the incident the men had completed the interior finish of the third silo and had begun to disassemble the scaffolding. Each man was using a nylon rope lanyard attached to a chain on a scaffold bracket. The brackets were spaced 6 feet apart. As each man reached a point in the operation where he was ready to drop a bracket to the ground, he hooked his lanyard to the chain on the next bracket.

At some point the victim lost his balance and fell off the end of the scaffolding. The co-worker stated that he saw the victim fall and jerk upwards as the lanyard caught him. As the victim's weight dropped back on the lanyard, it snapped, causing him to fall 160 feet to the concrete floor below. The emergency rescue squad was summoned immediately by the company secretary. Employer representatives stated that it was approximately 30 minutes before the rescue squad arrived at the scene. The victim was pronounced dead at the scene.

When the lanyard was inspected, burn damage was discovered in several places, including the point at which it had snapped. This damage probably occurred during welding or burning operations from a previous job.

CAUSE OF DEATH

Although the medical examiner had not completed his report at the time of this investigation, the cause of death is presumed to have been multiple traumatic injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fall-arresting devices should be periodically inspected for damage by a qualified person, and faulty equipment should be immediately removed from service. Additionally, employees required to wear fall protection should inspect their own equipment before the start of each job.

Discussion: In this instance, fall-arresting equipment was not individually assigned, but was obtained from a common pool. It was possible that a worker would not use the same piece of equipment on a daily basis. For this reason, fall protection equipment should be periodically inspected by a qualified person to determine if it is in suitable condition to be used by workers. Additionally, employers should train workers in inspection techniques that would allow them to identify faulty equipment. Workers should inspect their equipment before the start of work each day. Faulty equipment should be immediately removed from service to ensure worker safety. A properly trained worker would have identified the faulty lanyard upon inspection. Had the faulty lanyard been removed from service, and an undamaged one used instead, this fatality might have been prevented.

Recommendation #2: Personal protective equipment should be able to withstand the harshest conditions to which it may be subjected on any given job.

Discussion: The nylon lanyard involved in this incident received burn damage, probably while being used in the vicinity of welding or cutting operations. Many materials, including nylon, can be easily damaged in the presence of extreme heat. For this reason, nylon lanyards should not be used where they might be exposed to conditions that could include extreme heat; rather, steel mesh or wire core lanyards would have been more suitable. Personal protective equipment should be evaluated before being used on any job to ensure that it can withstand the harshest conditions to which it may be subjected without sustaining damage that would jeopardize the safety of a worker.

Recommendation #3: OSHA requires that workers working from float or ship scaffolds (scaffolds suspended from overhead supports) be protected by an approved safety lifebelt, lanyard, and lifeline secured above the point of operation to an anchor point or structural member.

Discussion: According to 29 CFR 1926.451 (w)(6), workers working from float or ship scaffolds shall be protected by a safety lifebelt and lanyard hooked to a lifeline which is secured above the point of operation. In this instance, no lifeline was used and the lanyard was hooked directly to the scaffold. Even the required fall protection, however, would not have prevented this incident because a damaged lanyard was used. For this reason, the feasibility of a redundant fall-arresting system should be evaluated. For example, if a lifeline and a lanyard, each anchored at different points on the structure, were both hooked to the safety lifebelt or body harness, two points of suspension would exist. In such a redundant system, if a lanyard broke (as in this instance), the lifeline would still support the worker. If a redundant fall-arresting system had been in effect, this incident might have been prevented.

FACE 89-29: Caulking Mechanic Dies in Fall when Scaffold Fails

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 15, 1989, a 33-year-old male caulking mechanic died when the scaffold upon which he was working failed, causing him to fall 60 feet to the ground.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On April 18, 1989, a DSR safety specialist and safety engineer discussed this case with state officials and emergency services personnel. The incident was reviewed with company officials and the incident site was visited and photographed.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer is a caulking contractor with 13 employees, including seven caulking mechanics. The company has been in existence for 52 years. The victim had been employed by the company for the past 16 years, working the last 12 years as a caulking mechanic. The company has no formal safety program. Employee safety training in recognition, identification and control of job hazards is provided through on-the-job training. The victim was serving as the foreman of a two-person crew at the time of the incident.

SYNOPSIS OF EVENTS

On the morning of the incident, the victim and one co-worker completed a 2-hour caulking job, then went to the site of a newly constructed 7-story building to continue a caulking job they had started several days earlier. The front and rear building exterior utilized a combination of precast concrete panels and plate glass, while the sides were entirely of plate glass. They were caulking the precast concrete panels which were architecturally arranged from ground level to the sixth floor.

The caulking contractor provided a personnel lift on site; however, it did not reach above the fifth floor. In order to caulk the precast concrete panels at the sixth-floor level, the workmen would have to use a suspended scaffold.

The victim and co-worker arrived on the site at approximately 9:30 a.m. A window washing contractor was on site and had already rigged a powered 2-point suspended scaffold on the building. The scaffolding was located so that the caulking crew could caulk part of the sixth-floor level. The victim and a window washer decided that they would share the suspended scaffold while the two remaining co-workers, one caulker and one window washer, would share the personnel lift. With this arrangement, the caulking contractor's employees would not have to rig the scaffold they had brought to the jobsite.

The victim and the window washer began their work from the scaffold at the six-floor level. Although the victim had brought safety belts and lifelines to the site, neither group of workers used this personal protective equipment. They had completed work on a section of the sixth floor, and as they began their descent, the end of the scaffold where the victim stood suddenly dropped until the scaffold platform was in a vertical position. The victim, who was not tied off to an independent lifeline, fell approximately 60 feet from the scaffold to hard packed earth. The window washer managed to cling to the other end of the scaffold and a nearby ledge until the personnel manlift could be moved to the scene approximately 25 minutes after the fall.

The victim struck the building numerous times as he was falling. Workers in the area immediately telephoned the local Emergency Medical Service which arrived on the scene approximately 5 minutes after the incident. The victim, who was still conscious, was immediately transported to a nearby medical center where he died from massive internal injuries.

Although the victim had several years of experience using similar 2 point suspension scaffolds, he had not been trained to use this particular type. When the workers were ready to descend, the victim may not have disengaged the parking brake before activating the climber in a downward direction. With this brake set, the scaffold would not lower. Instead, it would lift the cable hanging beneath the scaffold, causing the cable to accumulate slack in the climber housing mechanism. When the victim noticed his end of the scaffold was not descending, he possibly realized the brake was set and released it. When this occurred, the scaffold began to fall because of the accumulated slack line in the housing. It continued to fall because either the slackened line condition allowed the cable to get free of the climber mechanism, or the impact force of the falling scaffold was greater than the resisting force of the climber mechanism.

In addition to the parking brake, these climbing scaffold units are equipped with a centrifugal safety brake. This spring-loaded mechanism is designed to be in contact with the suspension cable and rotate as the cable passes by it. The brake is designed to activate when the centrifugal force of the rotating mechanism exceeds the force of the springs. Although this braking device was designed to activate in this type of circumstance, it malfunctioned because a spring had apparently come loose and jammed in the brake device. This allowed the victim's end of the scaffold to drop to a vertical position. The other climbing unit held the scaffold in suspension. (The problem with the centrifugal safety brake was discovered by the state OSHA compliance officer during inspection of the equipment immediately following the incident.)

CAUSE OF DEATH

The Medical Examiner gave the cause of death as a ruptured liver due to acute abdominal injuries received as a result of the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Appropriate personal protective equipment should be worn whenever the potential for a serious fall exists.

Discussion: In this case, none of the four workers (two caulking mechanics and two window washers) were using any form of personal fall protection, despite the fact that the caulking contractor's employees had safety belts and lifelines in their truck. Although the scaffold climbing mechanism was equipped with an emergency braking device, the device malfunctioned allowing the end of the scaffold to lose its support

causing the victim to fall 60 feet to the ground. Failure to use personal fall protection equipment contributed to the severity of this incident. If fall protection equipment had been used, this fatality may have been prevented.

Recommendation #2: Employees should receive training in the safe operation of all equipment prior to use.

Discussion: The victim had worked with suspension scaffolds for several years, but had no experience with the particular type of scaffold involved in this incident. Although most such scaffolds are similar in design, the controls are not standardized. The victim was not trained in the operation of this scaffold. This lack of training in operation of the scaffold involved in this incident may have contributed to this incident.

Recommendation #3: Equipment should be periodically inspected to ensure that all components are operational. This inspection should be accomplished by personnel thoroughly familiar with the equipment and the design capabilities.

Discussion: While the scaffold in this incident had reportedly been inspected the previous week, the inspector apparently did not detect the broken spring in the emergency brake. Failure to detect and correct this problem contributed to this incident.

Recommendation #4: Manufacturers of suspension scaffolds should review design of controls for these units to determine if practical design changes could be made which would reduce the chance of incidents like this in the future.

Discussion: A design modification which automatically disengaged the parking brake whenever the hoist mechanism is engaged to raise or lower the scaffold could prevent this type of incident from developing. In addition, a standardization of control design for these scaffolds among all manufacturers could reduce the chance of employee error in the operation of the scaffold.

Recommendation #5: The employer should design, develop, implement, and enforce a comprehensive safety program.

Discussion: Employers should ensure that employees are trained to recognize and avoid hazardous work conditions and that the work environment is safe. Employers should design, develop, implement, and enforce a comprehensive safety program to protect workers as required by OSHA Standard 1926.20. The company had no formal comprehensive safety program, and unsafe work practices had been tolerated. Although a relatively small company, the employer should immediately evaluate the tasks performed by workers; identify all potential hazards; and then design, develop, implement, and enforce a comprehensive safety program addressing these issues. Also, prior to starting any job, the employer should conduct a jobsite survey, identify all hazards, and implement appropriate control measures.

FACE 89-35: Stucco Mason Dies in Fall from Scaffold

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 21, 1989, a 28-year-old male stucco Mason died as the result of falling approximately 48 feet from a scaffold.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On May 15, 1989, two research safety specialists met and discussed the incident with the company's representative and the Occupational Safety and Health Administration (OSHA) compliance officer assigned to the case. The foreman assigned to the job was interviewed, and the incident site was inspected and photographed. Reports relating to the incident were obtained from the responding emergency medical service and investigating police department.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 6 months as a stucco mason by a contracting company that has been in operation for 18 months. (Stucco is a material which is applied while in a plastic state to masonry or frame walls to form a hard exterior finish.) The company employs 16 workers, including 8 stucco masons. The employer has no written safety policy and does not use written safety rules or procedures. Also, personal protective equipment was not used at the jobsite, except for head protection (i.e., hard hats).

SYNOPSIS OF EVENTS

The company had been contracted to apply stucco to the outside walls of a recently built six-floor college dormitory. Tubular welded frame scaffolding had been erected around the perimeter of the dormitory from ground level to the uppermost floor to enable the workers to apply the stucco material.

On the morning of the incident the victim was working as a member of a 16-person crew assigned to continue work on the dormitory. Several small (2-3 person) groups were involved in different phases of work on two sides of the dormitory. The victim and two co-workers were affixing lath (i.e., 2-foot by 8-foot sheets of heavy gauge perforated paper laminated to approximately 14-gauge wire) to the outer wall of the dormitory. The lath would later be covered by the stucco material. The victim was working from the scaffolding at the fifth level, while the two co-workers were working from the scaffolding at the fourth and sixth levels.

Although the incident was unwitnessed, it is assumed that the victim started to climb to the next level of scaffolding by stepping onto the bottom guardrail. (The victim had been previously observed climbing from level to level of the scaffolding without using the built-in scaffold ladder.) The guardrail, which may have

been loosely secured or not secured at all to the scaffolding uprights, gave way allowing the victim to fall approximately 48 feet to the ground. Another employee saw the victim strike the scaffold planking at the first level before he struck the ground (see Figure).

Emergency medical service (EMS) personnel arrived at the scene in approximately 4-5 minutes. EMS technicians found the victim unconscious and breathing intermittently. They began advanced life saving support treatment and then transported the victim to the local hospital emergency room. The victim died at the hospital approximately 90 minutes after the incident.

CAUSE OF DEATH

The medical examiner reported the cause of death as multiple blunt force trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Where the potential for a fall from an elevation exists, employers should ensure that fall protection equipment is provided and used by workers.

Discussion: The use of safety belt/lanyard combination is required by 29 CFR 1926.104. Use of the safety belt or body harness/lanyard with a rope grab device and lifeline is appropriate for persons working from scaffolds at varying heights. This type of fall protection permits employees to move about the scaffold without being restricted while still providing fall protection. Properly used, this type of fall protection may have prevented the worker in this incident from falling. In this case, however, no fall protection equipment of any type was provided for the workers, clearly indicating management's lack of concern for worker safety.

Recommendation #2 Employers should conduct initial and periodic inspections of erected scaffolding.

Discussion: After the erection of scaffolding at any project site the employer should designate a competent person to initially inspect the scaffolding and again, at designated intervals, re-inspect the scaffolding. Areas of consideration for inspection should include, but not be limited to the following:

- 1) Braces
- 2) Brackets
- 3) Footing (anchorage)
- 4) Guardrails and Toeboards
- 5) Ladders
- 6) Legs
- 7) Locking Pins
- 8) Overhead Protection
- 9) Planking
- 10) Poles
- 11) Securing
- 12) Slippery Conditions
- 13) Trusses
- 14) Uprights.

The loose or unsecured guardrail may have been identified and corrected had proper installation, initial inspection, and/or periodic inspection procedures been used.

Recommendation #3: Employers should comply with OSHA standards 1926.451 (a)(4), which requires guardrails and toeboards be installed on all open sides and ends of platforms more than 10 feet above the ground or floor, and 1926.451(a)(6), which requires screens between guardrails and toeboards where persons are required to work or pass under the scaffold.

Discussion: Although additional injuries to other employees haven't occurred, the potential does exist. The scaffolding around the perimeter of the dormitory does not have any toeboards or protective screens installed. Employees working on the ground are at risk of being struck by falling objects (e.g., tools, materials). Employers should comply with OSHA standards 1926.451(a)(4) and 1926.451(a)(6) to further protect these employees at risk.

Recommendation #4: Employers should ensure that foreign-born workers fully understand all information, particularly safety-related information, pertaining to their jobs.

Discussion: The victim was of Korean descent and could not speak any English. He was from a different culture with possible different ideas of "safe" work ethics. The company has the responsibility to ensure that all workers understand the hazards associated with the work involved. Companies that employ foreign-born (immigrant) workers should identify the different languages spoken by the employers and design, implement, and enforce a comprehensive multilanguage safety program. The program should include, but not be limited to, a competent interpreter to explain the safety regulations to the foreign-speaking employees. Also, the employer should develop and post, at conspicuous places, safety posters/signs in that language.

Recommendation #5: 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, safety procedures for the work being performed were not planned. Employees were allowed to work in an area where the potential for a fall existed without adequate written and verbal instructions in recognition and avoidance of fall hazards, and without adequate fall protection equipment.

Recommendation #6: The employer should design, develop, implement, and enforce a comprehensive safety program which includes worker training in recognizing and avoiding hazards.

Discussion: The company had no formal comprehensive safety program, and unsafe work practices had been tolerated. Although a relatively small company, the employer should immediately evaluate the tasks performed by workers; identify all potential hazards; and then design, develop, implement, and enforce a comprehensive safety program addressing these issues as required by OSHA standard 1926.20. Additionally, OSHA Standard 1926.21(b)(2) requires employers to "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." Also, prior to starting any job, the employer should conduct a jobsite survey, identify all hazards, and implement appropriate control measures.



Figure. *The victim fell from the fifth-floor level of the scaffolding shown here, when he either stood on or fell against the guardrail causing it to give way. The victim was not wearing any fall protection equipment.*

FACE 90-12: Painter Dies When Scaffold Falls Inside Municipal Water Tank in Indiana

SUMMARY

A journeyman painter died when the swing scaffold he was using to access the interior of a 68-foot-tall by 32-foot-diameter municipal water tank fell. The painter was working from a single point suspension scaffold near the top of the tank. The painter was wearing a safety belt and lanyard secured to a lifeline. When he finished painting the upper area of the tank the painter disconnected his lanyard from the lifeline and moved to the other end of the scaffold to hand the spray paint gun he was using to his foreman. The foreman had just taken the spray paint gun from the victim when he heard a "pop" and saw the scaffold on which the victim was standing fall to the floor of the tank 65 feet below. Investigation after the incident revealed that the two "U" bolts on the cable which supported the block and tackle from which the scaffold was suspended had loosened enough to allow the cable to slip through them, causing both the scaffold and all of its supporting hardware to fall. The victim was pronounced dead at the local hospital approximately 1 1/2 hours after the incident. NIOSH investigators concluded that, in order to prevent similar incidents in the future, employers must ensure that:

- *appropriate personal protective equipment be worn properly and consistently whenever the potential for a serious fall exists*
- *suspension scaffold rigging be inspected periodically to ensure that all connections are tight and that no damage to the rigging has occurred since its last use.*

INTRODUCTION

On October 22, 1989, officials of the Indiana Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death of a 37-year-old male painter who died on October 21, 1989, when the suspension scaffold he was working fell 65 feet inside a municipal water tank. Technical assistance was requested by the Indiana Occupational Safety and Health Administration, and on November 30, 1989, a DSR safety specialist conducted an investigation of this incident. The investigator discussed the case with state officials and emergency services personnel. The investigator reviewed the incident with company officials, and investigated and photographed the incident site.

The employer, a painting contractor with 20 employees, has been in business for 7 years. The company has a designated safety officer and written safety rules and procedures, but no formal training program. The victim was hired as a journeyman painter, and had worked for the company for 1 month at the time of the incident. The victim had previously been employed as a painter by other contractors for approximately 10 years.

INVESTIGATION

The victim was a member of a three-man crew engaged in painting the interior and exterior of two 68-foot-tall by 32-foot-diameter municipal water tanks. The crew had been working on this project for 2 weeks prior to the incident, and had completed all work on one tank and most of the exterior work on the second.

On the day of the incident, the crew arrived at the worksite at approximately 11:30 a.m. The crew consisted of a foreman, the victim, and a groundman. The foreman was going to spray paint the interior of the water

tank while the victim was to finish work on the exterior of the tank. The groundman was to work inside the tank handling the spray paint lines used in the operation. The victim, a journeyman painter, asked to paint the interior of the tank. The foreman agreed, and the victim proceeded to paint the interior of the tank while the foreman finished work on the exterior of the tank.

Access to the interior of the tank was provided through a manhole on the side of the tank at ground level, and a second manhole located on top of the tank. This second manhole was reached by climbing a fixed ladder on the exterior of the tank.

The interior sidewalls of the tank were reached via a swing scaffold rigged inside the tank. This scaffold consisted of an aluminum ladder secured to a steel "stirrup" (a steel bar bent into a box shape and installed perpendicular to the ladder) at each end. The ladder was thus subjected to loading while in a horizontal position, rather than in the vertical position for which it was designed. Cables from each stirrup ran to a common tie-off point. A cable from this common tie off point then passed through a block and tackle. By pulling on this cable the entire scaffold could be raised and lowered from the ground level of the interior of the tank (Figure). The block and tackle which supported the scaffold was secured by a single cable which looped around a vertical steel pipe on top of the tank and fastened back to itself by two "U" bolts.

The entire crew entered the tank through the lower manhole. The groundman and the supervisor then raised the scaffold with the victim on it to the top of the tank. The victim was wearing a safety belt and lanyard which was secured to a lifeline, with the lifeline secured to a steel railing on the top of the tank. The victim proceeded to paint the top few feet of the tank's interior. The foreman climbed the exterior ladder to the manhole on top of the tank to help complete work near the tank's top. At approximately 1:00 p.m., the victim completed painting at the upper level. He then disconnected his lanyard from his lifeline and moved over to where he could hand the paint spray gun to the foreman so the foreman could finish a small area at the top of the tank. The foreman had just taken the spray gun from the victim when he heard a "pop" and saw the victim and the scaffold on which he was standing, fall to the floor of the tank 65 feet below. The victim and the scaffold struck the floor of the tank, barely missing the groundman. The foreman called to the groundman and told him to go next door and call an ambulance. The foreman then descended the ladder on the exterior of the tank and went in to assist the victim. The Emergency Medical Service (EMS) unit arrived on the scene approximately 5 minutes after the incident, removed the victim from the tank via the lower manhole, and transported him to the local hospital. The victim was pronounced dead at the hospital at 2:29 p.m.

Investigation after the incident revealed that the two "U" bolts on the cable which supported the block and tackle had allowed the cable to slip through them, causing both the scaffold and all of its supporting hardware to fall. This particular rig had been used daily for 2 weeks preceding the incident with no problems.

CAUSE OF DEATH

The cause of death was listed by the coroner as "hemorrhage from severe liver laceration and brain stem hematoma."

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Appropriate personal protective equipment should be worn at all times whenever the potential for a serious fall exists.

Discussion: In this case the victim was wearing a safety belt and lanyard, however at the moment when the incident occurred he was not hooked up to his lifeline. This failure to use PPE at all times during the job allowed the victim to experience a fatal fall when a scaffold failure occurred.

Recommendation #2: Suspension scaffold rigging should be inspected periodically to ensure that all connections are tight and that no damage to the rigging has occurred since its last use.

Discussion: The scaffold rigging in this case had been used daily for 2 weeks prior to the incident; however, no periodic inspection program was in place. It appears that the "U" bolts holding the scaffold had loosened over time, although this loosening had not been observed by workers at the site.

Recommendation #3: Equipment should only be used for the purpose for which it was designed.

Discussion: The "scaffold platform" in this incident was a simple aluminum ladder. This ladder was designed to support a load in a vertical position but was being utilized to support a load while in a horizontal position. While this did not directly contribute to this incident, the potential for a failure of the ladder while being used in this manner was certainly present.

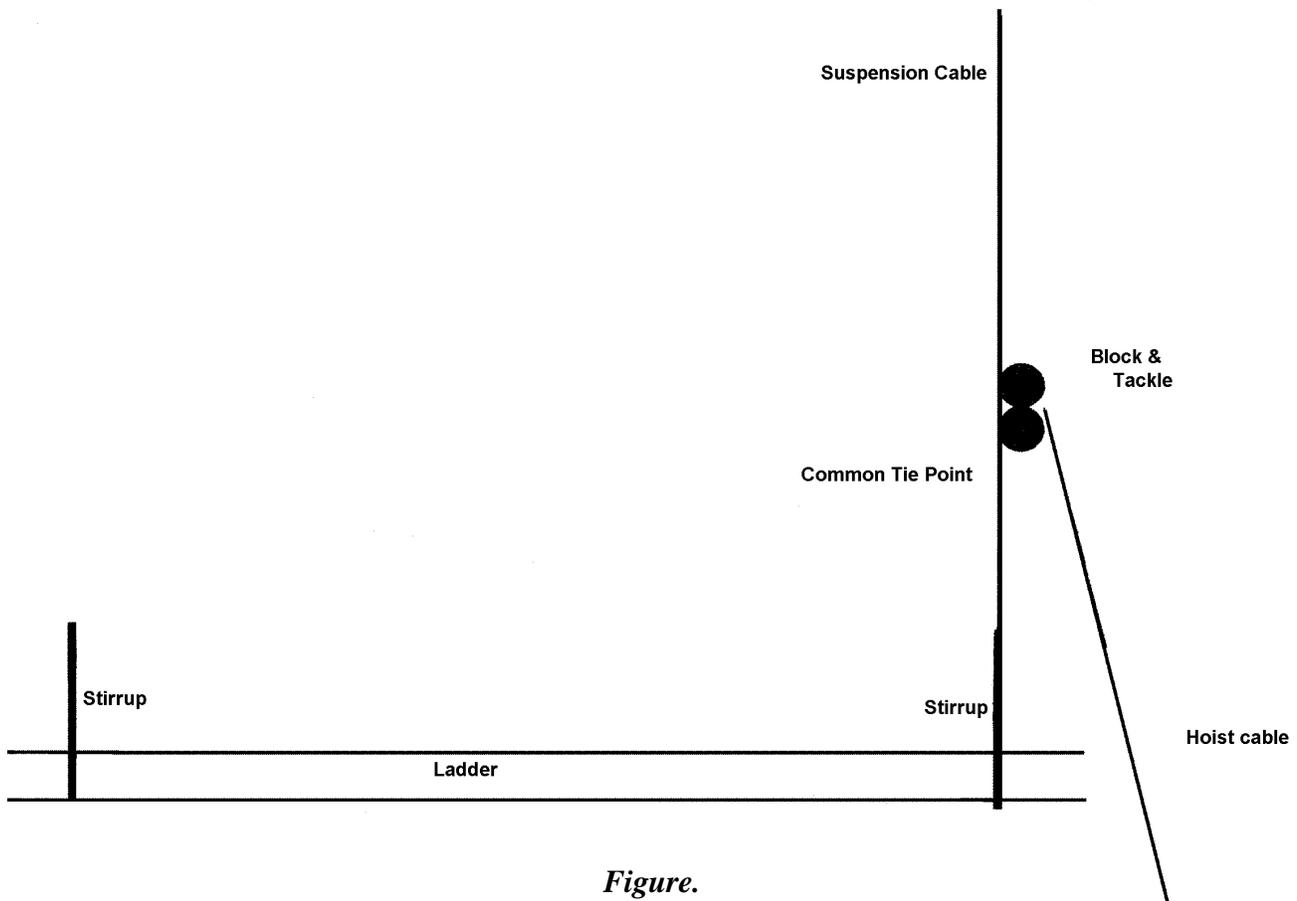


Figure.

FACE 90-13: Asbestos Worker Dies in Fall from Scaffold in Indiana

SUMMARY

A 21-year-old asbestos worker died as a result of injuries sustained in a 12-foot fall from a scaffold. The victim was a member of a six-man crew engaged in the removal of asbestos-contaminated insulation from a series of large ducts on the exterior of an electric power generation plant. The victim was removing asbestos insulation from a large outdoor metal duct approximately 14 feet above the ground. The worksite was accessed by tubular metal scaffolding. The victim was working at the 12 foot level of the scaffold. The scaffold was not decked at this level. Instead, the crew had installed a single 2-inch by 12-inch plank across the tubing. The plank extended beyond the tubing on both sides and was not fastened in position to the tubing. Instead, the crew had driven two nails into each end of the plank at 45 degree angles to hold the plank against the tubing while allowing them to slide the plank along the tubing to various areas where they were working. The nails on one end of the plank had loosened sufficiently to slip free from the scaffold. The weight of the victim on the opposite end of the plank caused the plank to rise up in the air, dropping the victim to the ground below. NIOSH investigators concluded that, in order to prevent similar occurrences in the future, employers and employees must:

- *fully deck all scaffolds and secure decking material in accordance with existing OSHA regulations*
- *provide appropriate fall protection equipment to all employees whenever the potential for a serious or fatal fall exists*
- *provide safety training to all employees which address all potential hazards to which the employee may be exposed, especially the proper use of scaffolding and fall protection equipment.*

INTRODUCTION

On November 2, 1989 officials of the Indiana Occupational Safety and Health Administration notified DSR of the death of a 21-year-old male asbestos worker who died as a result of a 12-foot fall from a scaffold on August 18, 1989 and requested technical assistance. On November 29, 1989 a DSR safety specialist conducted an investigation of this incident. The case was discussed with state officials and emergency services personnel, and the incident was reviewed with company officials.

The employer is a large, multistate insulation contractor. The company employs 500 individuals, including 100 asbestos workers who remove asbestos-contaminated insulation. The company has a designated safety officer and written safety policy and procedure manuals. The victim had been employed by the company for 1 month at the time of the incident. Although the victim had received safety training from the company, the primary focus of this training was asbestos removal procedures. (Note: The company had no policy in place requiring the use of fall protection equipment at the time this incident occurred. Since the incident, a policy has been implemented requiring the use of safety belts/lifelines whenever employees are working on any elevated surface.)

INVESTIGATION

On the day of the incident, a six-man crew was removing asbestos-contaminated insulation from a series of large ducts on the exterior of an electric power generation plant. The crew had been working intermittently at the plant (as environmental conditions permitted) for several days prior to the incident.

On the morning of the incident, the crew started work at 7:00 a.m. The victim was removing asbestos insulation from a large outdoor metal duct approximately 14 feet above the ground. The worksite was accessed via metal tubular scaffolding.

Each section of the scaffolding formed a 10-foot by 6-foot rectangle. The victim was working at the 12-foot level where the scaffold was not decked. Instead, the work crew had installed a single 8-foot-long, 2-inch by 12-inch plank across the tubing. This plank extended approximately 14 inches past the end of the scaffold tubing on one side, and approximately 10 inches past the tubing on the other side. This plank was not fastened in position on the scaffold tubing; rather, the crew had driven two nails into each end of the plank at 45 degree angles, to hold the plank against the tubing (Figure). This procedure allowed the workers to slide the plank along the tubing (along the 10-foot side) to various areas where they were working.

The victim was sitting astride the tubing, on the end of the plank with the 14-inch overhang, to remove asbestos from the duct. Two co-workers had stepped off of the same plank about 5 minutes earlier.

Although no one witnessed the incident, it appears that the nails on one end of the plank had loosened sufficiently to allow the plank to slip free from the scaffold. The weight of the victim on the opposite end of the scaffold caused the plank to rise up in the air, dropping the victim to the ground below where he was struck by the falling plank. The two co-workers heard the victim and the plank strike the ground. The co-workers immediately called for help and went to the victim. The victim was conscious but told the co-workers that he "couldn't feel anything." He asked the co-workers to "put my hands on my chest," which they did.

Local Emergency Medical Service (EMS) personnel arrived on the scene approximately 8 minutes after the incident, and promptly transported the victim to a local hospital. The victim died in the hospital 65 hours after the incident.

CAUSE OF DEATH

The Coroner gave the cause of death as bronchopneumonia and sepsis complicating blunt force injury of the neck.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: All scaffolding should be fully decked and all decking material secured in accordance with 29 CFR 1910.28(1) and 1926.451(2).

Discussion: The scaffold in this incident was not properly decked, and the planking used for decking was not properly secured. These two conditions were major contributors to this incident.

Recommendation #2: Appropriate fall protective equipment should be employed wherever the potential for a serious or fatal fall exists.

Discussion: The victim was not using any type of fall protection equipment when this incident occurred. A safety belt and lanyard could have prevented this fatality had they been utilized.

Recommendation #3: Employee safety training should address all potential hazards to which an employee may be exposed.

Discussion: While the employer in this case did have a safety training program, this program dealt specifically with the hazards of asbestos removal work. The employer's program failed to address other hazards to which employees may be exposed, such as falls and the proper installation and use of scaffolding. A comprehensive safety training program emphasizing the hazards posed by falls and stressing the use of appropriate personal fall protection equipment, might have prevented this fatality.

REFERENCES

1. 29 CFR 1910.28. Code of Federal Regulations. Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.
2. 29 CFR 1926.451. Code of Federal Regulations. Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

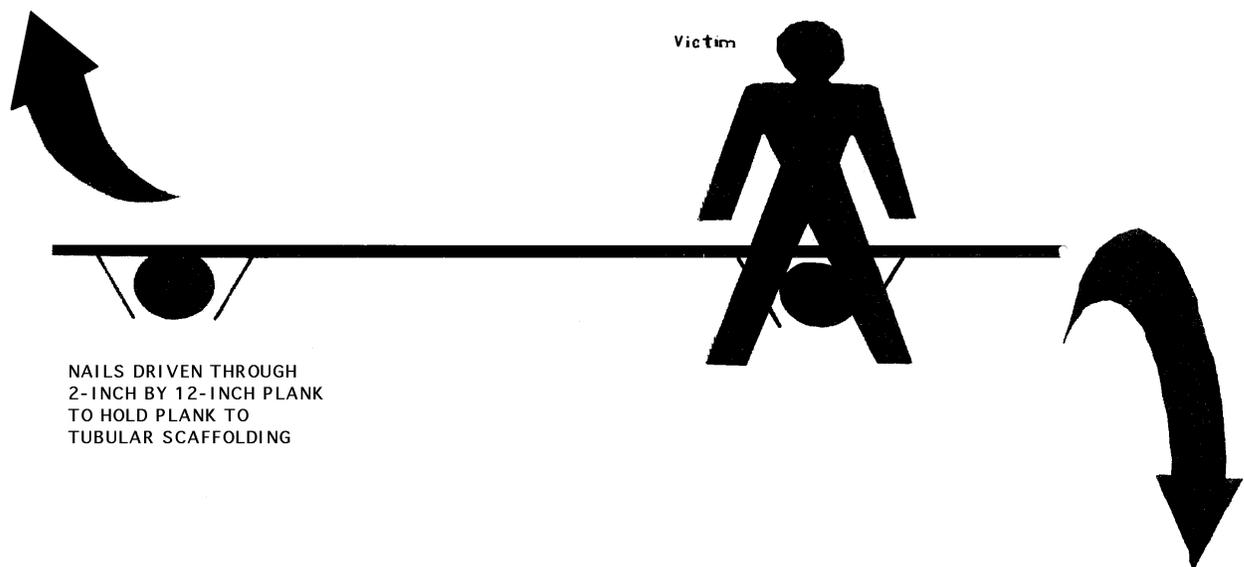


Figure.

FACE 90-16: Painter Dies Following a 40-foot Fall from Scaffold Inside Water Tank in Ohio

SUMMARY

A painter sandblasting the interior of a water tank, died after falling 40 feet from a four-point suspension scaffold when one of the nylon suspension ropes broke. The painter had previously welded some steel brackets to the inside top wall of the tank in order to install a fall protection anchor cable. Later, as the painter, a co-worker, and the company owner were raising one end of the scaffold platform during a sandblasting operation, a suspension rope broke, causing the painter to fall. An OSHA investigation determined that the rope broke at a point where it had been burned, presumably when the steel brackets were welded. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *prohibit welding in the vicinity of synthetic rope suspension scaffolding*
- *construct and maintain suspension scaffolding in accordance with OSHA and ANSI Standards*
- *ensure that fall protection equipment is provided and used by workers as needed*
- *develop and implement a safety program to help workers recognize and control hazards*
- *develop and implement procedures for entry and work in confined spaces.*

Additionally, tank designers/manufacturers should:

- *design and install appropriate tank anchor points for maintenance purposes*

INTRODUCTION

On November 20, 1989, a 39-year-old male painter (victim) fell 40 feet from a scaffold, when one of the nylon suspension ropes supporting the scaffold broke. Although the incident occurred in Ohio, the victim died in a Pennsylvania hospital. On November 30, 1989, officials from a county coroner's office in Pennsylvania notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On December 12, 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 the OSHA compliance officer assigned to the case, and obtained photographs and diagrams of the incident site.

The employer is an industrial painting contractor who has been in business for 10 years. Most of the employer's business involves painting building exteriors and other outdoor structures. Contracted work is either done by the owner himself or with the help of one or two hired workers, depending on the job. The victim in this incident was the owner's brother, who also owned his own painting company and had been an industrial painter for 15 years. The employer has no safety program.

INVESTIGATION

The employer had been contracted by a manufacturing company to sandblast and paint the interior and exterior of a 250,000- gallon steel water tank, which measures 48 feet high by 30 feet in diameter. The tank

has an 18-inch-diameter manway on the side 12 inches from the bottom, and a 3-foot-square hatch on top of the tank near the edge.

The employer hired a laborer to help him with the job. The owner and laborer had sandblasted and painted the outside of the tank 3 weeks prior to the incident, using a two-point suspension scaffold. The scaffold consisted of a platform (20 feet long and 2 feet wide) constructed of angle iron and wood planks with a metal guardrail. The top rail of the guardrail was 40 inches above the platform. The platform was suspended by two, 5/8-inch-diameter nylon ropes from a triangular framework ("stirrup") of angle iron at the ends of the platform. The nylon ropes passed through a block and tackle hoist at both ends of the platform. The other end of each rope was tied to a vent pipe on top of the tank. By pulling and letting up on the individual ropes and tying them to the platform, the scaffold platform could be positioned at the desired height.

After painting the exterior of the tank, the owner hired his brother (the victim) to help him sandblast and paint the interior. In order to remove the moisture and condensation inside the tank, the owner opened the manway and hatch, and positioned two propane salamander heaters equipped with blowers just outside the manway to blow warm air into the tank. The owner, the victim, and the laborer entered the tank through the manway and hatch with the necessary scaffold parts, and set up a suspension scaffold similar to the two-point suspension scaffold used on the outside of the tank. However, with this scaffold, three platforms were joined together by overlapping the ends of two other platforms inside the stirrups at the ends of the center platform. The resulting configuration formed a "U"-shaped, four-point suspension scaffold (Figures 1 and 2).

Before the suspension scaffold was raised into position, the victim climbed a ladder to weld steel brackets to the opposite side walls at the top of the tank. The brackets were used to anchor a horizontal 3/8-inch-diameter steel cable (to be used as a fall protection anchor cable). The nylon suspension ropes were lying on the floor of the tank while the brackets were being welded. After the welding, the owner inspected the suspension ropes by passing each rope length through his hands, but did not notice any apparent damage to the ropes.

The four suspension ropes and two, 300-watt portable utility lights were then tied to angle iron roof support beams at the top of the tank. Another 300-watt utility light was secured to the center scaffold platform. The entire scaffold platform was raised to approximately 40 feet above the floor and the victim began sandblasting the top portion of the tank wall. During the sandblasting, the victim wore a supplied air respirator (without an auxiliary, escape-only SCBA), a sandblaster's hood, gloves, and coveralls. The owner urged the victim to wear a safety belt, secure it to a vertical rope (lifeline) with a rope-grab device, and secure the other end of the lifeline to the horizontal steel cable at the top of the tank. The victim chose not to wear the fall protection equipment, saying that it would get in his way. After the victim had sandblasted as much of the top portion of the tank as he could reach, the platform was lowered to the floor of the tank and the nylon suspension ropes were reattached to roof support beams above the portion of the tank which had yet to be sandblasted. The three men began raising the scaffold platform by alternately raising each suspension point a few feet at a time. Again, the victim did not wear any type of fall protection equipment. The laborer, however, did wear a safety belt/lifeline tied off to the steel cable as the owner had suggested. The owner was standing at the bottom of the tank during this time.

While the victim (who was standing on the platform at one end) was pulling on a suspension rope to raise one end of the scaffold, it broke, causing that end of the platform to fall. The victim fell approximately 40 feet, landing on a horizontal, 2-inch-diameter water pipe at the bottom of the tank. The laborer managed to remain standing on the other platform leg which stayed intact (Figure 2). The owner rushed to the victim

(who was unconscious but still breathing), placed the victim on a piece of planking, and the owner and laborer subsequently removed him from the tank through the manway. The laborer then ran to the manufacturing plant for help. The county emergency medical service (EMS) was notified and arrived at the site 12 minutes later. The victim was rushed to a local hospital and then air transported to a larger hospital where he died in the operating room 3 hours later. An OSHA investigation determined that the suspension rope broke at a point where it had been burned.

CAUSE OF DEATH

The coroner listed the cause of death as blunt force trauma to the head and trunk.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Synthetic rope used in suspension scaffolding should be protected from heat producing sources.

Discussion: Paragraph 3.25 of the American National Standards Institute (ANSI) "Safety Requirements for Scaffolding," A10.8-1977, states that "Special precautions shall be taken to protect scaffold members, including any wires, fiber, or synthetic rope when using a heat producing process." Occupational Safety and Health Administration (OSHA) standard 29 CFR 1926.451(a)(18) states that "No welding, burning, riveting, or open flame work shall be performed on any staging suspended by means of fiber or synthetic rope." An OSHA investigation after the incident determined that the rope had broken at a point where it had been burned. Exactly how the rope was burned is not clear. The victim had previously welded steel support brackets to the inside of the tank. Although the welding was not done from the scaffolding platform, it was performed above the nylon rope which was lying on the floor of the tank before the scaffolding was raised. Also, the 300-watt utility lights may have come too close or contacted the nylon suspension ropes sometime during the sandblasting operation.

Recommendation #2: Suspension scaffolding should be constructed and maintained in accordance with OSHA Standard 19 CFR 1926.451, and ANSI Standard A10.8-1977.

Discussion: The OSHA and ANSI Standards require synthetic or fiber rope used for scaffold suspension to be capable of supporting at least six times the rated load (29 CFR 1926.451(a)(19) and (i)(5), and ANSI A10.8-1977, 3.23). Due to the size and type of rope being used it is questionable whether it was capable of meeting this requirement.

Recommendation #3: Where the potential for a fall from an elevation exists, employers should ensure that fall protection equipment is provided and used by workers.

Discussion: Although fall protection equipment, consisting of a steel anchor cable secured horizontally across the top of the tank (to secure lifeline ropes), lifeline ropes, safety belts, and rope-grab devices, was available at the site during the incident, it was not used by the victim. The use of a safety belt/lanyard combination is required by 29 CFR 1926.451(i)(8) for use on two-point suspension scaffolds. The use of the safety belt or body harness/lanyard with a rope-grab device is appropriate for persons working from scaffolds at varying heights. Properly used, this type of fall protection would have prevented the victim from falling even when the scaffolding fell.

Recommendation #4: Employers should develop and implement a safety program designed to help workers recognize, understand, and control hazards.

Discussion: OSHA Standard 1926.21(b)(2) states that "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." Even small companies should evaluate the tasks performed by workers, identify all potential hazards, then develop and implement a safety program addressing these hazards, and provide worker training in safe work procedures. Prior to starting any job, the employer should conduct a jobsite survey, identify all hazards, and implement appropriate control measures.

Recommendation #5: Employers should develop and implement specific procedures for entry and work in confined spaces.

Discussion: The owner and workers in this incident were working inside a confined space. Even though the victim died from the result of a fall, there were other potential hazards associated with the work to be performed inside the tank (i.e., painting the inside of a tank with a toxic and flammable paint). Although most of the work contracted by the employer does not require confined space entry, it is reasonable to expect that future work might require the employer and hired workers to enter other types of confined spaces. The company should therefore, develop and implement a confined space entry program as outlined in NIOSH publications 80-106, "Working in Confined Spaces," and 87-113, "A Guide to Safety in Confined Spaces." Minimally, the following items should be addressed:

1. *Has the air quality in the confined space been tested for safety?*
 - Oxygen supply at least 19.5%
 - Flammable range less than 10% of the lower explosive limit
 - Absence of toxic air contaminants
2. *Have employees and supervisors been trained in the selection and use of personal protective equipment and clothing?*
 - Fall protection
 - Respiratory protection
 - Emergency rescue equipment
 - Protective clothing
3. *Have employees been trained for confined space entry?*
4. *Have employees been trained in confined space rescue procedures?*
5. *If ventilation equipment is needed, is it available and/or used?*
6. *Is the air quality tested when the ventilation system is operating?*

Recommendation #6: The designers/manufacturers of tanks of this type should design and install appropriate anchor points for maintenance purposes.

Discussion: Permanent structures of this type are known to require extensive maintenance when they are designed. It is essential that designers/owners of these facilities incorporate appropriate anchor points on tanks to which workers can adequately secure scaffolds and lifelines. Omission of designed anchor points causes workers to improvise anchors or not use them at all. This increases the possibility that a scaffold will be erected using improper procedures and components.

REFERENCES

1. American National Standards Institute (ANSI) Inc., Safety Requirements for Scaffolding. ANSI A10.8-1977, 1977.
2. Office of the Federal Register. Code of Federal Regulations. Labor. 29 CFR Part 1926, pages 20, 180-181, U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C.
3. National Institute for Occupational Safety and Health, Criteria for a Recommended Standard ... Working in Confined Spaces. DHHS (NIOSH) Publication Number 80-116, December 1979.
4. National Institute for Occupational Safety and Health, A Guide to Safety in Confined Spaces. DHHS (NIOSH) Publication Number 87-113, 1987.

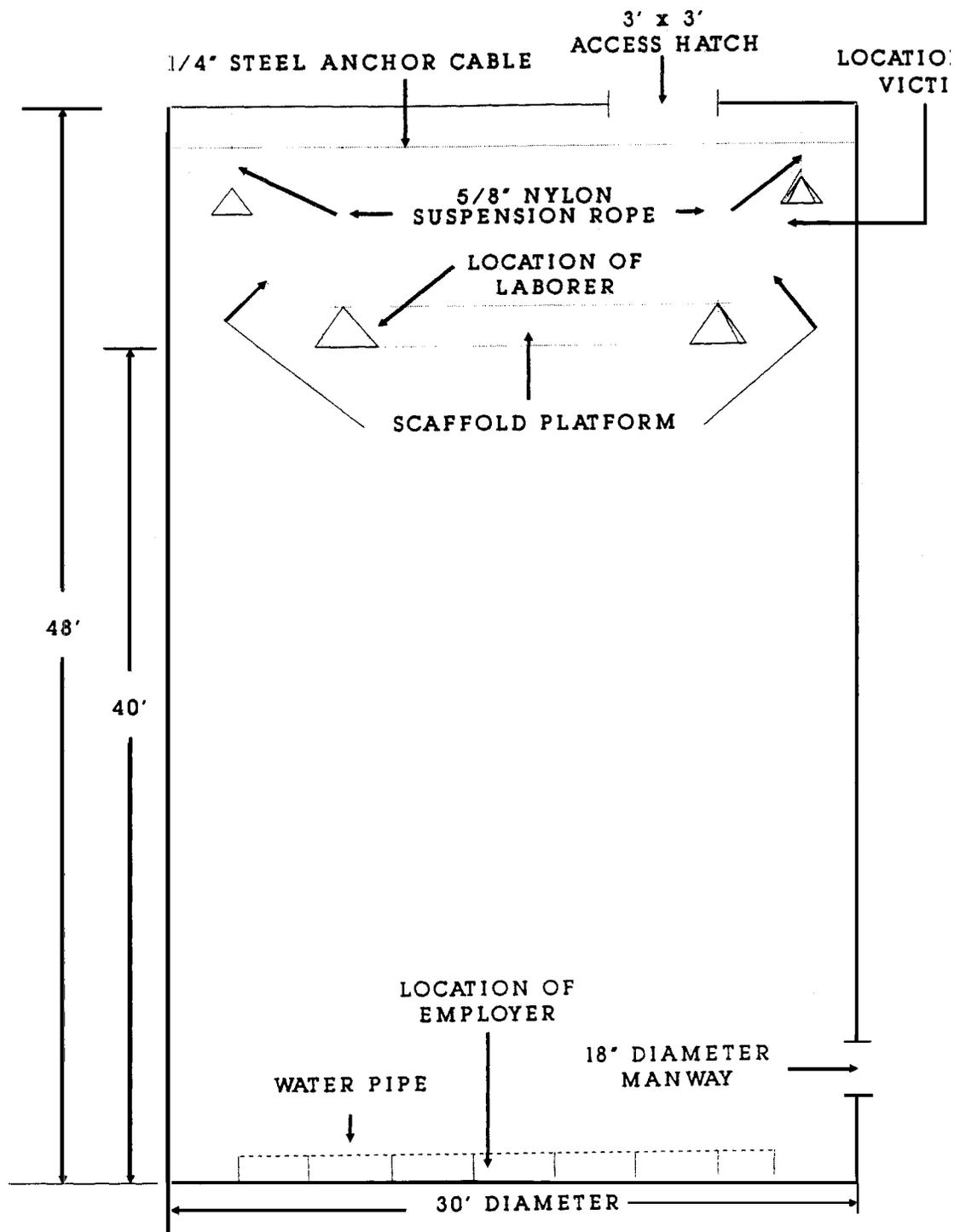


Figure 1. Water Tank (Side View)

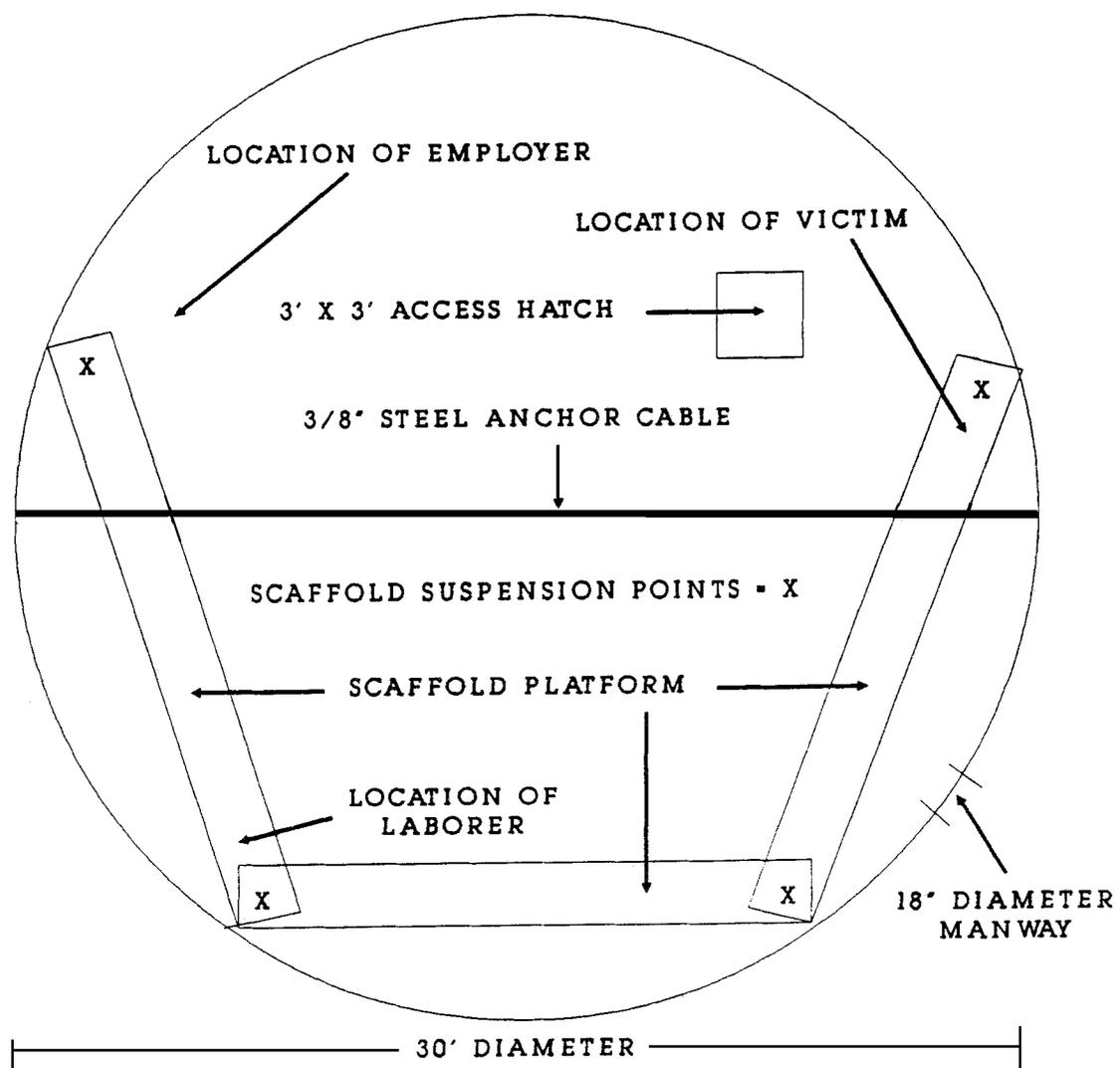


Figure 2. Water Tank (Top View)

FACE 90-20: Mason Dies after Falling 36 Feet from Scaffolding

SUMMARY

A male brick mason (victim) fell 36 feet to his death while working from a tubular welded frame scaffold. The victim was working as part of a brick laying crew on the exterior of a new building. At the time of the incident, the crew was working from the 6th level of the scaffold. When the work had been finished at this level, the foreman told the workers to take a break while he and a laborer raised the planks to the next level. For some unknown reason, the victim stayed on the scaffolding. Prior to his unwitnessed fall 36 feet to the ground, the victim was seen with one foot on a scaffold brace and the other on the brick sill of the building. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *ensure that employees are informed of the hazards of using diagonal braces as a means of climbing a scaffold*
- *conduct scheduled and unscheduled safety inspections regularly at each jobsite*
- *develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training workers in the proper methods of erecting and working from scaffolds*
- *provide appropriate fall protection equipment to all workers who may be exposed to a fall hazard.*

INTRODUCTION

On November 3, 1989, a 33-year-old brick mason died after falling 36 feet from a tubular metal frame scaffold. On November 9, 1989, officials of the Maryland Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death and requested technical assistance. On December 12, 1989, a DSR safety engineer conducted an investigation and met with a company official to discuss the incident. Photographs of the incident site were taken and emergency medical services (EMS) records were obtained.

The employer is a masonry construction company that has been in business for 6 years. The company employs 100 workers, including 30 masons. The company has a designated safety officer and a written safety policy and safety procedures. The company holds regular safety meetings and provides both on-the-job and classroom safety training. Prior to this incident the company had gone approximately 2 years without a lost-time injury. Since this incident, the company has instituted measures for taking disciplinary action for failure to comply with safety rules.

The victim had been hired as a mason/foreman approximately one month prior to the incident. The victim had worked as a mason for over 10 years prior to coming to work for this company.

INVESTIGATION

The victim was working as part of a four-person crew (foreman, two masons and a laborer) laying brick on the exterior of a new building. The crew was working from the 6th level of a tubular welded frame scaffold. (Each level of the scaffold was 6 feet high.) The scaffolding was erected about 2 feet parallel from the face of the building and had attached outriggers (metal brackets installed on the scaffolding toward the

building) on which planks were placed for the masons to work from. The crew had just finished laying the brick for the window sill at the third floor level. The foreman told the victim and another mason to take a break while he and a laborer raised the planks to the next level. The co-worker stepped from the scaffold into the building and went down to the ground floor to get some coffee. The victim, for unknown reasons, decided not to leave the work area. He was noticed by a worker to have one foot on the brick sill and his other foot on one of the scaffold's diagonal braces. Witnesses stated that there was some moisture on the scaffolding components that morning which may have made the metal slippery. The victim apparently lost his balance (or slipped) and fell, unwitnessed, to the ground through the center of the scaffolding. The foreman had his back to the victim and was two sections of scaffolding away when the incident happened. The sound created when the victim hit the ground alerted the other workers that he had fallen.

The emergency medical service (EMS) was summoned and arrived at the scene within 2 minutes after receiving the call. The EMS records indicate that the victim was unconscious and in respiratory arrest. He was bleeding from both ears and the nose and had a compound fracture of the skull. The technicians were unable to determine the victim's blood pressure and 8 minutes after arriving were no longer able to detect a pulse. The victim was transported by helicopter to a trauma center where he was pronounced dead on arrival.

CAUSE OF DEATH

The medical examiner's report stated that the cause of death was due to head injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that employees are informed of the hazards of using diagonal braces as a means of climbing a scaffold.

Discussion: The victim was apparently climbing or maneuvering on the scaffolding by using the diagonal braces as a foot support. Employers should instruct workers that the proper way to climb scaffolding is via the ladders provided.

Recommendation #2: Employers should conduct scheduled and unscheduled safety inspections regularly at each jobsite to ensure worker compliance with established safe work procedures.

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 develop, implement, and enforce a comprehensive safety program that includes, but is not limited to, training workers in the proper methods of erecting and working from scaffolding.

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 proper methods for erecting and working from scaffolding.

Recommendation #4: Employers should provide appropriate fall protection equipment for all workers who may be exposed to a fall hazard.

Discussion: Employers should provide appropriate fall protection equipment for all workers exposed to fall hazards, and should provide worker training in the proper use of this equipment. Once this training is provided, employers should initiate measures to ensure the use of this fall protection equipment. A safety belt and lanyard would be appropriate fall protection equipment for use on scaffolding.

FACE 91-02: Electrician Dies After Fall in South Carolina

SUMMARY

A 34-year-old male electrician died after falling 12 feet from a scaffold that he was erecting. The victim and a helper were installing conduit for the lighting system in a new shopping mall directly below the steel-beam framework of the building's ceiling. The victim and his helper were using a mobile, aluminum-tubular-frame scaffold with 6-foot-high tiers, to access their work area. After dismantling the scaffold and moving to a location 30 feet from their previous work area, they erected the first tier and locked it in place. The victim erected the second tier of scaffold while the helper returned to the previous location to get some components for the third tier. At the time the helper left, the victim was moving two wooden floorboards from the second tier to the third tier. When the helper returned, he found the victim lying facedown on the concrete floor. The victim was bleeding severely from the nose and mouth, but was conscious. The supervisor at the scene called the job superintendent in the company trailer by two-way radio and told him to call the emergency medical service (EMS). Five minutes after the incident occurred, the victim lost consciousness and no vital signs could be detected. Cardiopulmonary resuscitation (CPR) was initiated immediately by co-workers. The emergency medical service (EMS) arrived 15 minutes after being called and transported the victim to the hospital, where he was pronounced dead on arrival. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *provide required personal protective equipment to employees, and ensure that it is used*
- *provide safety training to all new employees*
- *periodically observe the working habits of new employees to ensure that they are accomplishing their assigned tasks in a safe manner.*

INTRODUCTION

On October 11, 1990, a 34-year-old electrician died after falling 12 feet from a mobile scaffold. On October 16, 1990, officials of the South Carolina Safety and Health Administration notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On November 8, 1990, two safety specialists from DSR traveled to the incident site to conduct an investigation. The investigators reviewed the incident with the jobsite superintendent, the city police, and the county coroner. Photographs of the incident site and a final report were obtained from the county coroner. The police report was also obtained.

The employer is an interstate electrical contractor that has been in operation 70 years and employs 250 workers. The 17 workers employed at this jobsite included 7 electricians, 8 helpers, 1 supervisor, and the jobsite superintendent. The company hired the electricians and helpers from applications obtained through the local job service. The victim had been on the job for 2 days. New employees receive a handbook that contains the company safety rules. Weekly tailgate safety meetings are conducted at the jobsite by the job superintendent. The company provides on-the-job training, and funding for employees to attend a certified technical college. The job superintendent is responsible for safety.

INVESTIGATION

The company had been contracted to install the electrical system for a new shopping mall complex under construction. The company had been working at the site for 4 months. On the day of the incident, the victim (an electrician) and a helper were installing conduit directly below the steel-beam framework of the structure's ceiling. The 1/2-inch conduit would encase the conductors for the structure's lighting system. The victim and the helper were using a mobile, aluminum-tubular-frame scaffold to access their work area. The scaffold was three tiers high. Each tier measured 4 feet wide by 8 feet long by 6 feet high. The work area was about 22 feet above ground.

The two men began work at 7:00 a.m., and by 8:00 a.m. were ready to move the scaffold to a new position. The two top tiers were dismantled and the bottom tier unit was moved 30 feet across the concrete floor to a new work area. Once in position, the scaffold's outriggers were put in place and the casters were locked. The men began to re-assemble the top two tiers of the scaffold. The second tier was put in place and the bottom section for the third tier was placed across its top. The victim began to move the two 2-inch by 8-inch by 8-foot floor boards from the second tier to the third tier. He had moved one of the boards when the helper walked to the previous work area to retrieve one of the side sections for the third tier.

When the helper returned, he found the victim lying facedown on the concrete floor. The victim was bleeding severely from the nose and mouth. The supervisor in the area called the superintendent in the company trailer by two-way radio and told him to call the emergency medical service (EMS). Five minutes after the incident occurred, the victim stopped breathing and no vital signs could be detected. Co-workers immediately initiated cardiopulmonary resuscitation (CPR). The EMS arrived 15 minutes after being called and transported the victim to the hospital, where he was pronounced dead by the attending physician.

CAUSE OF DEATH

The coroner listed head trauma as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide adequate personal protective equipment and ensure its use.

Discussion: As required by 29 CFR 1910.268(g), safety belts and straps should be provided and the employer should ensure their use when work is performed at heights more than 4 feet above ground.

Recommendation #2: Employers should instruct new employees in the proper methods to be used in the performance of assigned tasks.

Discussion: Employers should ensure that new employees are instructed in the proper methods for performing assigned tasks, such as erecting and working from scaffolds, prior to the initiation of work.

Recommendation #3: Employers should periodically observe the working habits of new employees to ensure that the workers are performing their assigned tasks in a safe manner.

Discussion: Employers should conduct periodic random safety inspections to ensure that employees are performing their assigned tasks in accordance with established safe work procedures. Any violation of safety rules should be corrected immediately.

REFERENCE

29 CFR 1910.268(g), Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

FACE 91-06: Construction laborer Dies After Falling 61 Feet From Work Platform in Virginia

SUMMARY

A 33-year-old male construction company laborer (victim) died after falling 61 feet from an elevated, electric-powered, mast climbing work platform. Brickmasons and other company employees (including the victim) were working from the platform to complete the brick-laying phase for the exterior of a six-story building. At the beginning of the work day, the work platform had been raised to the fifth floor level when the victim realized that the work he needed to do was on the fourth floor level. The victim notified one of the brickmasons (co-worker), who lowered the platform. When the platform walkway cleared the top of a window opening (measuring 4 feet wide by 5 feet high), the victim sat down on the walkway edge and attempted to step onto the window sill about 3 feet below. The victim's feet slipped off the sill, and he fell through the opening between the window and platform walkway to the ground 61 feet below. The victim died from injuries sustained in the fall. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- *conduct jobsite surveys to identify potential hazards and implement appropriate control measures*
- *provide safety training that specifically addresses all identified jobsite hazards*
- *develop and implement safe work procedures for workers who are exposed to fall hazards*
- *provide appropriate fall protection equipment to all workers who may be exposed to a fall hazard.*

INTRODUCTION

On November 1, 1990, a 33-year-old male construction laborer died after falling 61 feet from a brickmason's motorized lift/work platform. On November 14, 1990, officials of the Virginia Occupational Safety and Health Administration (VOSHA) notified the Division of Safety Research (DSR) of the death and requested technical assistance. On December 6, 1990, a research industrial hygienist from DSR traveled to the incident site and conducted an investigation. The DSR investigator reviewed the incident with the company owner, the medical examiner, and the VOSHA compliance officer assigned to the case. Photographs of the incident site were obtained during the investigation.

The employer in this incident is a construction company that has been in business for 36 years. Most of the work performed by the company involves masonry construction for large buildings. The company employs 50 workers, most of whom are brickmasons and laborers. The victim had been employed by the company over the previous 4 years as a laborer. The company has a written safety program consisting of general construction safety requirements. Enforcement of the company safety requirements is documented and had resulted in previous terminations of some employees. Construction safety is the responsibility of the jobsite foreman, who also conducts weekly "tailgate" safety meetings. The victim had attended numerous weekly safety meetings for this construction project. These safety meetings covered such subjects as general construction site safety, jobsite emergencies, and scaffolding. New employees receive on-the-job safety training from supervisors and co-workers.

INVESTIGATION

A general contractor subcontracted the employer to lay the exterior brick for a six-story building at a university. The employer assigned a construction crew consisting of a foreman, four brick-masons, and two laborers (one of whom was the victim) to do the job. The crew had been working at the jobsite for about 2 weeks. By this time they had completed laying the bricks up to the fifth floor on one side of the building.

The brick work was done from an electric-powered, mast-climbing work platform (Figure). The platform was supported by a steel-frame mast secured to the building with cross members. The base of the mast was supported on an I-beam frame trailer (26 feet by 5 feet) with outriggers. The center of the main platform rode up and down the mast on a rack and pinion carriage, and was powered by two, 4-horsepower electric gear motors. The platform was operated with a remote pendant controller located on the platform.

The work surface of the steel-frame platform measured 7 feet wide by 50 feet long. It consisted of a plywood-surfaced main platform for holding materials (bricks, mortar, etc.), 5.5 feet wide by 50 feet long, and a wood-planked walkway platform ("foot boards") 20 inches wide by 50 feet long where workers stood to lay the brick.

The walkway was positioned 18 inches below the surface of the main platform and extended along the working face of the building at about 4 inches clearance. The outboard side and ends of the entire work platform were surrounded by a 42-inch-high steel frame/wire mesh guardrail and fence. Under normal working conditions, a guardrail is not installed on the walkway side of the platform.

At 6:30 a.m. on the day of the incident, the victim, co-worker and other brickmasons arrived at the site and climbed on the work platform to begin their work for the day. Using the pendant controller, the co-worker raised the work platform to the fifth story of the building. After reaching this level, the victim realized that the work he needed to do was inside the building on the fourth floor. He mentioned this to the co-worker, who lowered the work platform back toward the fourth floor.

As the platform descended, the victim attempted to enter the building through a window opening (measuring 4 feet wide by 5 feet high) on the fourth floor (Figure). When the platform walkway cleared the top of a window opening, the victim sat down (facing the building) on the walkway edge and began to step onto the window sill frame. When he did this, the walkway was still about three feet above the sill. At this moment, the co-worker yelled to the victim, "Wait a minute ... Wait a minute." The victim responded, "That's okay Buddy, no problem."

The victim supported himself with his elbows on the walkway foot boards. As he placed his feet on the sill and pushed off with his elbows, he slipped, falling forward. The victim struck his chin on the window sill, fell 61 feet, struck a horizontal I-beam on the trailer base, and landed 18 inches below the I-beam on the ground in the center of the trailer base.

The co-worker was the only one who witnessed the victim's fall. He yelled to the other brickmasons that the victim had fallen. The foreman, who was on the ground near the trailer, ran to the victim. The co-worker lowered the platform to a few feet above the ground. The co-worker and other brickmasons administered cardiopulmonary resuscitation (CPR) while the foreman called the emergency medical service (EMS). Personnel from the local EMS and the university police arrived approximately five minutes after receiving the call. EMS personnel checked the victim's vital signs, then called the local coroner, who pronounced the victim dead at the scene.

CAUSE OF DEATH

The medical examiner listed multiple severe injuries as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should conduct jobsite surveys to identify potential hazards and implement appropriate control measures.

Discussion: Employers should conduct jobsite and equipment surveys to identify potential worker hazards. Once potential hazards have been identified, appropriate control measures should be recommended and implemented prior to the start of work at any jobsite.

Workers on this type of work platform (or scaffolding) at positions in front of open areas (e.g., windows, cantilevered sections, etc.), are exposed to a fall hazard. Fall protection consisting of a guardrail or other appropriate fall protection equipment (e.g., safety belt and lifeline) should be provided in accordance with OSHA Standard 29 CFR 1926.451(a)(4), and ANSI Standard A.92.6-90, Self-Propelled Elevating Work Platforms.

Recommendation #2: Employers should provide safety training that specifically addresses all identified jobsite 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." Workers who use work platforms, scaffolds, etc., are exposed to fall hazards, and should be trained in specific safe work procedures and the use of fall protection equipment pertaining to their work.

Recommendation #3: Employers should develop and implement safe work procedures for workers who are exposed to fall hazards.

Discussion: The platform manufacturer had provided an operator's manual for the work platform. There are safe work procedures in the manual, but none specifically address fall protection. Printed safe work procedures for all elevated work platforms should address fall protection, especially for situations when the platform is in front of open areas at locations more than 4 feet above the ground level, and/or when the platform is in motion. Workers should not be allowed to stand or sit on the walkway of this type platform while the platform is in motion.

Recommendation #4: Employers should provide appropriate fall protection equipment for all workers who may be exposed to a fall hazard.

Discussion: Employers should provide appropriate fall protection equipment for all workers exposed to fall hazards, and should provide worker training in the proper use of this equipment. Once this training is provided, employers should initiate measures to ensure the use of this fall protection equipment.

REFERENCES

1. Office of the Federal Register, Code of Federal Regulations, Labor, 29 CFR Part 1926.21(b)(2), and Part 1926.451(a)(4), U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C., July 1989.
2. American National Standards Institute, Inc., A.92.6-90, Self-Propelled Elevating Work Platforms, October 1990.

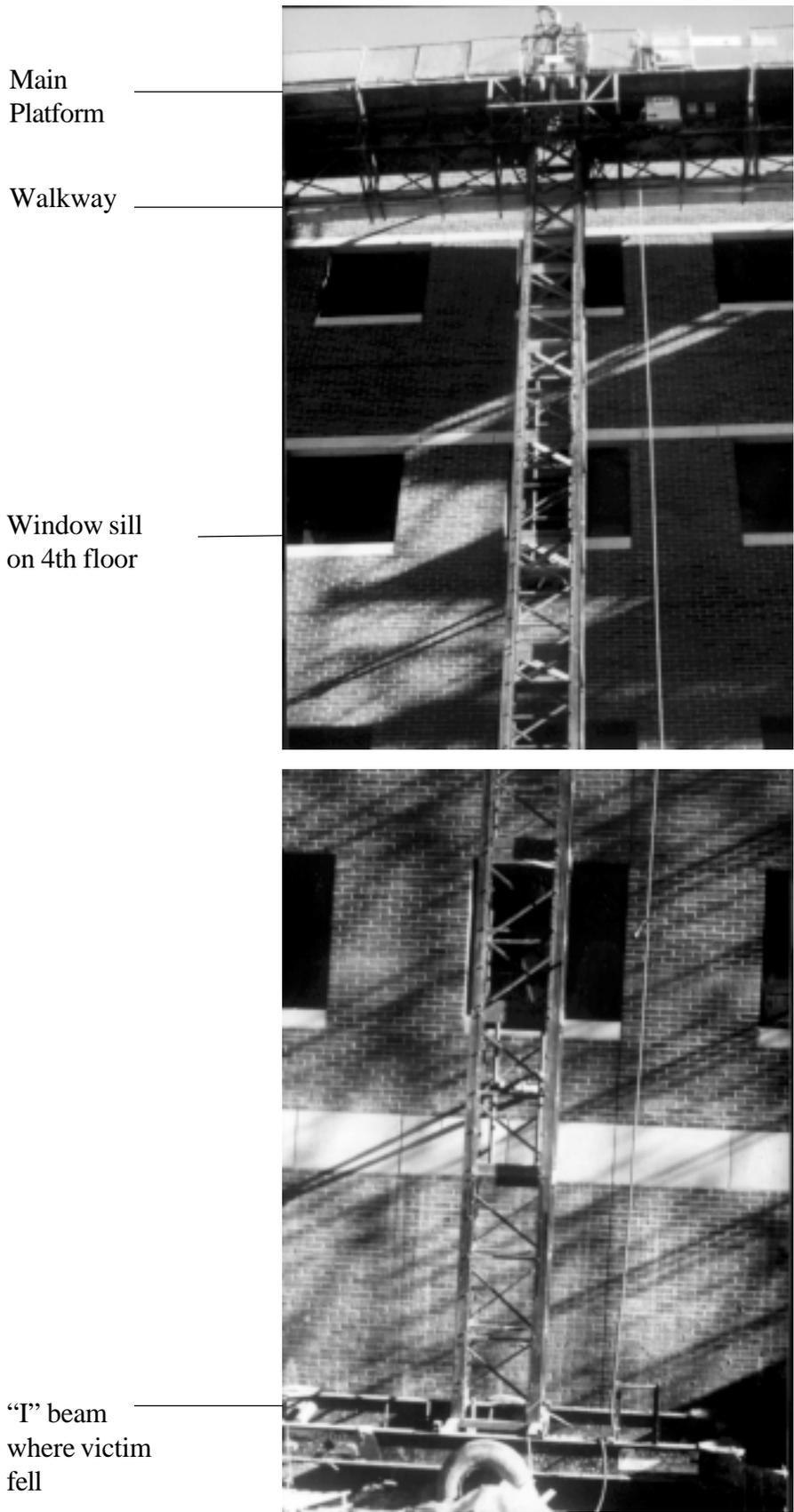


Figure.

FACE 93-15: Painter/Sandblaster Dies Following a 30-foot Fall from Scaffolding Inside a Water Tank--South Carolina

SUMMARY

A 48-year-old male painter/sandblaster (the victim) died of injuries received after falling 30 feet from a tubular welded frame scaffold. The victim was part of a three-man crew that was sandblasting the interior of a newly constructed water storage tank needed for fire fighting. In preparation to sandblast and spray paint the tank's interior, workers on the daylight shift (7 a.m. to 5 p.m.) had erected 2 separate 30-foot-high tubular welded frame scaffoldings inside the tank. The victim and foreman were working the afternoon shift (5 p.m. to 3 a.m.) sandblasting the tank's interior walls, each working from an individual scaffold. A third crew member, the hole-watch, had been assigned ground duties which primarily consisted of getting supplies and assisting the sandblasters. At about 12:30 a.m. the following morning, the holewatch noticed that the victim had shut off his blast hose. A few minutes later, the foreman descended from the scaffolding upon which he was working and informed the holewatch he was ready to move his scaffolding. The foreman, after talking with the holewatch, wondered why the victim had stopped work and went looking for him. The victim was found lying injured and conscious, but incoherent, on the deck of the tank. The Emergency Medical Service (EMS) was called and arrived in less than 5 minutes. EMS personnel administered first aid and transported the victim 7 miles to the local hospital where he died 8 days later. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *ensure that fall protection equipment is provided and used by workers where the potential for a fall from an elevation exists*
- *evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing hazards in the workplace, and following established safe work procedures with particular consideration to using appropriate personal protective equipment*
- *designate a competent person to conduct regular safety inspections.*

INTRODUCTION

On April 7, 1993, a 48-year-old male painter/sandblaster (the victim) was injured when he fell 30 feet from a scaffold. He died 8 days later, on April 15, 1993, as a result of the injuries he received in the fall. On April 22, 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 May 13, 1993, a safety specialist from DSR investigated the incident and reviewed the circumstances with one of the two company owners and the SCOSHA compliance officer assigned to the case. Photographs of the incident site were taken, and the medical examiner's report was requested.

The employer in this incident was a commercial and industrial painting contractor that had been in operation for 14 years and employed about 100 workers, of which approximately 90 were painters/sandblasters. The employer had a written safety policy and a safety program which consisted of job-specific safety procedures, a confined space entry program, a hazardous communication program, random drug testing, and a disciplinary program. Company management personnel were responsible for the enforcement of the safety program on a collateral-duty basis. The employer provided on-the-job training, and management personnel conducted tool-box safety meetings on a weekly basis. The victim worked for the company for

1 day as a painter/sandblaster, but had approximately 20 years' experience working in this occupation. This was the first fatality the company had experienced.

INVESTIGATION

On the day of the incident, the victim arrived for his first day of work at about 4:40 p.m. The painting contractor had been hired by a paper processing plant to paint a metal, 40-foot-high by 40-foot-diameter water storage tank that had recently been constructed to store water for fire fighting. The contractor had rented tubular welded frame scaffolding to be used in completing the sandblasting and painting of the tank's interior. The daylight shift erected 2 separate 30-foot-high scaffoldings inside the tank in preparation for sandblasting during the afternoon shift.

The victim was picked up at the plant gate by the daylight foreman and given a site orientation which consisted of a review of basic safety rules for the paper processing plant (e.g., the need to wear eye and head protection within the plant) and location of the water storage tank. Following the orientation, the foreman spent 5 to 10 minutes with the victim discussing basic on-the-job safety rules, which included using personal protective equipment (e.g., safety belt, face shield, and blast hood). The victim was driven to the contractor's supply paint trailer (which was located on-site) and issued his blast hood, face shield, and safety belt and lanyard. Next, he was driven to the water tank and introduced to the afternoon foreman who was overseeing work at the water tank. Since the victim had approximately 20 years of experience, the afternoon foreman assumed he knew how to perform the job safely, and instructed him to start work. [Note: The victim apparently left the safety belt and lanyard that he had been issued in the daylight foreman's truck.]

At the time of the incident, approximately 12:30 a.m., the victim and foreman were each working from one of the 30-foot-high tubular welded frame scaffolds, sandblasting the interior wall of the tank. A third crew member, the holewatch, whose duties were restricted to ground activities, procured supplies and helped the sandblasters move the scaffolds. At about 12:35 a.m., the holewatch noticed that the victim had shut off his blast hose. A few minutes later, the foreman descended from the scaffolding upon which he was working, and informed the holewatch he was ready to move his scaffolding. The foreman, after talking with the holewatch, wondered why the victim had stopped work and went looking for him. He found the victim, lying injured and conscious, but incoherent, on the deck of the tank (Figure). The EMS responded in less than 5 minutes to the call for assistance, administered first aid, and transported the victim 7 miles to the local hospital, where he died 8 days later on April 15, 1993.

CAUSE OF DEATH

The medical examiner's report listed the cause of death as closed head injury.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that fall protection equipment is provided and used by workers where the potential for a fall from an elevation exists.

Discussion: Employers should ensure by observation that fall protection equipment is being used. A lifeline for attaching a safety belt and lanyard was secured to the tanks' interior wall and was available during the incident; however, the victim apparently left the fall protection equipment he had been issued in the back of the daylight foreman's truck when he was driven to the worksite. The victim had approximately 20 years' experience in this occupation, and it was assumed he was aware of the need to wear fall protection equipment.

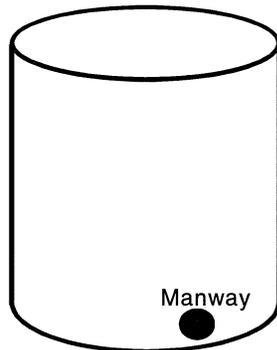
Recommendation #2: Employers should evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing hazards in the workplace, and following established safe work procedures with particular consideration to using appropriate personal protective equipment.

Discussion: In addition to developing a written safety program, employers should provide workers with appropriate training for the work they are to perform, and ensure they are proficient in job safety procedures before work begins. Such training should include recognizing hazards in the workplace, following established safe work procedures, and wearing appropriate personal protective equipment.

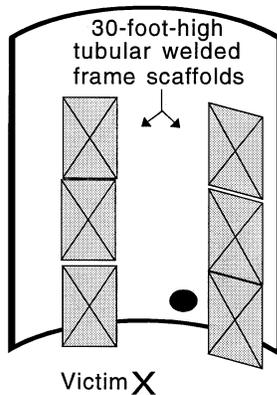
Recommendation #3: Employers should designate a competent person to conduct regular safety inspections.

Discussion: A competent person¹ should conduct scheduled and unscheduled safety inspections of worksites to help ensure that established company safety procedures are being followed, and that appropriate personal protective equipment is used. Such inspections also demonstrate that the employer is committed to the company safety program and to 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.



Exterior of 40-foot-diameter by 40-foot-high water tank.



Interior, including scaffolding arrangement and location of victim inside water tank.

Figure. Exterior and Interior of Water Tank
Not to Scale

FACE 94-15: Carpenter Dies After Falling 17 Feet From A Scaffold-- South Carolina

SUMMARY

A 28-year-old male carpenter (the victim) died after falling from a scaffold and striking his head on the ground. The victim and two co-workers had been assigned to install soffit board around the roof overhang of a private residence that was under construction. A co-worker observed the victim standing on the scaffold platform, nailing a board to the roof overhang, when he either lost his balance and fell, or became ill and fell onto the scaffold. He sat upright and started leaning to his right. At that time, a co-worker yelled to another co-worker in the area, to grab the victim as he might fall off the scaffold. Seconds later, the victim toppled off the unguarded scaffold, 17 feet to the ground, striking his head. The co-workers ran to the victim and found him unconscious and not breathing. One co-worker started cardiopulmonary resuscitation, while the other co-worker called for an ambulance. The ambulance and coroner arrived about the same time and the coroner pronounced the victim dead at the scene. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *provide adequate guarding on scaffolding*
- *develop, implement, and enforce a comprehensive written safety program*
- *utilize contract language that requires sub-contractors to implement a site-specific safety and health program prior to the initiation of work*
- *routinely conduct scheduled and unscheduled workplace safety inspections*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On June 22, 1994, a 28-year-old male carpenter (the victim) died from injuries received in a 17-foot fall from a scaffold. On July 23, 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 September 21, 1994, a DSR safety specialist conducted an investigation of this incident. The incident was reviewed with the employer, county coroner, and SCOSHA compliance officer assigned to the case. Police and coroner's reports were obtained during the investigation.

The employer was a roofing contractor that had been in business for 12 years and employed four workers, all of whom were carpenters. The employer had no written safety program, but informal safety talks were said to have been given at each job-site. The victim had been employed for 1 day prior to the incident, and had about 4 years experience as a carpenter. This was the first fatality experienced by the employer.

INVESTIGATION

The employer had been subcontracted to do outside trim work at a residence under construction in a private residential housing community. The house was a two-story wood and aluminum structure, and work had been in progress for about 2 days prior to the incident.

On the day of the incident, the workers (victim and two co-workers), arrived at the jobsite about 6:30 a.m., and were assigned to install soffit boards around the roof overhang of the house. Two carpenter's bracket scaffolds (i.e., scaffolds consisting of wood or metal brackets supporting a platform), were erected on opposite sides of the house. The scaffold from which the victim fell was 17 feet high and the platform consisted of one board (2-inches thick by 12-inches wide, which extended to a length of about 29 feet and was about 18 inches from the wall of the house). The platform, which was not protected by any guardrails, was supported by five pieces of angle iron irregularly spaced and attached to the studs of the house (Figure). The victim had been working from the platform nailing soffit boards to the overhang of the roof when the incident occurred. He was observed by a co-worker bending over, just prior to falling to the platform. It is unknown whether the victim became ill or lost his balance and fell to the platform; however, earlier that morning the victim had been complaining of chest pains but refused to go to the hospital for an examination. After the victim fell to the scaffold platform, he sat upright and began leaning over to his right. The co-worker on the ground had witnessed the event and yelled to the other co-worker, who was inside the house by the bay window, to grab the victim as he might fall off the platform. Seconds later, the victim toppled off the end of the unguarded scaffold, 17 feet to the ground, striking his head. The co-workers ran to the victim and found him unconscious and not breathing. One co-worker started cardiopulmonary resuscitation, while the other co-worker called for an ambulance. The ambulance and coroner both arrived about 10 minutes after being notified and the coroner pronounced the victim dead at the scene.

CAUSE OF DEATH

The coroner's report listed the cause of death as severe head injury and fractured cervical spine.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide adequate guarding on scaffolding.

Discussion: The victim was nailing soffit boards to a roof overhang while standing on an unguarded scaffold platform. Guarding of the scaffold platform, as required by CFR 1926.451 (a)(4), which states "Guardrails and toeboards shall be installed on all open sides and ends of platforms more than 10 feet above the ground or floor," was not present.

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 scaffold platforms with appropriate guardrailing and toeboards, the recognition and avoidance of fall hazards, and the use of appropriate safety equipment such as safety nets or safety belts and lanyards.

Recommendation #3: Employers should utilize contract language that requires sub-contractors 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. Subcontractors' 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 #4: 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 #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 from a platform 17 feet from the ground without any 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 1926.451 (a)(4) 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.

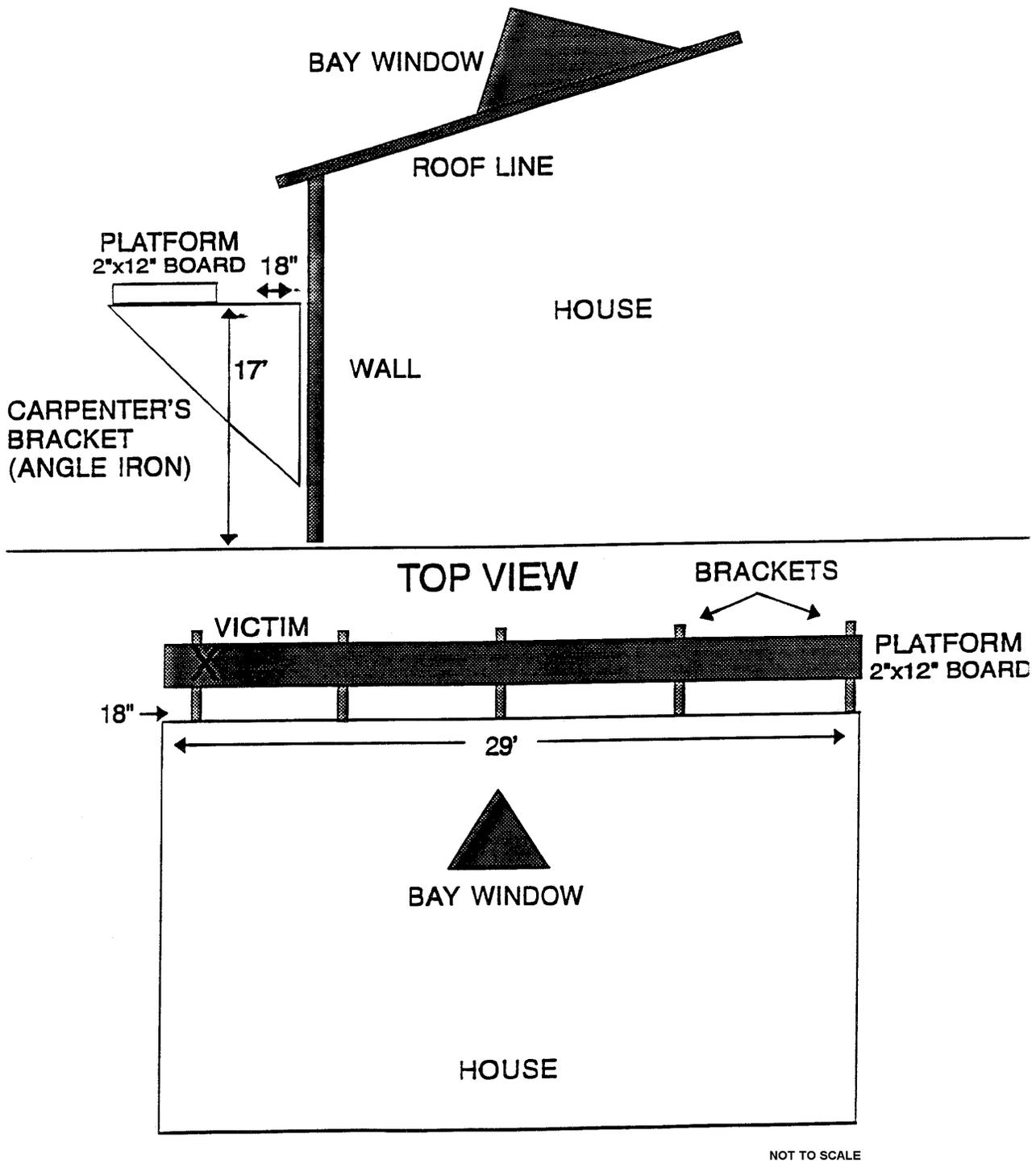


Figure. Scaffolding Layout (Side View)

FACE 95-06: Painter Dies After 35-Foot Fall From Scaffold--Tennessee

SUMMARY

A 60-year-old male painter foreman (the victim) died after falling 35 feet from the top stage of a tubular scaffold. The victim and a co-worker were painting the window frames and roof eaves of a church. The victim was working from a mobile tubular scaffold scraping and painting the roof eaves, while the co-worker was working on the windows from an extension step ladder. The top stage of the scaffold, from which the victim was working, was not equipped with side rails. After their morning break, the men repositioned the scaffold. The victim began to climb the scaffold to the top, and told the co-worker to put scrapers and a propane torch in the tool basket and tie the basket to the pull rope attached to the top rail of the scaffold. The victim was standing on two, 12-inch-wide by 6-foot-long unsecured boards that covered only 2/3 of the floor of the scaffold stage. As the co-worker was placing the tools in the basket, he heard a noise and looked up to see the victim falling from the top of the scaffold. The victim fell between the boards and the outside rails of the scaffold for approximately 15 feet. He then struck a scaffold cross brace that flipped him to the outside of the scaffold, and fell another 20 feet onto a 36-inch-high air conditioning unit. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *provide adequate guarding on scaffolding and ensure its proper set-up*
- *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 November 21, 1994, a 60-year-old male painter foreman (the victim) died of injuries received in a 35-foot fall from a scaffold. On January 30, 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 March 15, 1995, a DSR safety specialist conducted an investigation of this incident. The incident was reviewed with the employer and the TOSHA compliance officer assigned to the case. The medical examiner's report, the death certificate, and photographs of the site immediately following the incident were obtained during the investigation.

The employer was a commercial painting contractor that had been in business under the present ownership for 23 years, and employed anywhere from 20 to 90 painters, depending upon the workload. The employer had a written safety policy and basic written safe work procedures. Weekly safety meetings were conducted by the supervisor at the jobsite and training was conducted on the job. Fall protection equipment such as safety belts and lanyards were supplied by the employer. The victim had worked for the employer for 20 years. This was the first fatality experienced by the employer.

INVESTIGATION

The employer had been contracted to scrape, prepare, and repaint the window frames and roof eaves of a church. The work had progressed on a part-time basis over a 2-month period. Up to that point, the men had finished most of the window frames using extension ladders and were ready to begin work on the roof eaves using a mobile tubular scaffold. The scaffold stages were 5-feet-high by 3-feet-wide by 6-feet-long. Seven stages were necessary to access the eaves. The men did not put the side rails on the seventh stage. Two 12-inch-wide boards were placed on the floor of the 7th stage, leaving a 12-inch gap between the edge of the board and the outside rail of the scaffold.

On the day of the incident, the victim was working from the scaffold scraping the eaves while the co-worker was working from an extension ladder finishing the windows. After their morning break, the victim began to climb the scaffold and instructed the co-worker to place additional scrapers and a propane torch in the tool basket that was tied to a pull rope attached to the top rail of the scaffold. As the co-worker was gathering the tools to place in the basket, he heard a noise and looked up to see the victim falling from the top of the scaffold. The victim fell between the edge of the floor board and the outside of the scaffold, falling approximately 15 feet before striking a cross brace on the scaffold. The victim was flipped to the outside of the scaffold and fell an additional 20 feet, landing on a 36-inch-high air conditioning unit. The victim was unconscious but breathing. The emergency rescue service was summoned by phone from the church parsonage and transported the victim to the local hospital, where he was pronounced dead by the attending physician.

CAUSE OF DEATH

The medical examiner listed the cause of death as traumatic shock due to closed head trauma, ruptured spleen, and blunt force trauma, due to a fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide adequate guarding on scaffolding and ensure its proper set-up.

Discussion: The victim was scraping the roof eaves while standing on a scaffold stage without guardrails or toeboards. Guarding on scaffold platforms, is required by 29 CFR 1926.451 (a) (4), which states "Guardrails and toeboards shall be installed on all open sides and ends of platforms more than 10 feet above the ground or floor." Additionally, there were only two 12-inch-wide boards on the floor of the scaffold stage, leaving the 12-inch gap which the victim fell through. Proper set-up procedures include the installation of guardrails, midrails, and toeboards around the platform perimeter, as well as ensuring that the working surface is completely covered, eliminating floor openings.

Recommendation #2: 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, the scaffold was not equipped with guardrails, and although safety belts and lanyards were available in the truck, they were not used.

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

Discussion: The employer had basic written safety rules; however, 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, ensuring that scaffold platforms are equipped with appropriate guardrails and toeboards; 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 nets, or safety belts and lanyards.

Recommendation #4: 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 #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 on a scaffold 35 feet above the 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.

REFERENCES

29 CFR 1926.451 (a) (4) Code of Federal Regulations, Washington, D.C.: U. S. Government Printing Office, Office of the Federal Register.

29 CFR 1926.501 (b) (1) 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 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.

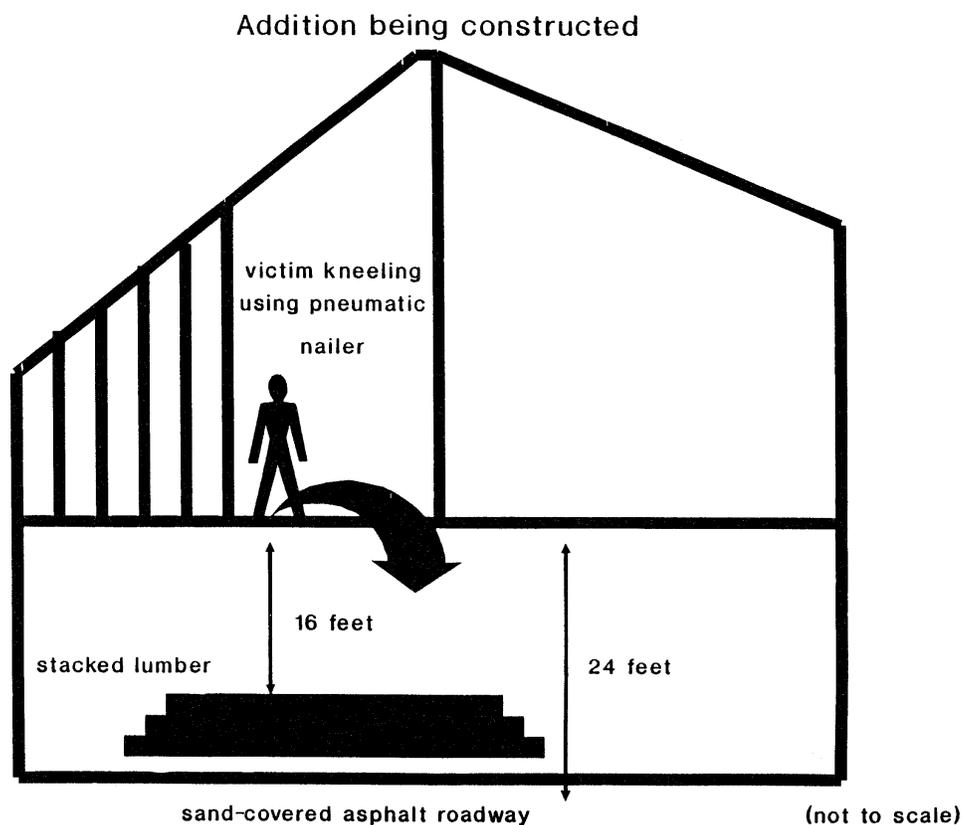


Figure.

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.

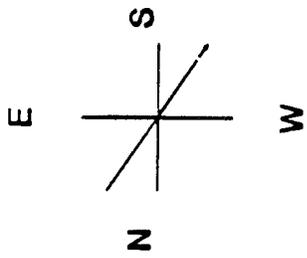
RECOMMENDATIONS/DISCUSSION

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.

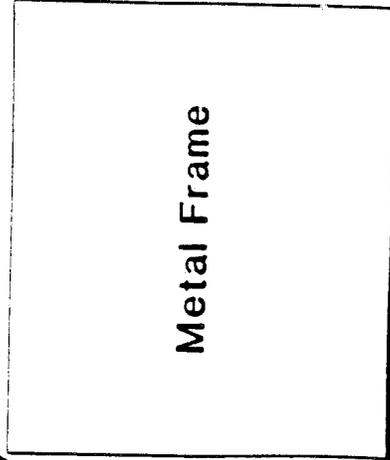
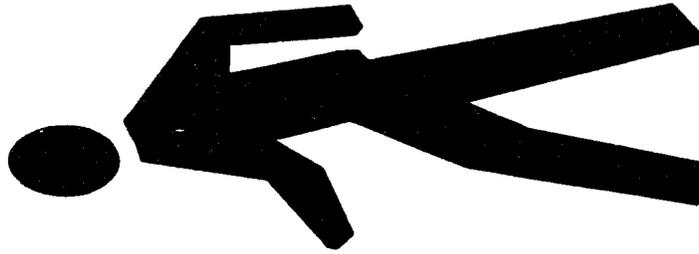
Discussion: A comprehensive safety program should address all aspects of safety, including job hazard analyses. A job hazard analysis should be performed by all employers, prior to the commencement of work, to identify and control all hazards likely to be encountered by all employees. Environmental conditions 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.

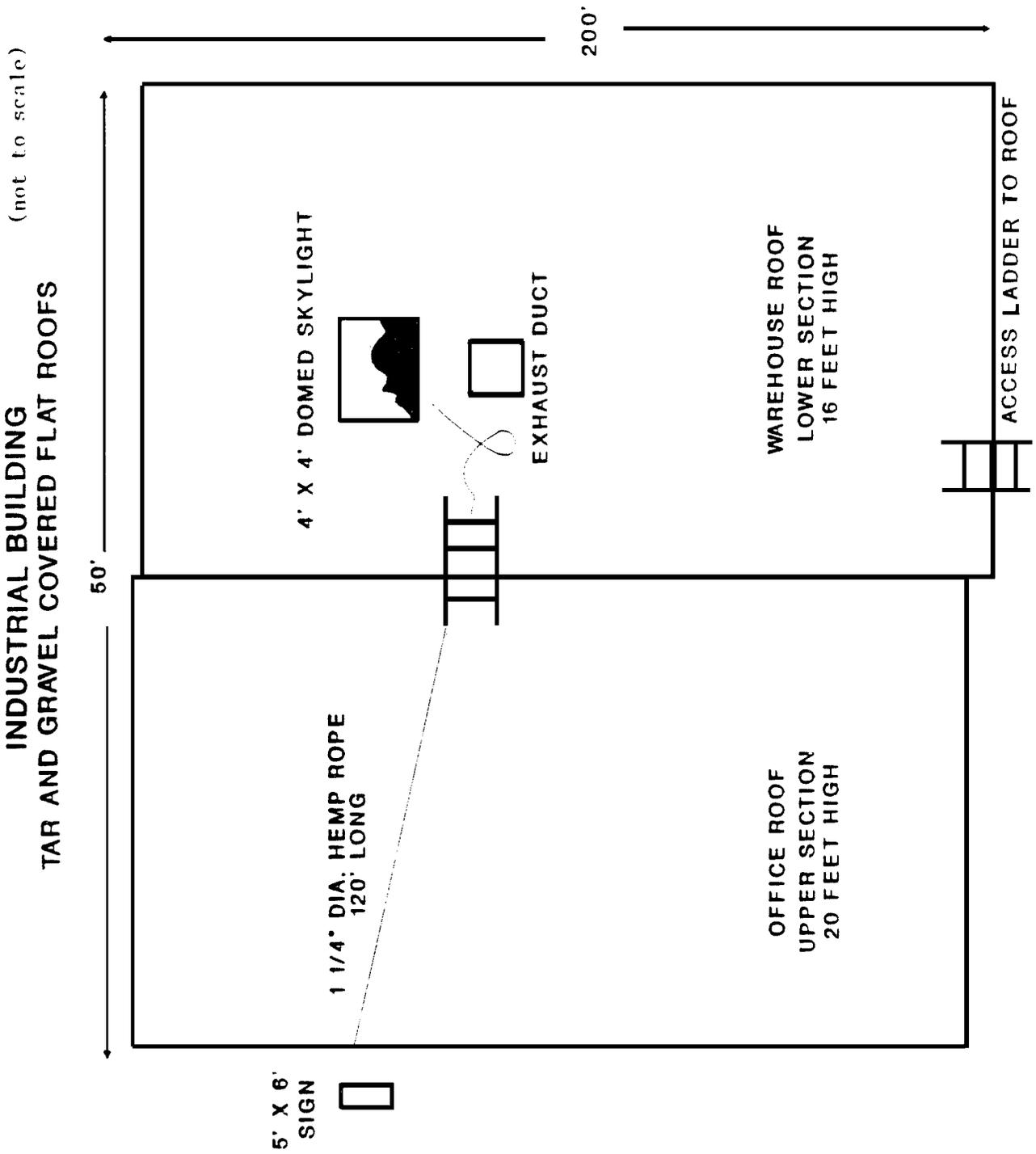


Figure 1. A Diagram Showing the Roof Area of the Industrial Building



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.]

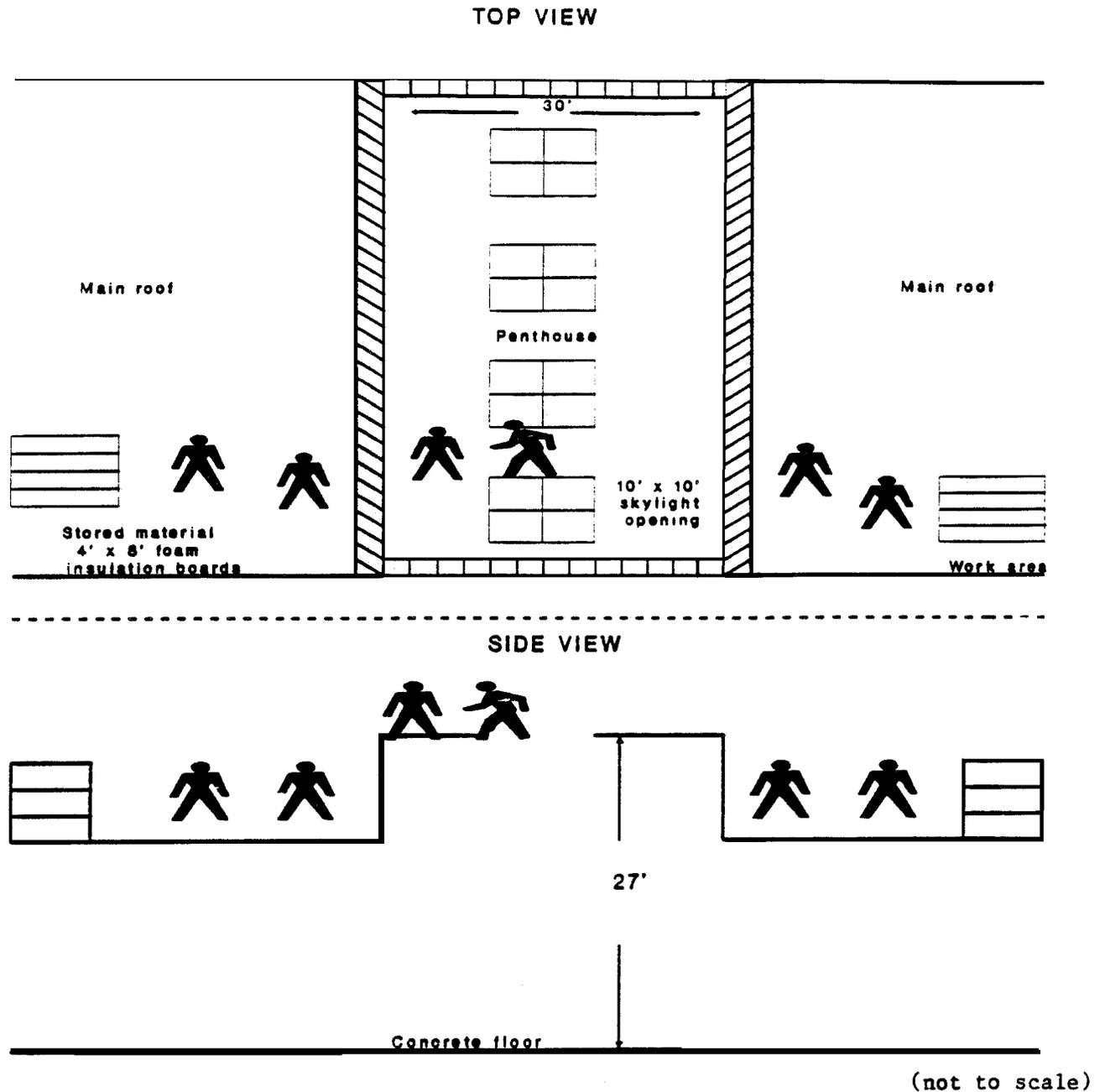


Figure 1. Top and Side Views of the Roof Area Where the Fatal Fall Occurred.

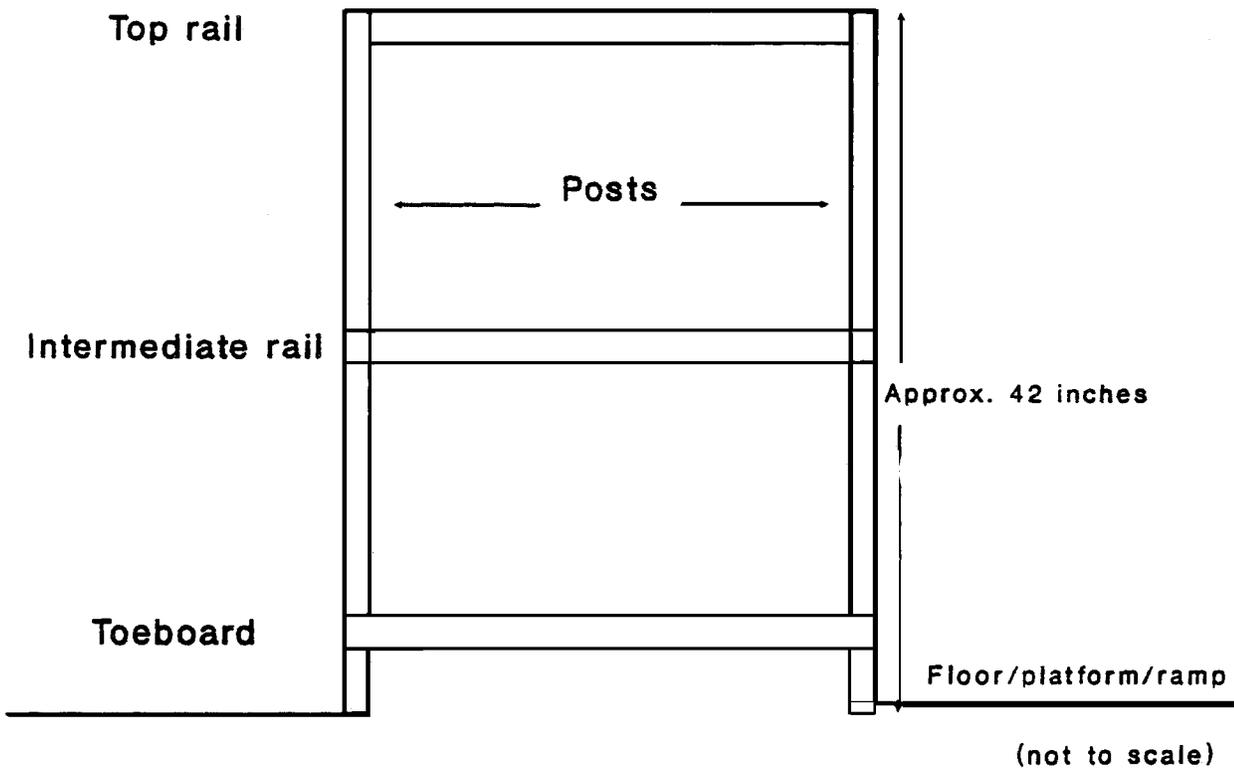


Figure 2. Specifications for Guardrails as Contained in 29 CFR 1926.500 (f) (1)

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.

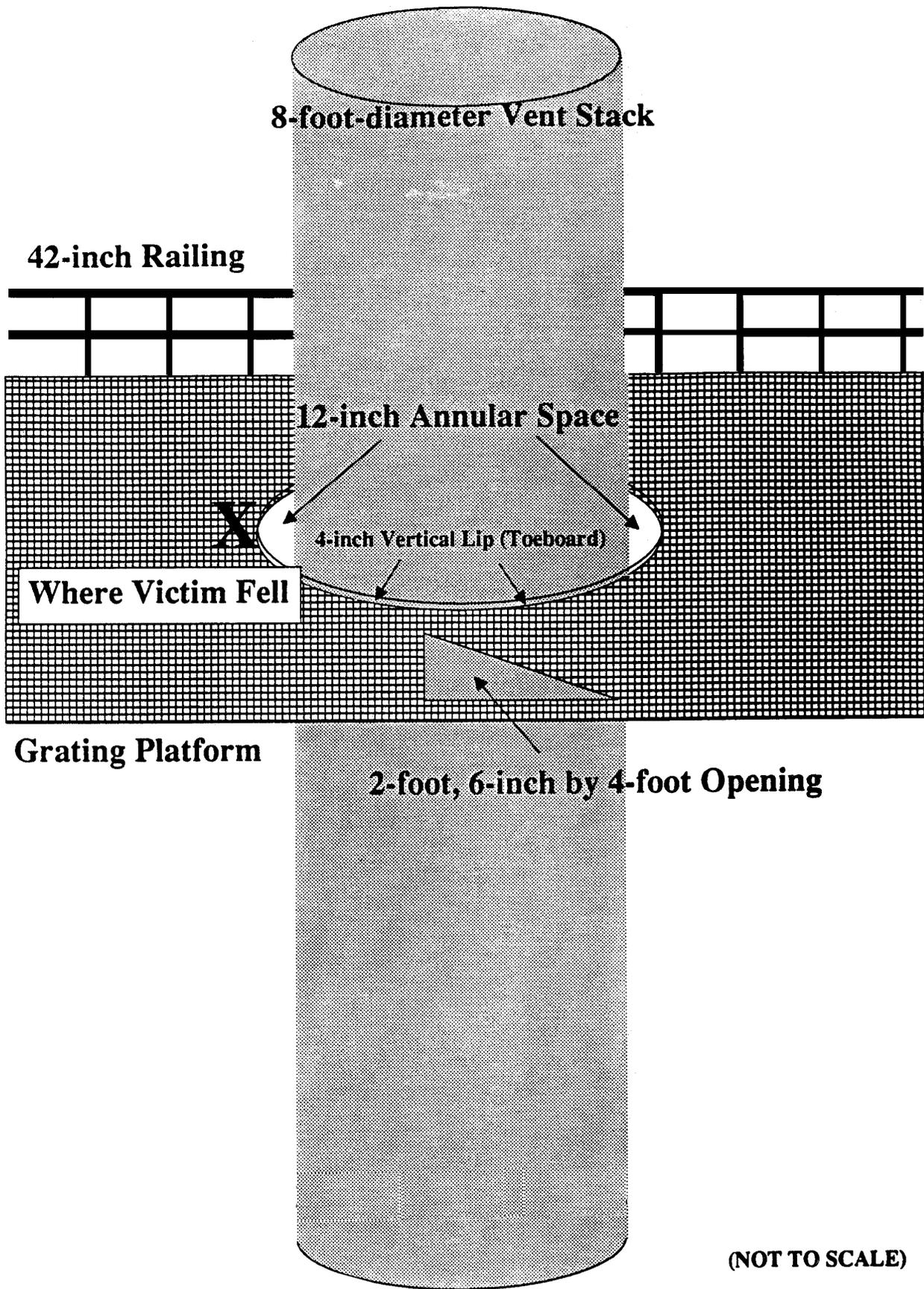


Figure. Vacuum Degasser

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)

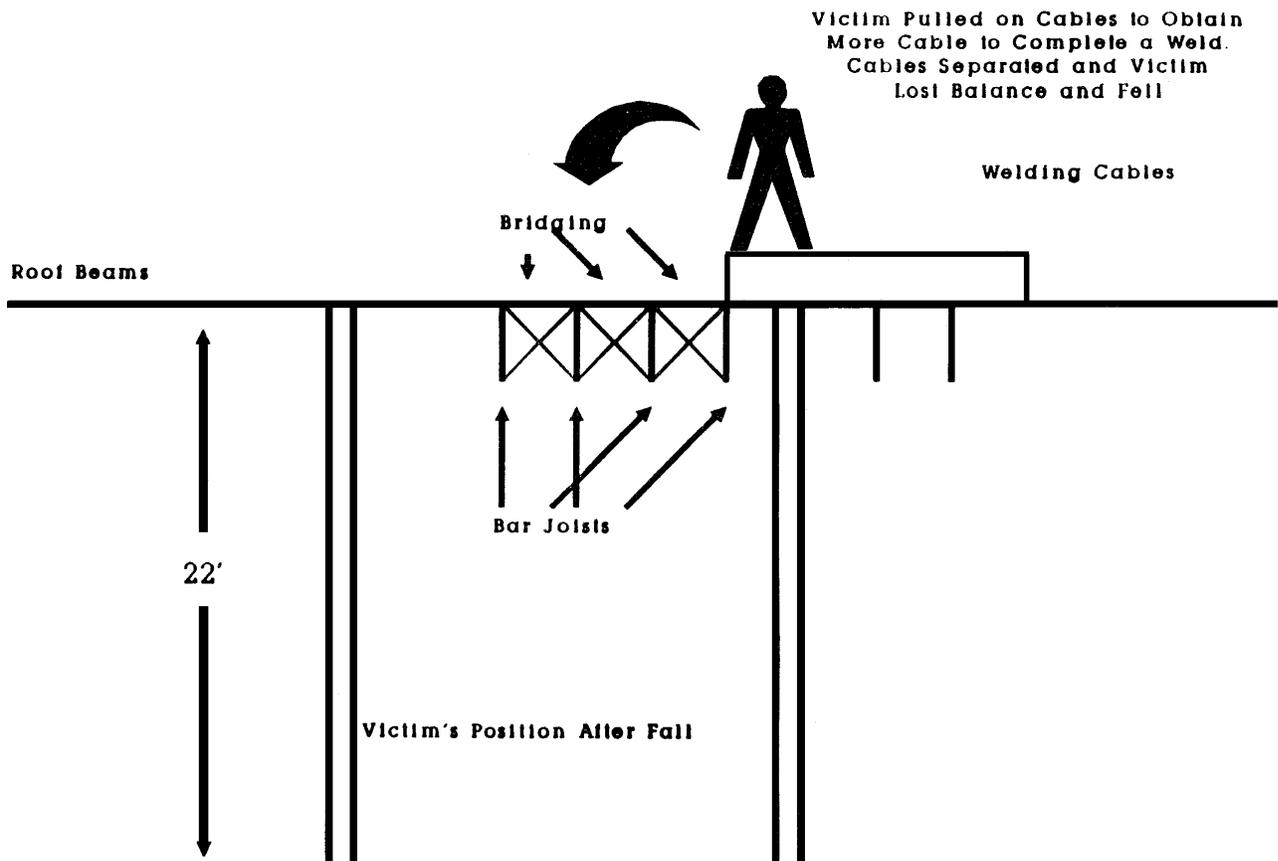


Figure.

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

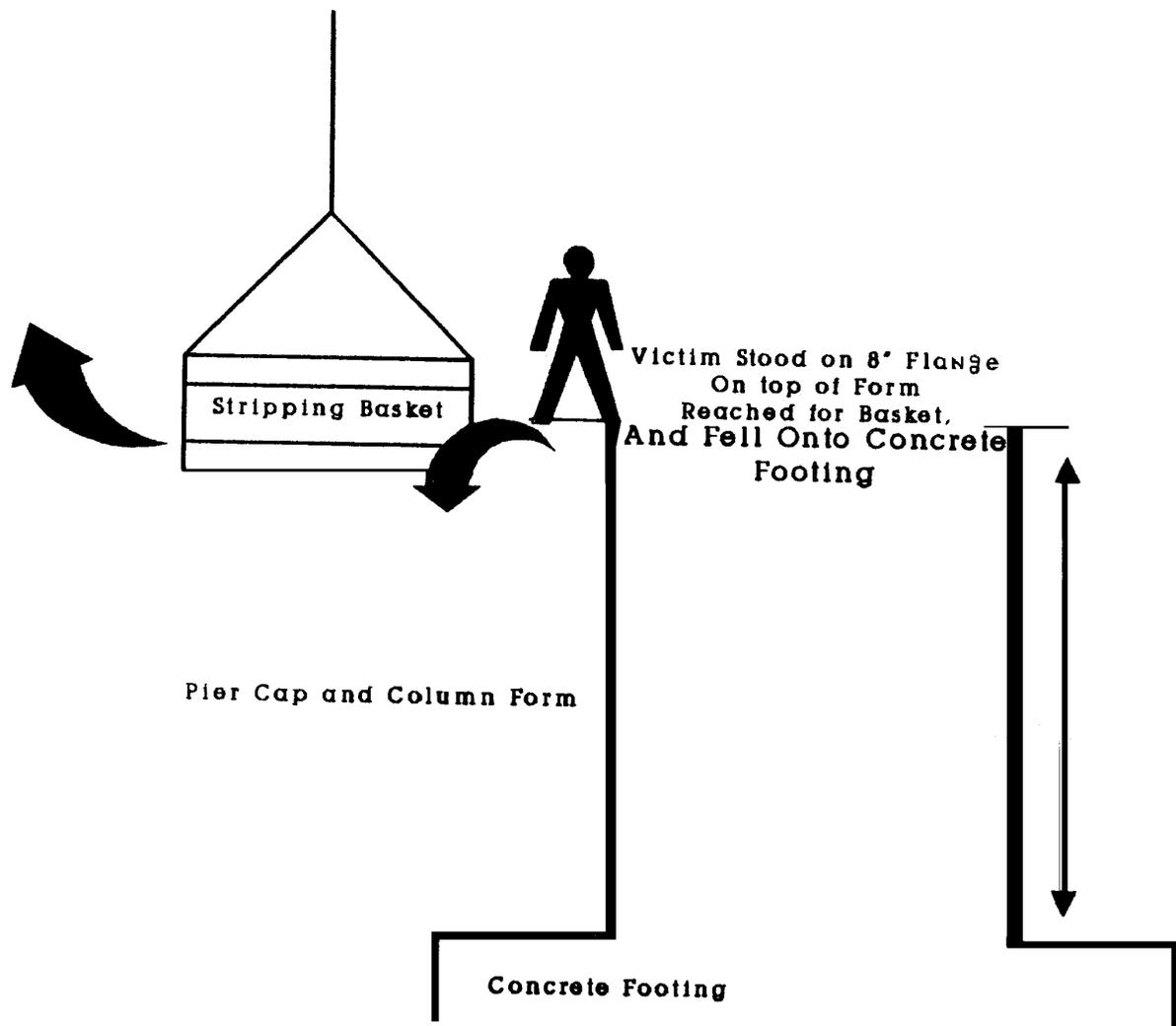


Figure.

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.

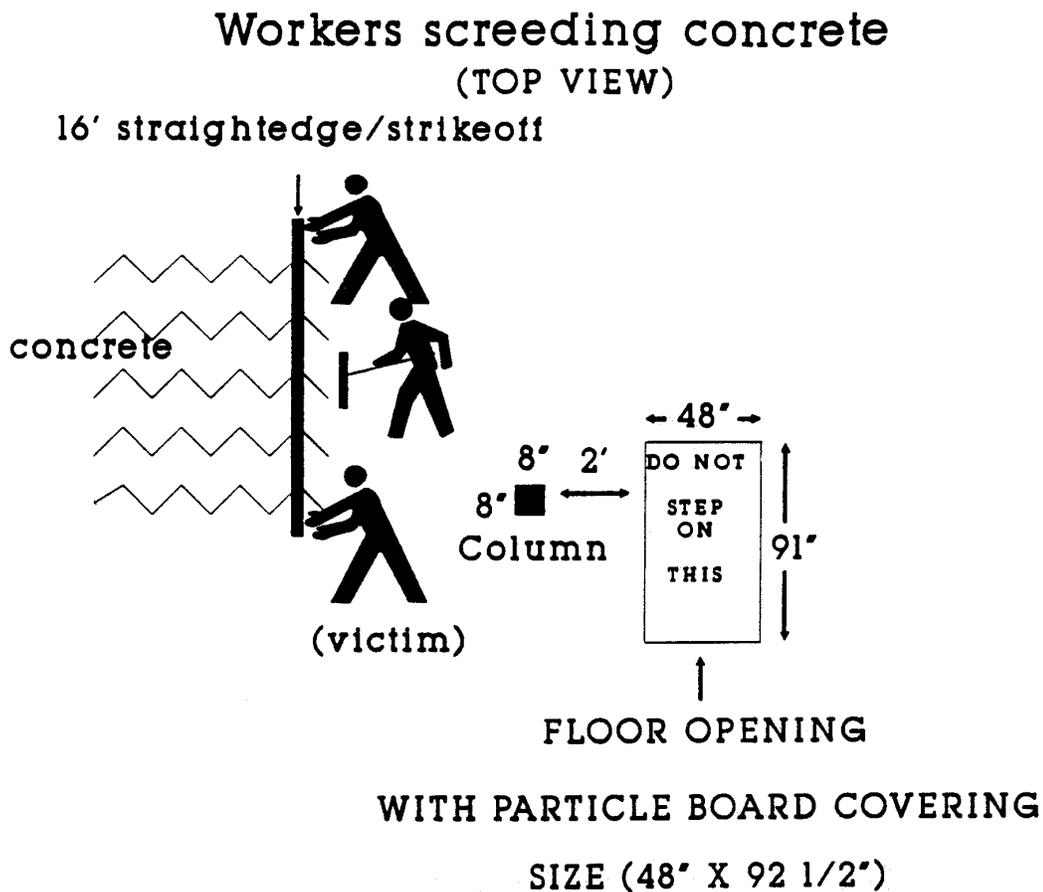


Figure. Three Story Building Under Construction

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.

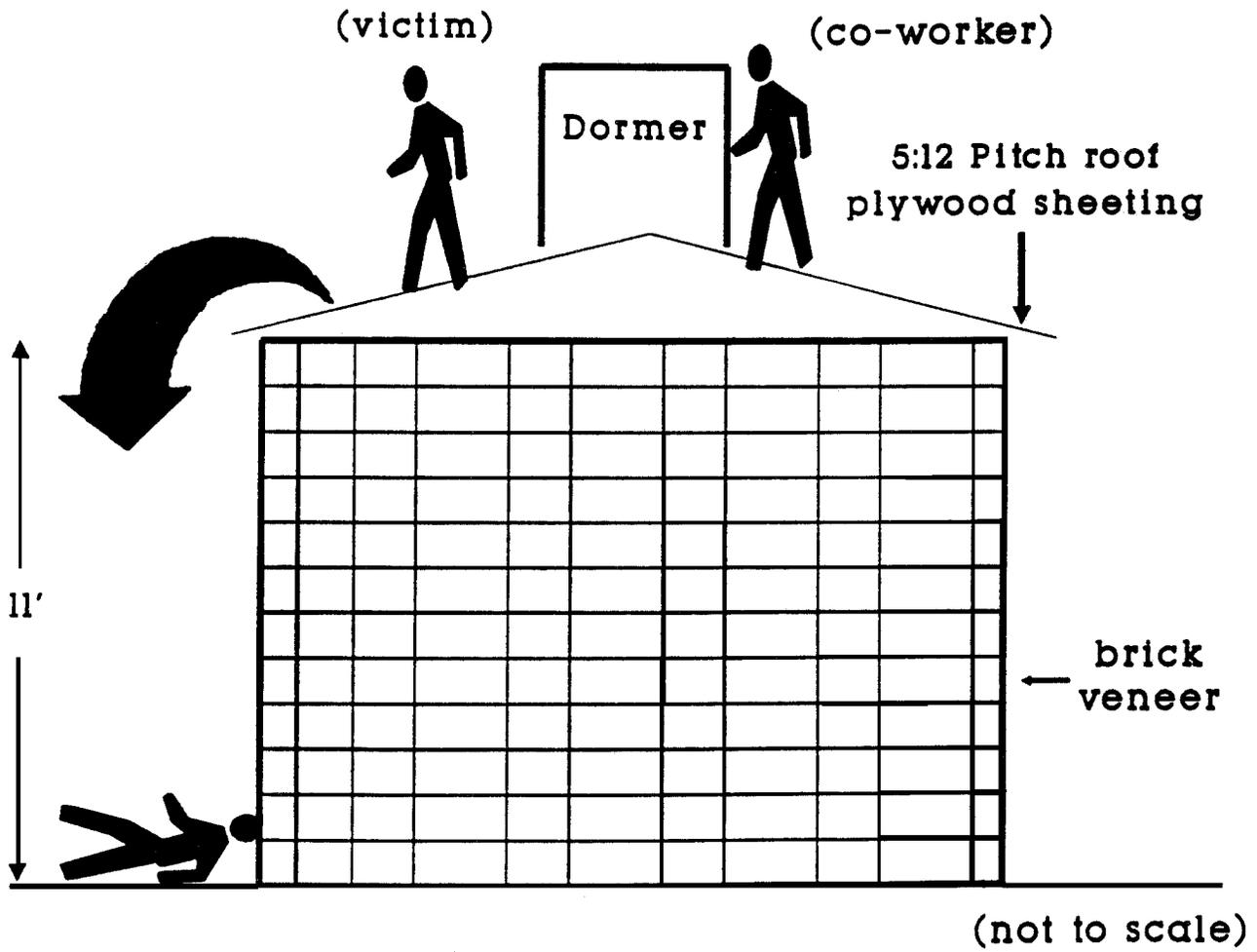
Discussion: Worker safety issues should be discussed and incorporated into all construction projects during planning and throughout the entire project. The planning for and incorporation of safety measures, prior to any work being performed at construction sites, will help to identify potential worker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

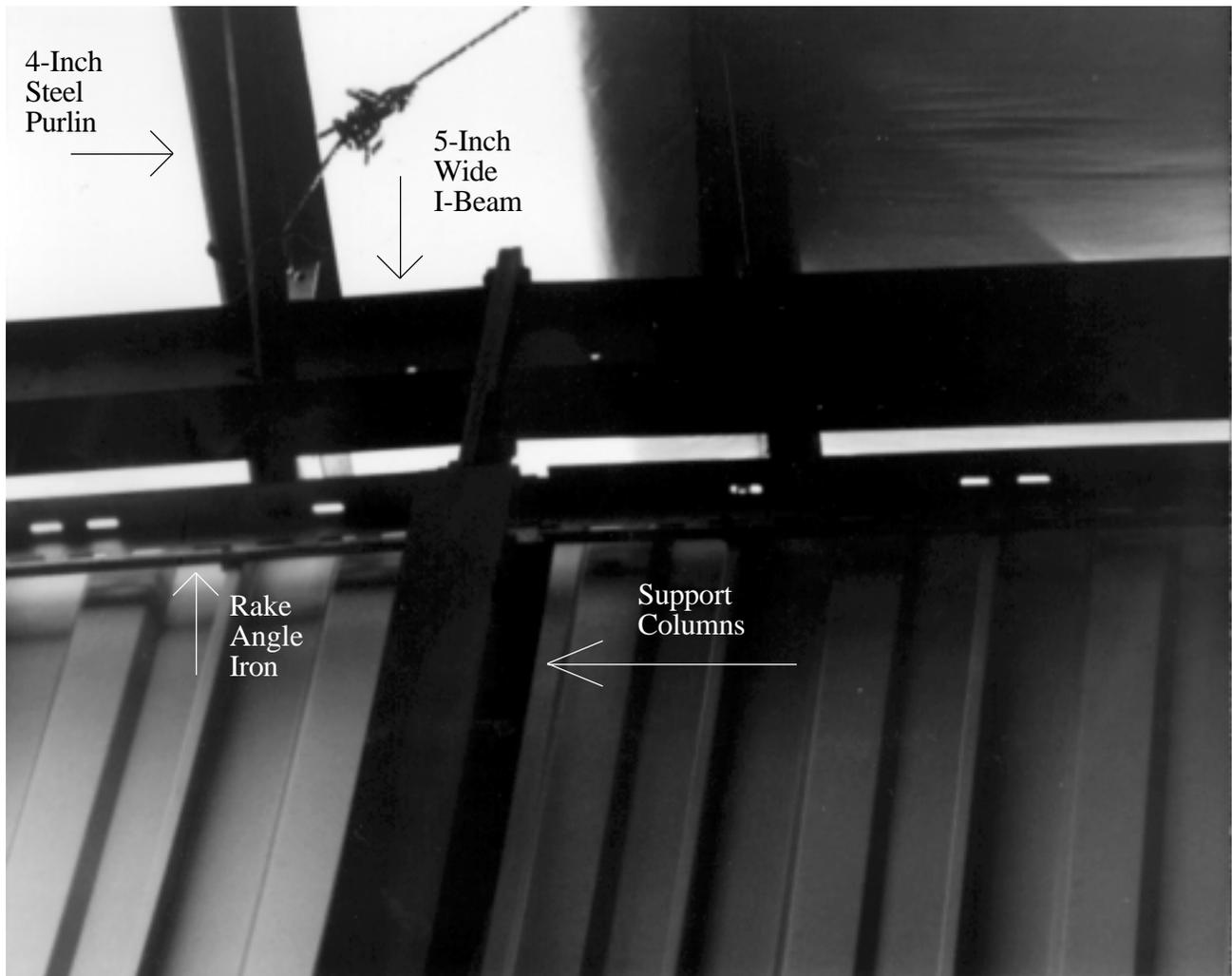


Figure.

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.

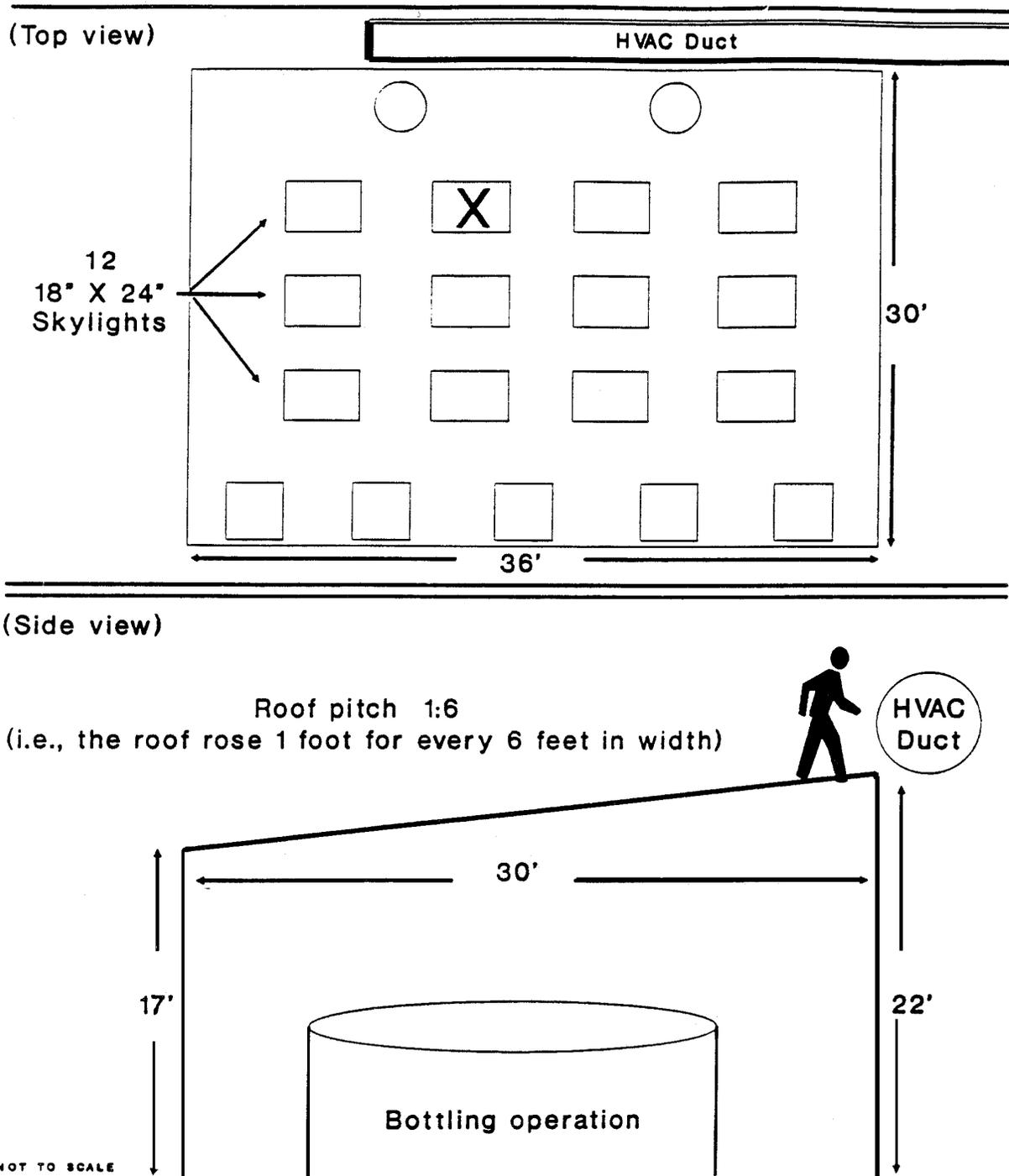


Figure. Bottling Line Enclosure/Roof

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.

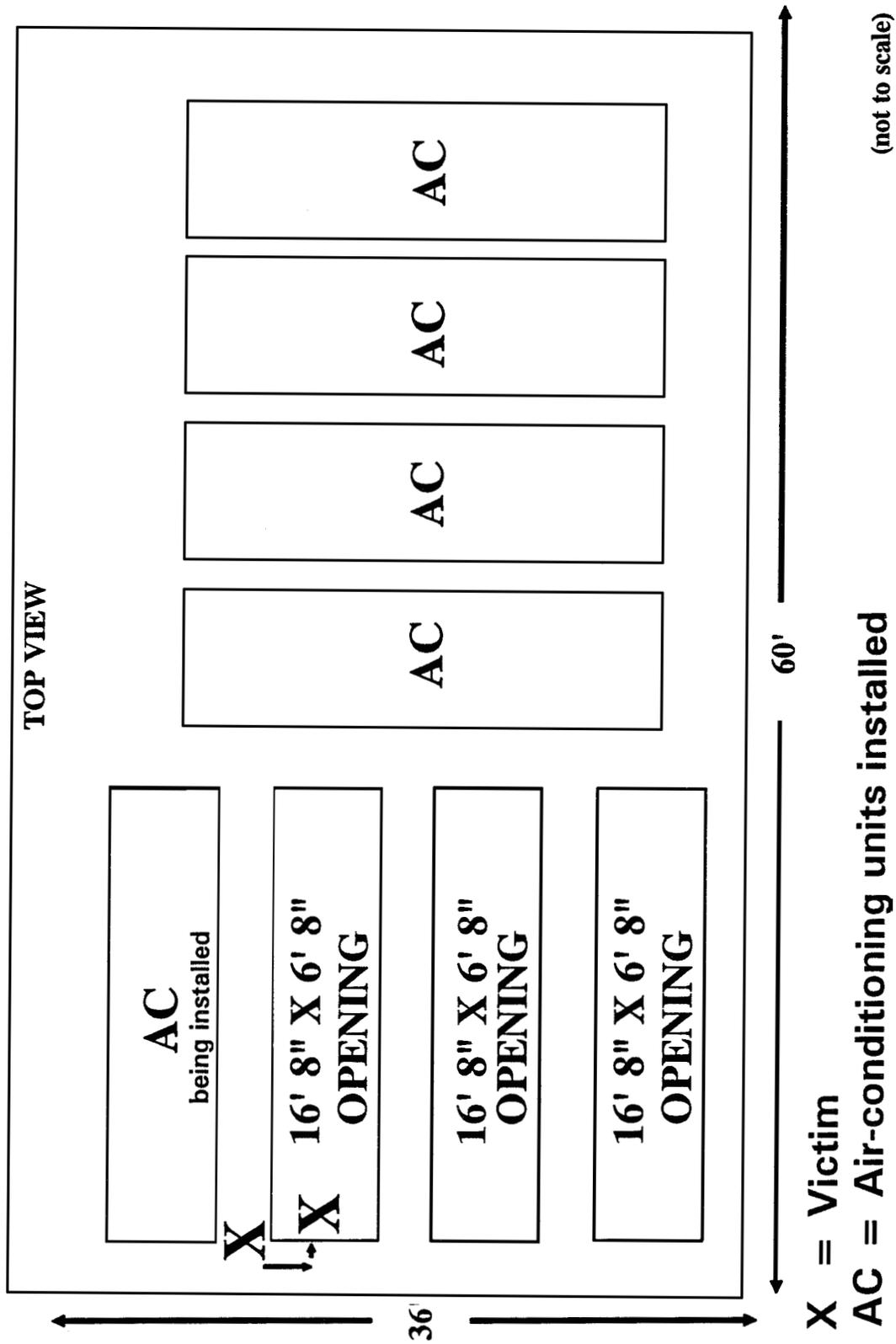


Figure. Open-sided Steel Structure Platform.

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.

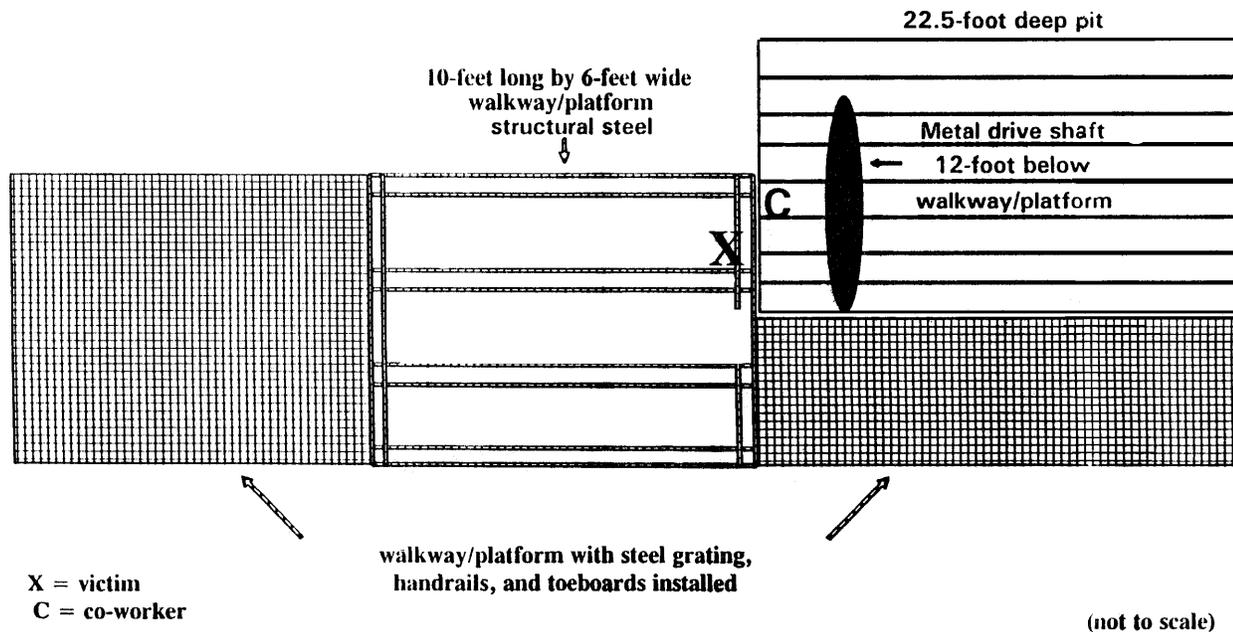


Figure. Walkway/platform (Top view)

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.

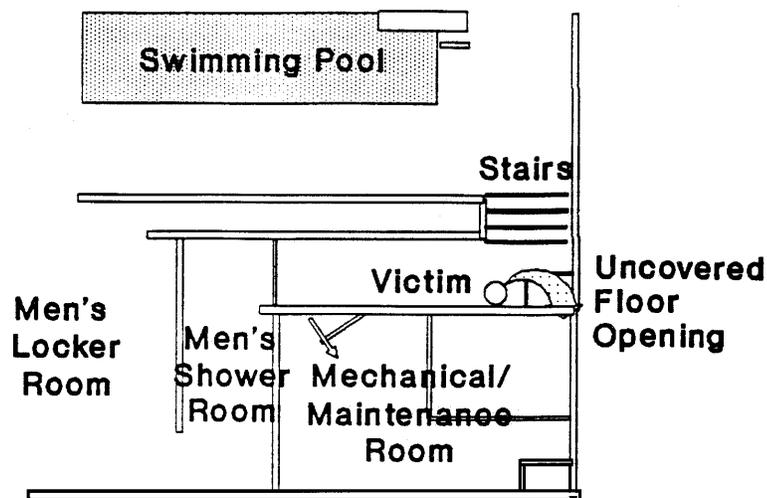
Discussion: Whenever a floor-level opening is left uncovered/ unguarded, there is a danger of falling through that should be controlled by some type of barrier or temporary cover. A warning sign could be used to provide additional protection. It is also inherently unsafe to work backwards into an area 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.

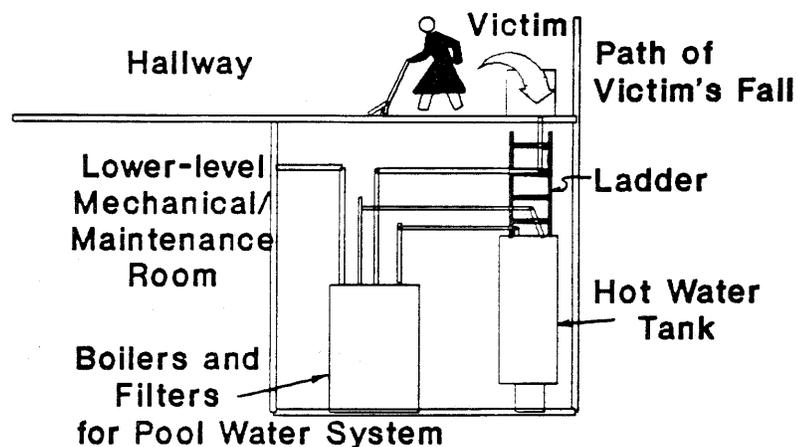
Discussion: To be effective, a safety program must be enforced at the worksite. Regular safety inspections demonstrate to workers that the village or municipality is committed to enforcing its safety policies and procedures. These inspections also provide opportunity to observe previously unidentified 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.



Plan View



Lateral View

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.

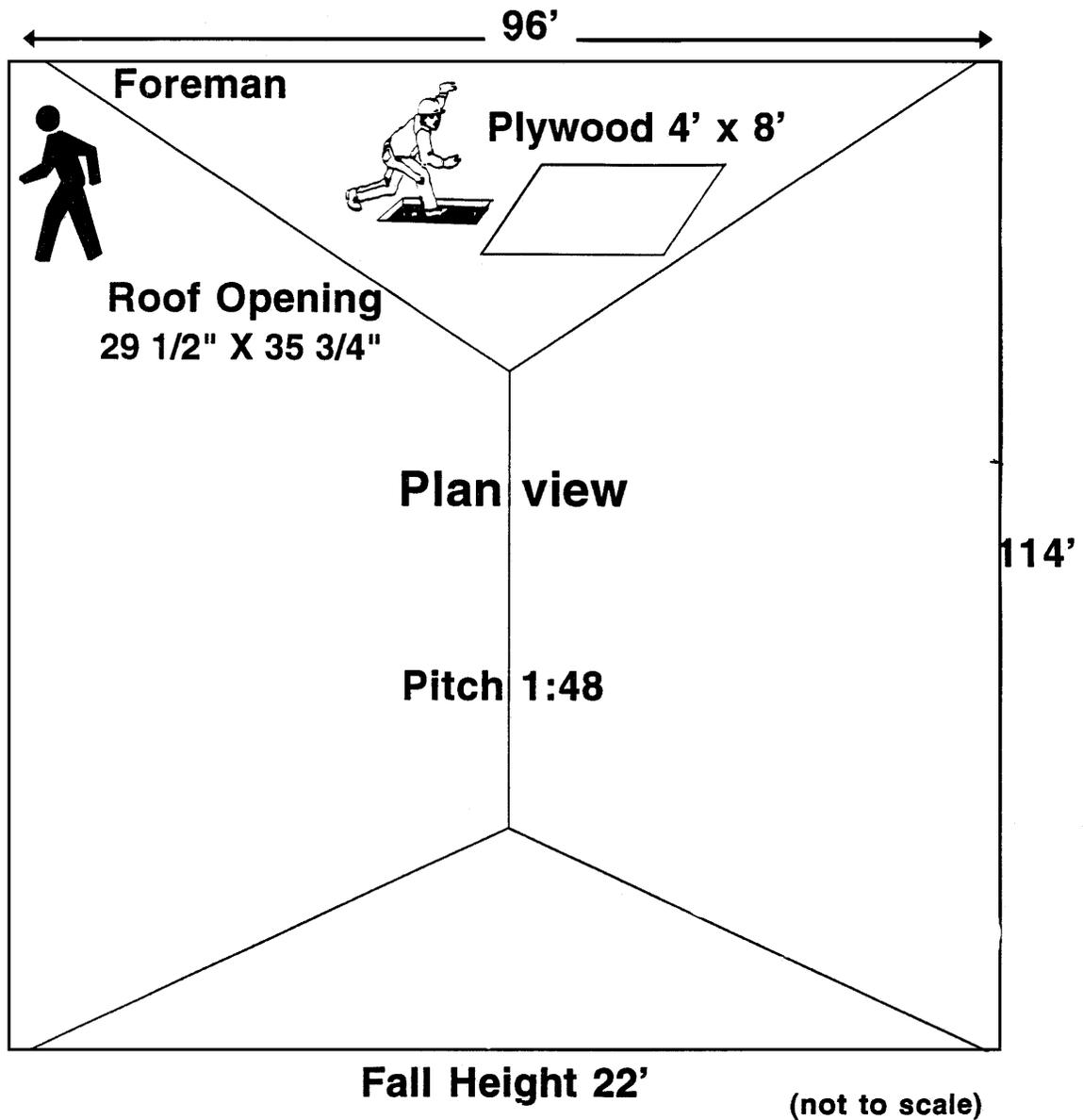


Figure. Roof Opening

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

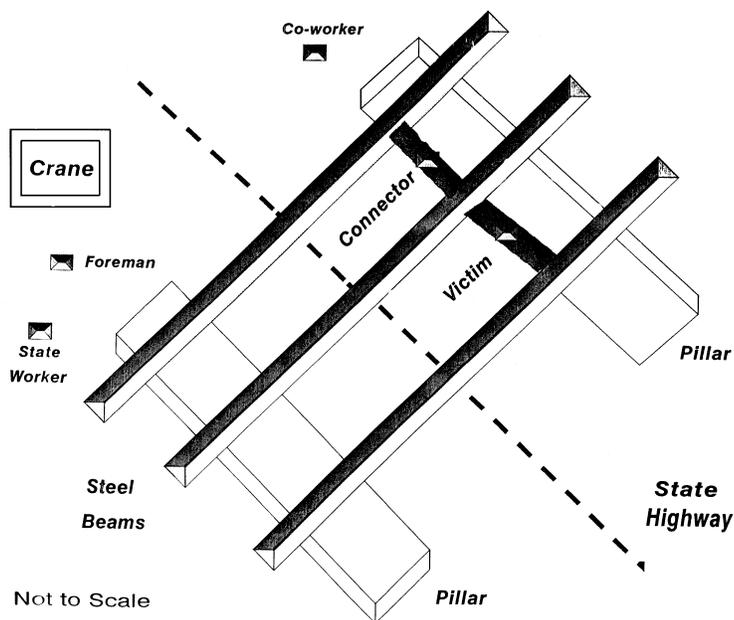


Figure.

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.

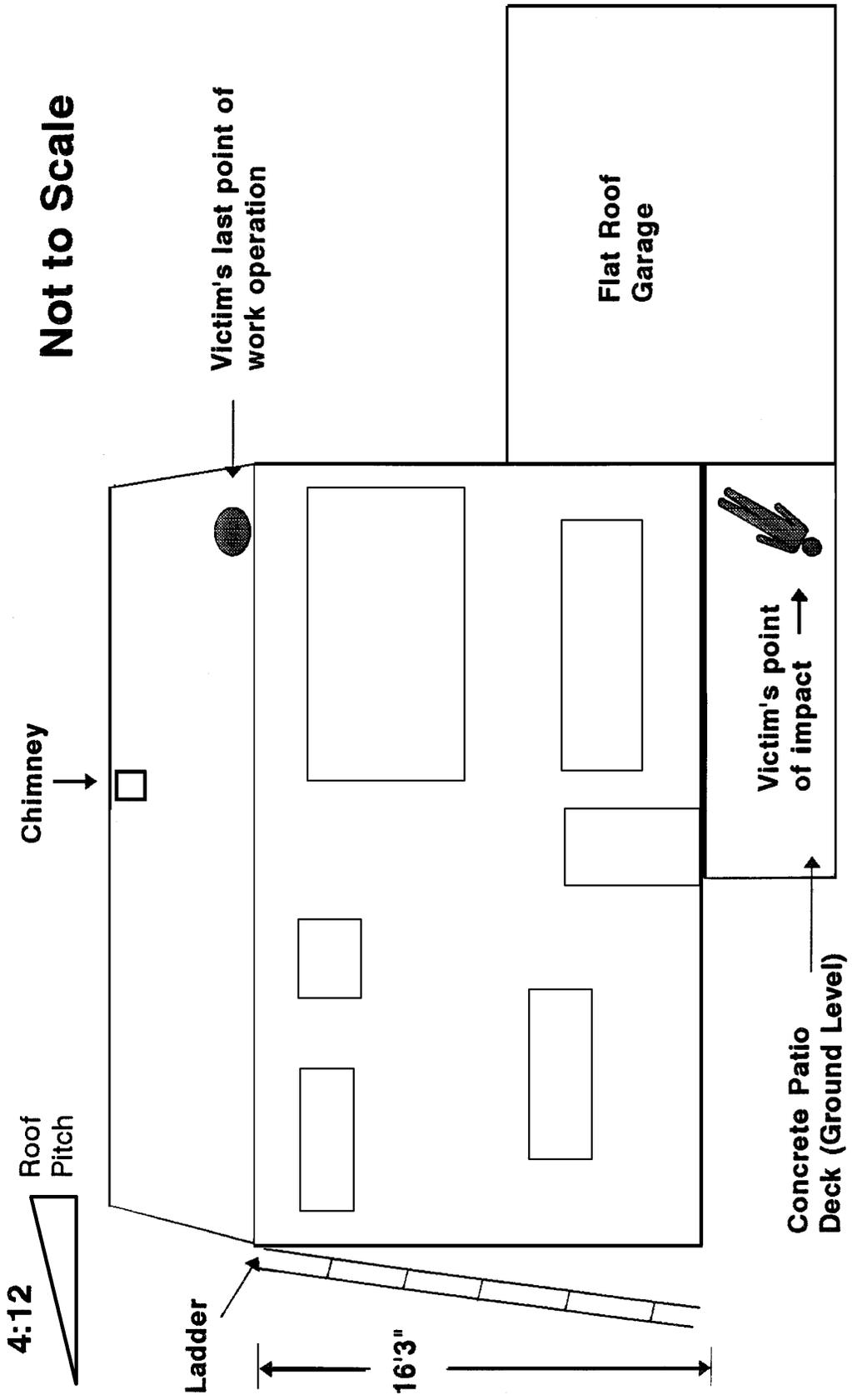
Discussion: Although the employer indicated that training programs were in place, these were largely informal procedures, such as "tailgate meetings" at the start of new jobs. Written procedural protocols were available, but safety training was not regularly scheduled. Structured training sessions could 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



Not to Scale

Figure 1.

Top View of Roof Plan

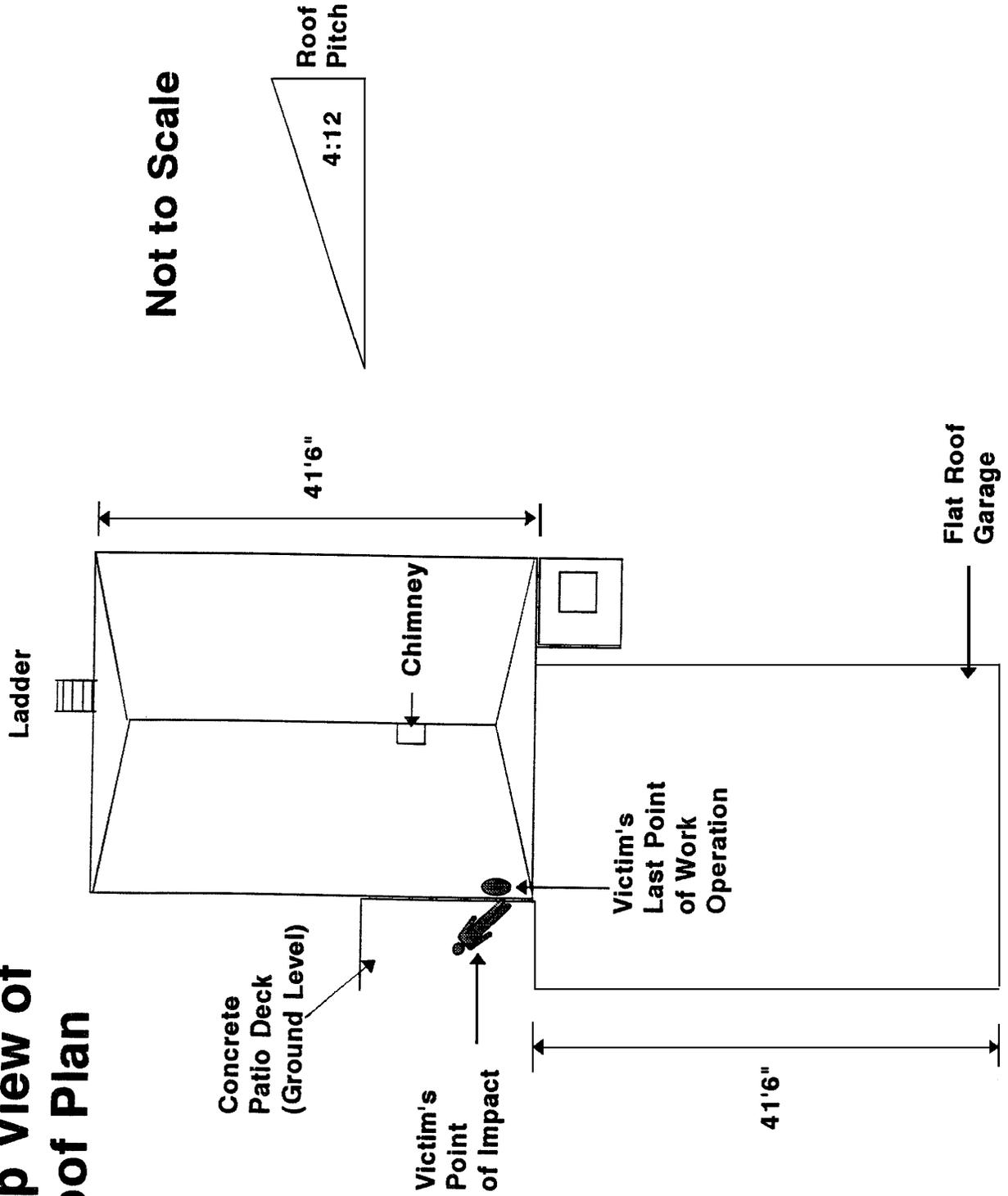


Figure 2.

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

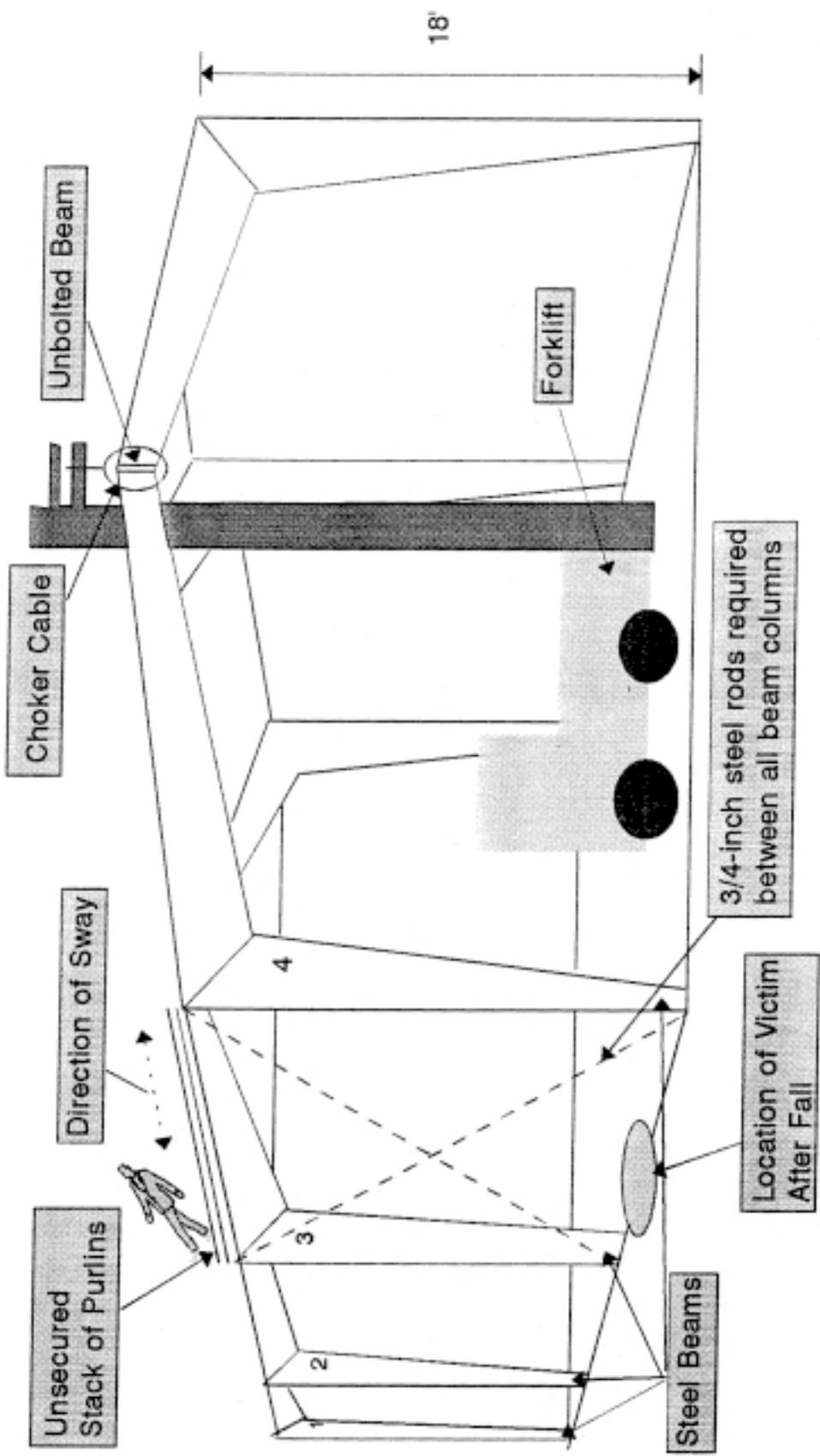


Figure 1.

Not to Scale
Top View

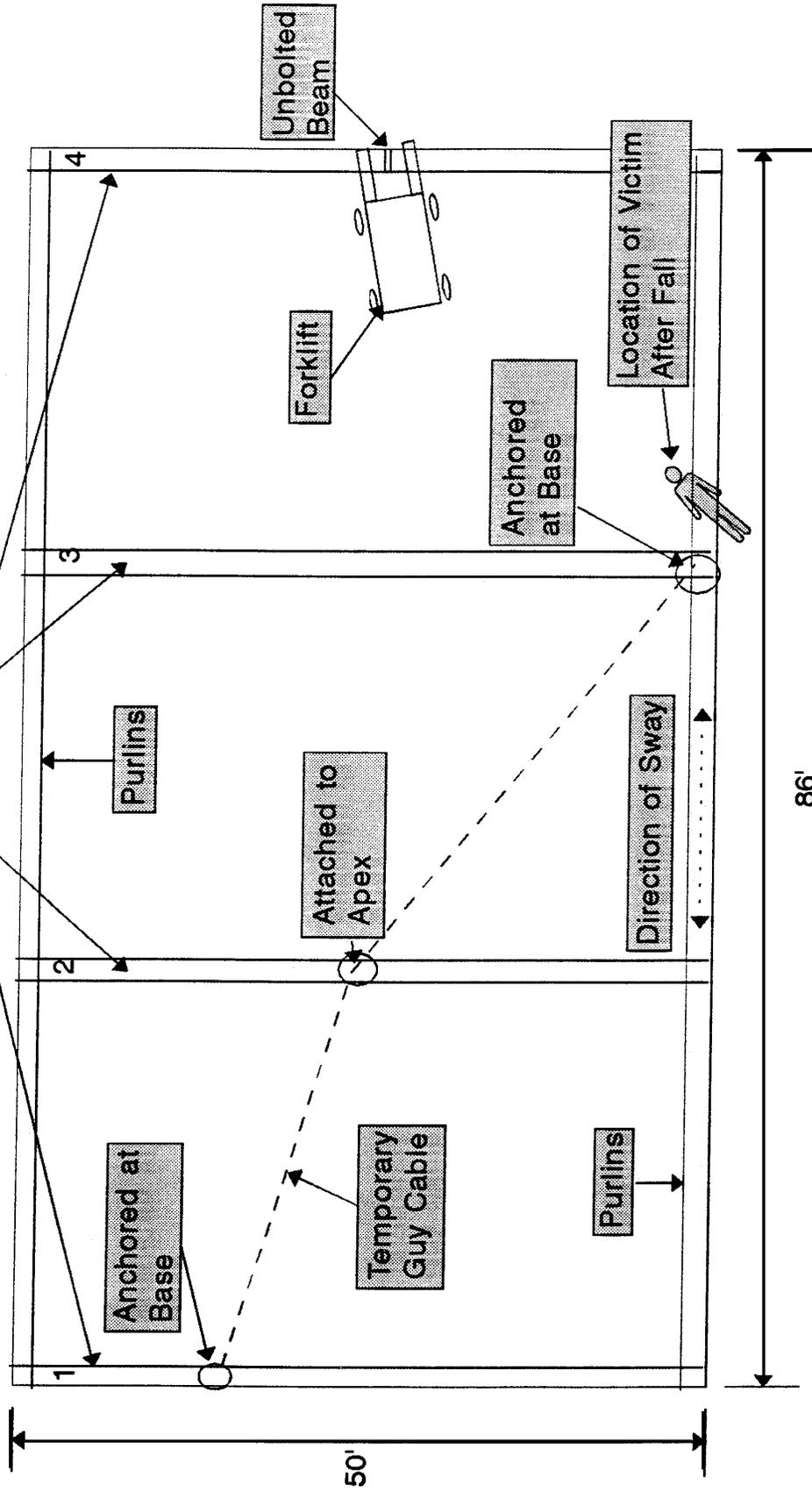


Figure 2.

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.

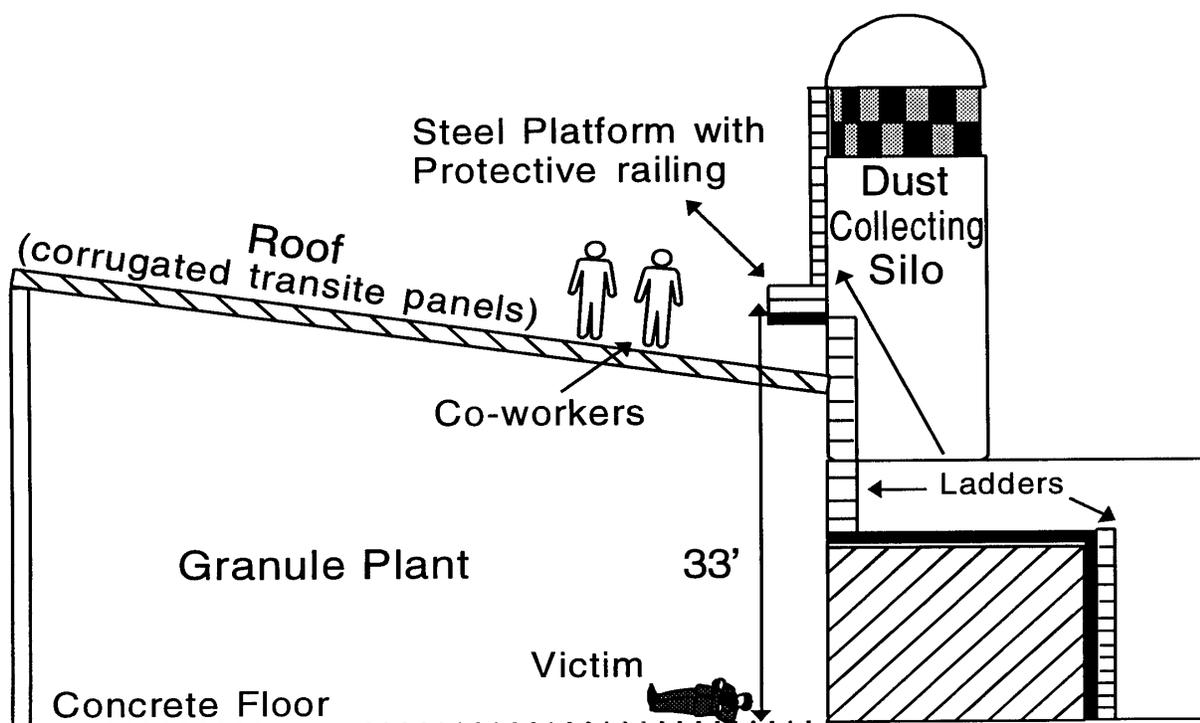


Figure. Dust-Collecting Silo and Granule Plant Roof

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.

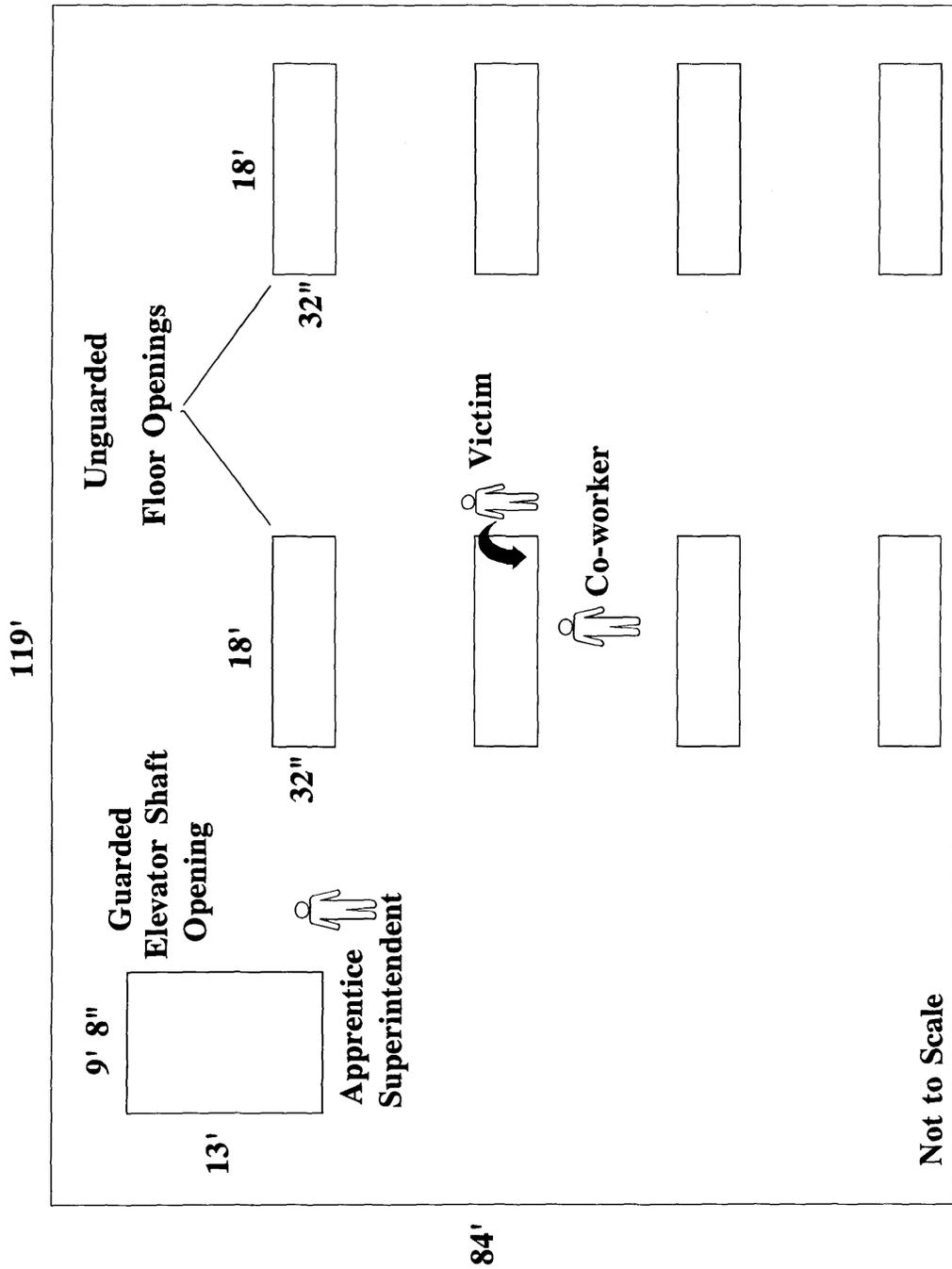


Figure. Second Story Floor Plan

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.

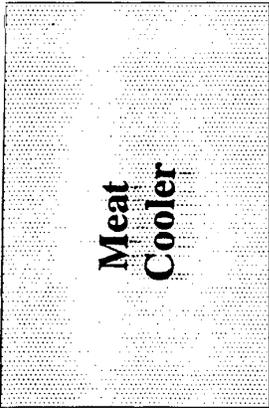
Discussion: Three sides of the elevated knocking platform were protected by guardrails at the perimeter, leaving unguarded the side where the steps were located. A spring-loaded, one-way gate could be installed on this side. The gate would have to be pulled open from inside the perimeter to access the 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.

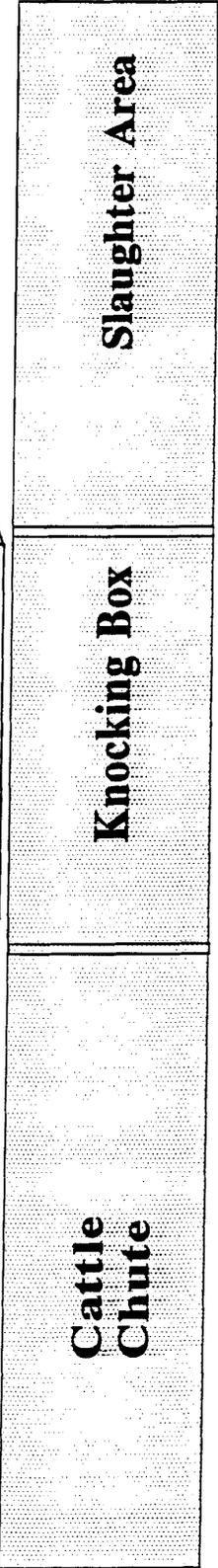
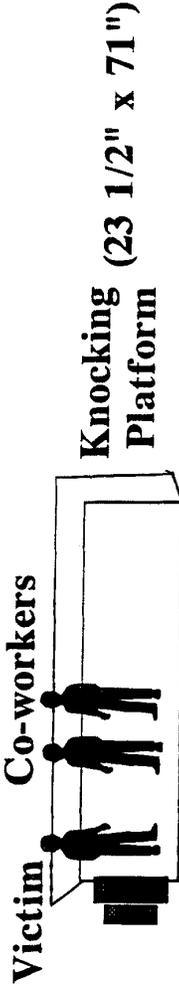
Discussion: Employees should be monitored by employers or supervisors for unusual, erratic, disruptive, or impaired behavior at the jobsite. When this type of behavior is observed, the supervisor should evaluate the situation, and the employee, and take immediate, appropriate action.

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



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.

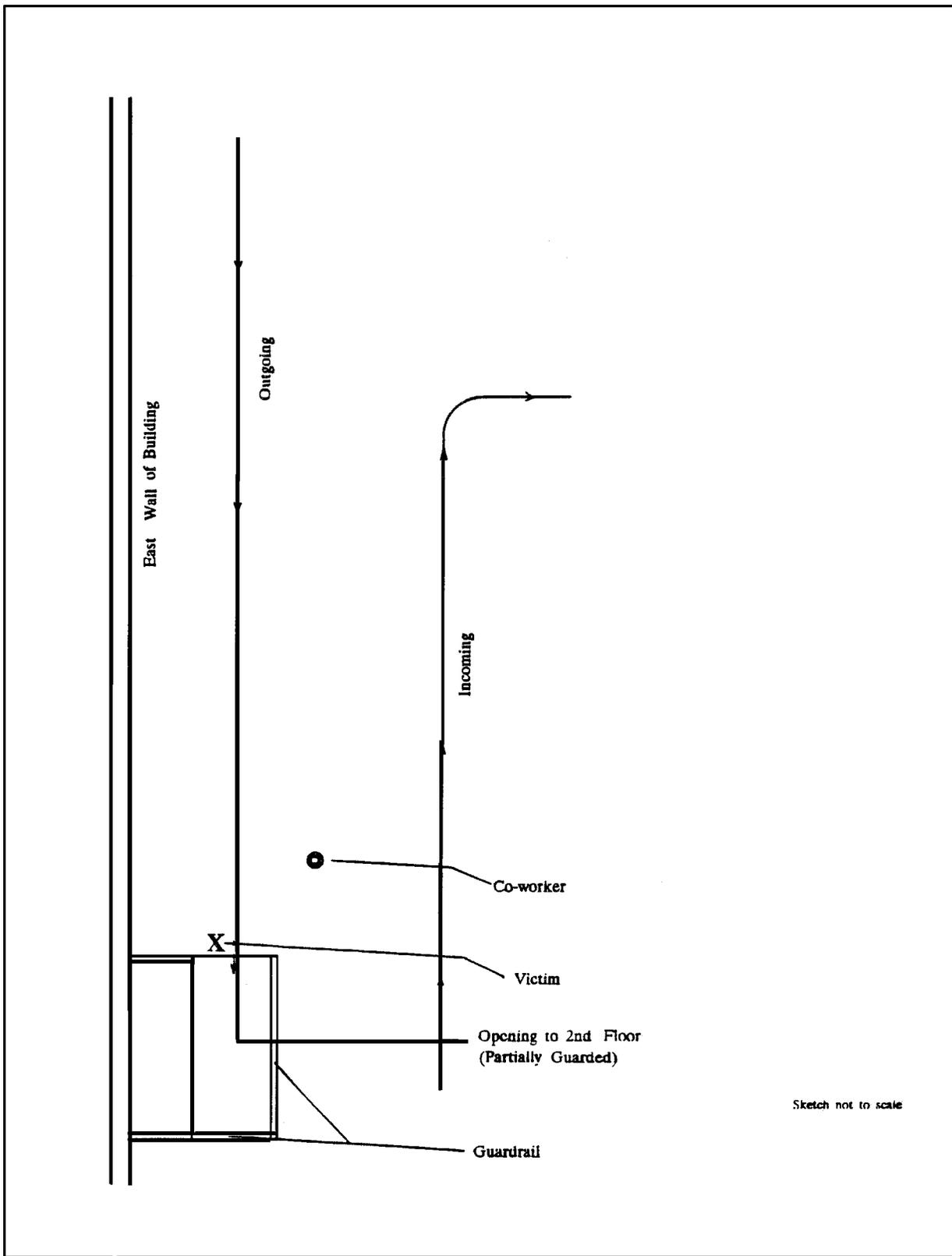


Figure 1. Furniture Warehouse

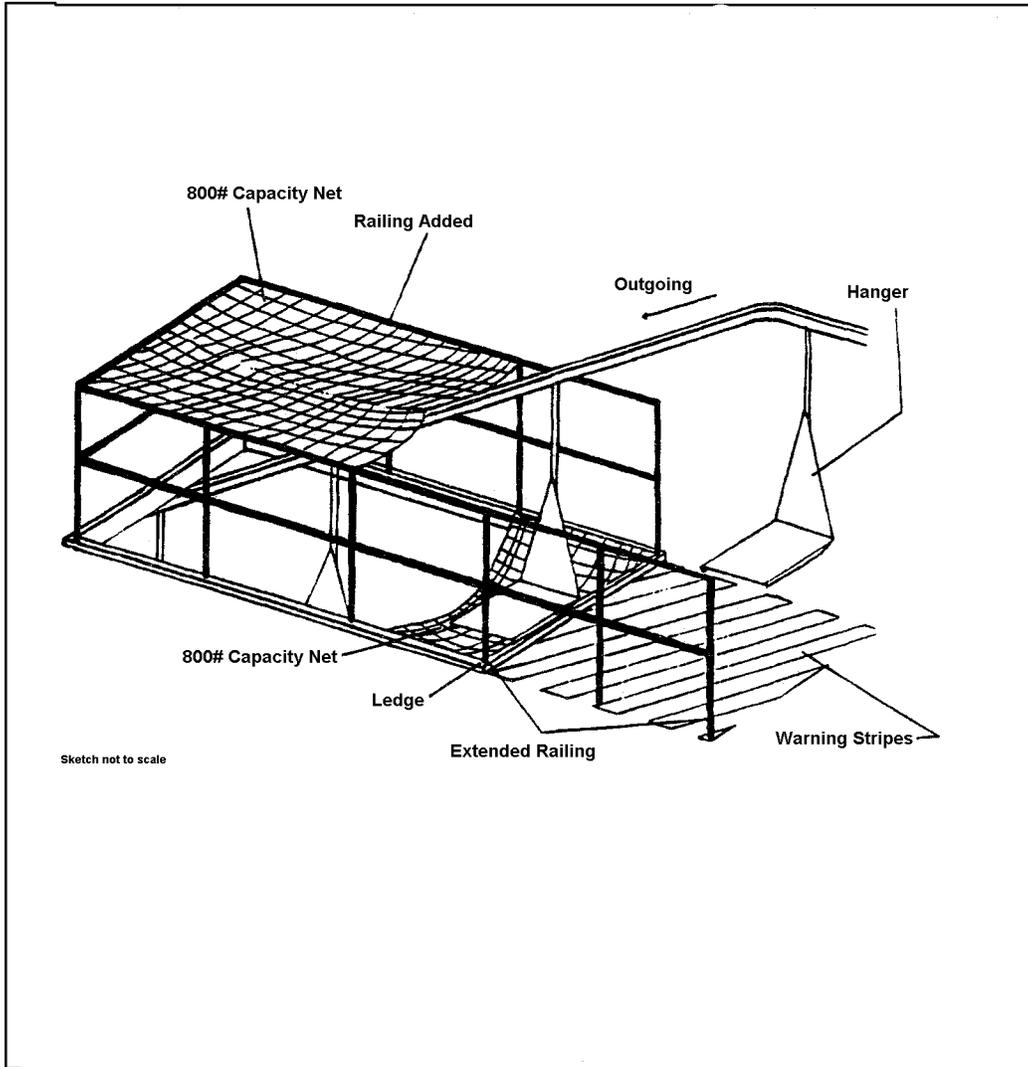


Figure 2. Overhead Conveyor System Floor Opening After Modification by Employer

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

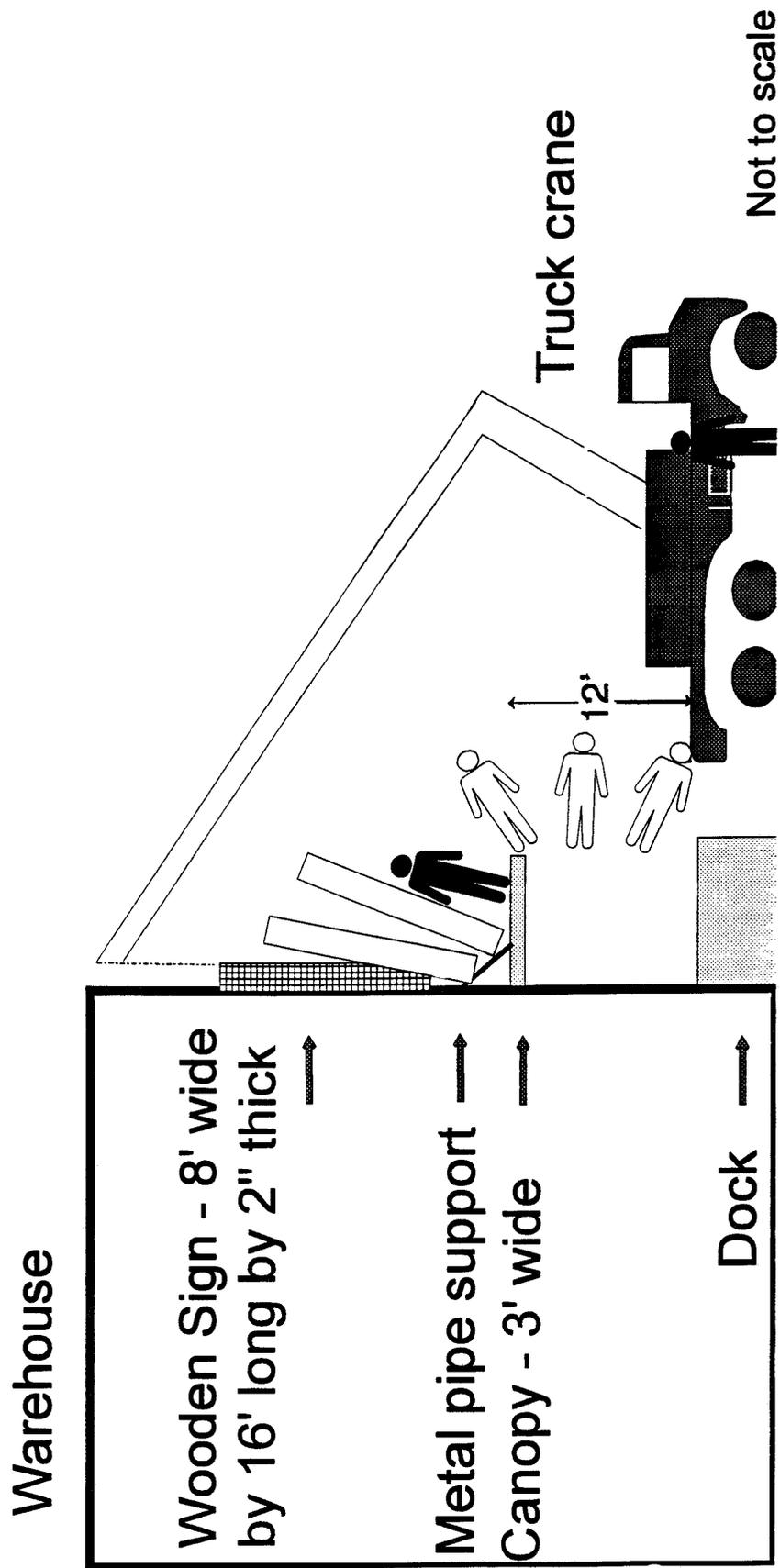


Figure. Victim's Position on Canopy

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

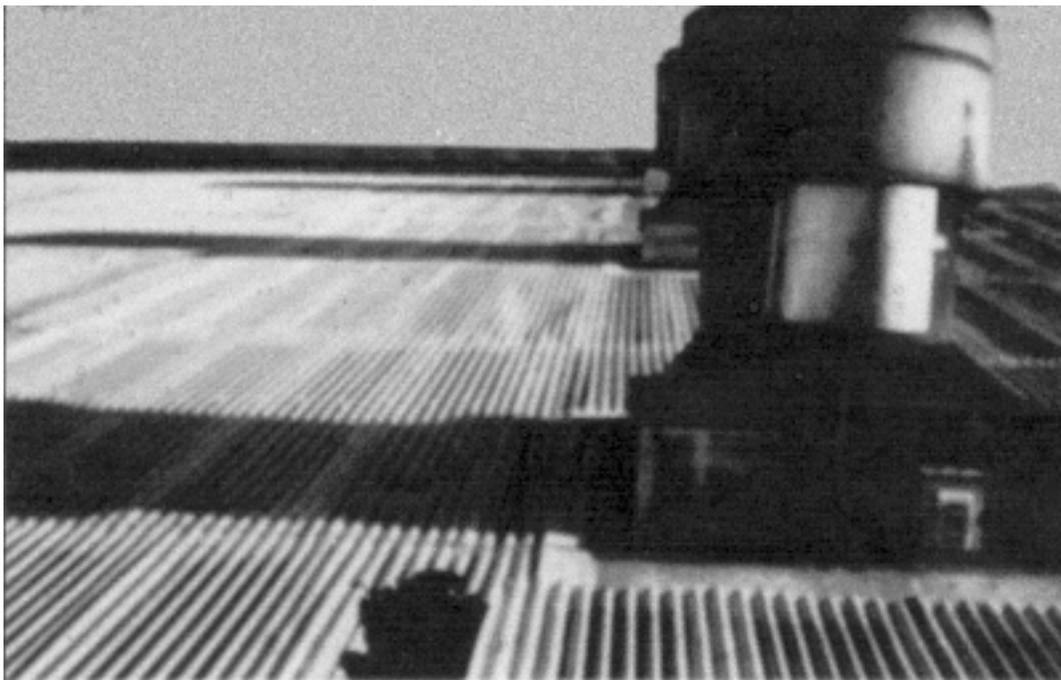
Recommendation #1: Employers should evaluate their current safety program and incorporate specific training procedures emphasizing the importance of recognizing and avoiding hazards in the workplace. These procedures should include, but not be limited to, conducting hazard evaluations before initiating 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.

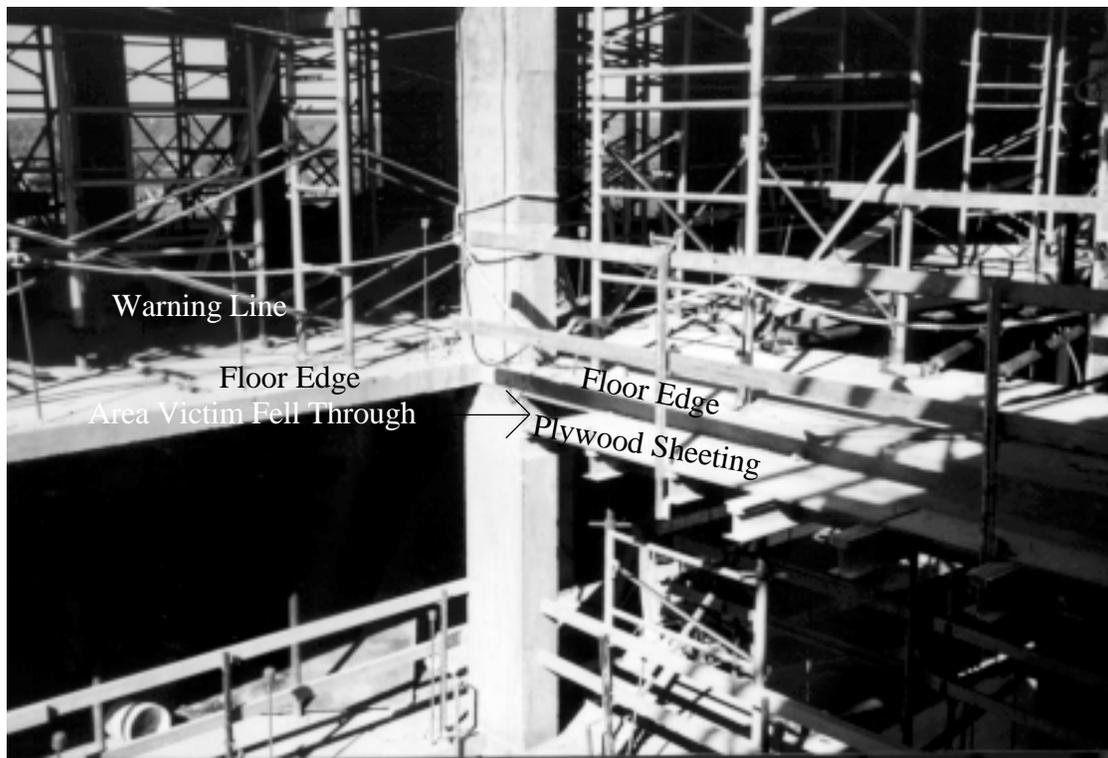


Figure. Atrium Floor Area

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.

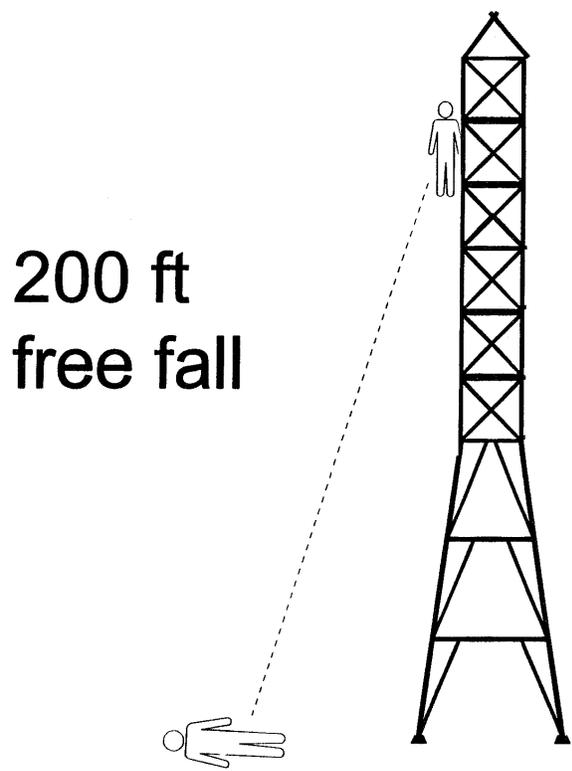


Figure 1. 300 Foot Telecommunications Tower

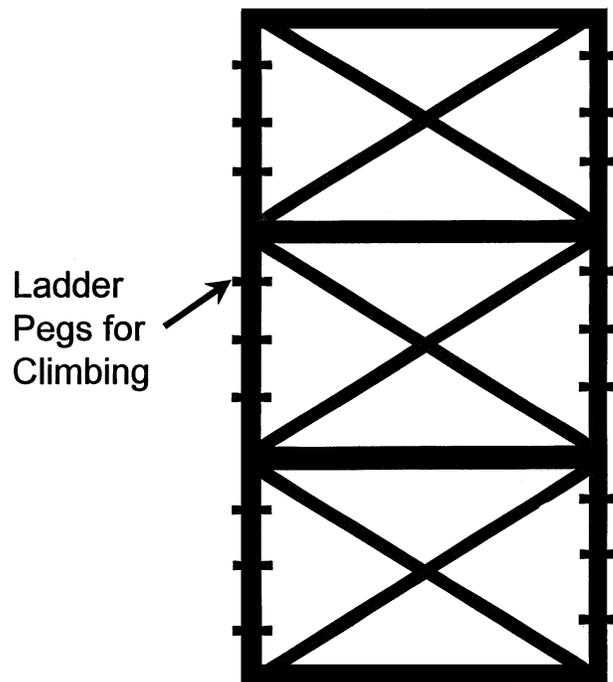


Figure 1a. Enlarged View, Tower Section

FACE 86-10: 33 Year-Old Apprentice Substation Electrician Fatally Injured

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrical-related fatal injuries and confined space fatalities. By scientifically collecting data from a sample of fatal accidents, it will be possible to identify and rank factors which influence the risk of fatal injuries for selected employees.

On November 6, 1985, a 33 year-old electrician came in contact with electrical energy while cleaning a substation switch. He died on November 8, 1985, from injuries sustained as a result of falling from the aerial bucket from which he was working.

CONTACTS/ACTIVITIES

Officials of the responsible Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. This case has been included in the FACE Project. On January 10, 1986, a member of the DSR research team (a physician) met with representatives of the company and the Occupational Safety and Health Program compliance officer, who investigated this case. The site of this fatality was visited and photographed. Interviews were conducted with two workers with essentially the identical job classification as the victim. A next-of-kin interview was conducted on January 9, 1986.

OVERVIEW OF THE COMPANY AND SAFETY PROGRAM

The victim worked for a large utility company employing over 5000 employees. This company provides both electrical and natural gas services to approximately one-third of the state. The victim worked for the electricity distribution division, which has 178 employees. These employees are classified as either journeyman or apprentice substation electricians. The training program for a substation electrician is approximately 6 years. Five and one-half years consist of both classroom and on-the-job training. Formal testing is done to ensure adequate understanding of classroom work. The last six months of the training is used for final evaluation, prior to attaining journeyman status. The victim was an apprentice substation electrician in his final six months of training. The victim would have been made journeyman substation electrician in March of 1986.

The company has a budgeted safety department and a program which emphasizes three functions: (1) to formulate and communicate a safety program for the entire company; (2) to deal with workman's compensation claims; and (3) to provide industrial hygiene services for the company.

The safety department has six full-time employees and is headed by a safety engineer with eleven years of experience in occupational safety and health, in addition to formal training in safety management. The safety staff also employs an industrial hygienist and a specialist in worker's compensation claims.

A written safety policy and safety program exist for this company. Several safety committees exist involving various levels of management and union employees. Formal task training is provided by a department whose only function is training. Safety rules are communicated to new employees at the time of initial orientation. Each new employee is given a written safety manual and formal classroom instruction

in safety. New employees are formally tested within ninety days of being hired to ensure adequate understanding of the safety rules.

SYNOPSIS OF EVENTS

The four-man crew consisted of two journeyman substation electricians and two apprentice substation electricians. The apprentice substation electricians (one of whom was the victim) were both in their final six months of training. The crew was cleaning high voltage disconnect circuits at a large substation. This is considered to be routine maintenance, is performed using established procedures, and had been done by all members of the crew for at least five years.

The crew was to clean five circuits (15 switches) on the day of the accident. Each circuit consists of three switches (one for each phase), located 40 feet above ground on a steel frame structure. The switches are cleaned with solvents, steel wool, and occasionally filed to remove corrosion. The crew was using an aerial bucket to access the switches. The three switches for each circuit are operated by a single control lever and are either all open or all closed. The control lever is operated from ground level. Prior to cleaning switches, the system must be de-energized. The crew foreman is ultimately responsible for this activity. Once the incoming lines are de-energized, the line is tested using a method called "fuzzing". "Fuzzing" consists of wrapping insulating material around one end of a metal object and holding it close to the incoming power line. If no noise is heard, the line is assumed to be dead and grounds are placed from the incoming line to the steel support structure. The system is also grounded on the outgoing side of the circuit so that there is no possibility of feedback into the three switches. The switches are to remain in the open position during this maintenance procedure.

On the day of the accident, several crews were working at the substation site. One crew was removing obsolete equipment and had placed grounds on the outgoing side of the circuits that were to be cleaned. After lunch, this crew left the substation removing their grounds. These grounds were not replaced. The victim had completed cleaning the fourth circuit shortly before 3:00 p.m. He left the 4th circuit closed to drain off any static charge that may have built up in the system. (There would have been no static charge had the outgoing side of the circuit been grounded.) The victim was asked if he wanted the fourth circuit opened by two different crew members. He supposedly told them he would do it himself. The victim moved the truck so that the aerial bucket could be positioned for cleaning the fifth circuit. The fourth circuit was re-energized. The crew foreman de-energized the incoming line to the fifth circuit. The line was "fuzzed" and grounds were placed on the incoming line. At 3:14 p.m. the victim was in the process of cleaning the switches when he contacted both sides of one of the three switches. This action completed the connection, as if the switch itself were closed and current flowed through the victim's body and to ground by way of the ground on the incoming line. The system was energized by feedback through the fourth circuit. The victim fell from the aerial bucket approximately forty feet to the ground. The victim had extensive burns of both arms and hands. It is estimated that the victim completed a single-phase circuit of approximately 20,000 volts. First aid was administered at the accident site by co-workers and subsequently paramedics. The victim was transported to a local hospital approximately 20 minutes after the accident occurred. He was later transferred to another medical center and died two days later on November 8, 1985.

Standard operating procedure was not followed by the crew while cleaning the switches. The fourth circuit should have been left open. The crew was aware of this. The outgoing side of the circuit was not grounded as required by the company. The victim did not have himself belted to the aerial bucket as required. This would have prevented his fall and the injuries sustained in the fall.

CAUSE OF DEATH

Following an autopsy, it is the opinion of the medical examiner that the victim "died as a result of cerebral injuries when he fell from a height of 40 feet." The victim's contact with electricity is noted in the medical examiner's report as the cause of the fall.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Standard operating procedures and hazard awareness should be routinely presented and reviewed at safety meetings. Employers should enforce strict adherence to company policy. Employees should follow all standard operating procedures.

Discussion: The crew did not follow standard operating procedure while providing maintenance to the substation. Three violations of standard operating procedure occurred that contributed to this fatality: 1)the switches on the fourth circuit were left closed when they should have been open; 2)the outgoing side of the circuits were not grounded; and 3)the victim was not secured to the bucket from which he was working. Had standard operating procedure been followed, this fatality would not have occurred.

Recommendation #2: De-energization of both sides (incoming and outgoing) of the substation circuit should be verified.

Discussion: The incoming line to the circuit is "fuzzed" as part of the standard operating procedure to verify that the line is de-energized. The outgoing side of the circuit should also be checked to verify that no voltage is present (from feedback). Additionally, the absence of low voltage (not detected by "fuzzing") should be verified by a low voltage testing device, prior to grounding. Had both sides of the circuit been tested, the victim would have been alerted that the system was not de-energized.

FACE 88-46: Female Receiving Clerk Dies in Fall in Warehouse

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 September 3, 1988, a 33-year-old female receiving clerk died as the result of a fall sustained on September 2, 1988, while trying to locate misplaced merchandise on 7-foot-high steel shelving. The attending physician determined that the victim landed head first on the concrete floor.

CONTACTS/ACTIVITIES

State officials notified DSR of this fatality and requested technical assistance. On September 20, 1988, a research safety specialist met with company officials and the victim's immediate supervisor, photographed the incident site, and discussed the incident with the county coroner and the Occupational Safety and Health Administration (OSHA) compliance officer.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was employed by a wholesale merchandise distributor that has been in operation for 55 years. The company employs 240 workers, including 3 receiving clerks. The company has no written safety program and all training for work-related tasks is conducted on the job.

SYNOPSIS OF EVENTS

On the day of the incident, the victim was assigned by her supervisor to locate misplaced merchandise that was previously stocked. The merchandise was on 7-foot-high by 3-foot-wide rows of steel shelving spaced 5 feet apart in a 25,200 square yard warehouse. The shelving was arranged so that four shelves existed for inventoried merchandise. The top of the shelving was used to store excess merchandise. The victim decided to check the storage area at the incident site even though a co-worker informed her that the storage area had already been searched. Co-workers noted that the victim apparently climbed the shelves to reach the top shelf instead of using an available 6-foot-high wheel-mounted ladder with handrails.

A fork-truck driver passing the scene offered the victim assistance in getting down, but she declined. A short time later workers in the area heard a scream and found the victim lying in the aisle between two rows of shelves. The emergency medical service arrived in 10 minutes and summoned a medical helicopter. The victim was flown to the local hospital where emergency neurosurgery was performed. However, the victim died the following morning as a result of injuries received in the fall.

CAUSE OF DEATH

The attending physician listed accidental closed-head injuries as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should perform task hazard analysis for all tasks performed at their establishments, adopt safe work procedures for the performance of these tasks, and ensure that workers adhere to these procedures at all times.

Discussion: As previously stated, the employer had no written safety program or task procedures. Hazard analysis should be performed to identify any hazards that may be encountered by workers during the performance of their duties. Although a receiving clerk might not be identified as a dangerous occupation, there may be unanticipated hazards. One hazard encountered by receiving clerks is a fall hazard, especially while working at the level of the top of the shelving (i.e., 7 feet). The employer provides 6-foot-high, wheel-mounted ladders for working at this level or below, if necessary.

Written safety procedures should be developed that address the task of stocking shelves. These procedures should require the use of ladders. If a ladder had been used in this incident, the possibility of a fall would have been reduced once these procedures are developed, workers should be trained to perform their duties in the safest possible manner. Employers must ensure adherence to these safe job procedures in order to provide workers with the safest possible work environment.

FACE 89-45: Welder Dies in Fall from Fork Lift

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 16, 1989, a 47-year-old male welder died as the result of falling approximately 7 feet from a fork truck (commonly referred to as a fork lift or towmotor).

CONTACTS/ACTIVITIES

The county coroner contacted DSR about this fatality and requested technical assistance. On July 27, 1989, a research team consisting of a safety specialist and an epidemiologist discussed this case with state officials, conducted an investigation, met with the company owner, and photographed the site of the incident.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim had been employed for 5 years as a welder for a welding and machining services company that has been in operation for 21 years. The company employs 45 workers, including 35 welders. The employer uses written safety rules and procedures and provides on-the-job training. The company owner is also the safety officer. Jobsite foremen are responsible for administering and enforcing the safety program. This fatality is the first in the history of the company.

SYNOPSIS OF EVENTS

On the day of the incident, welding and machining tasks were being performed throughout the plant as usual. The welder (victim) was performing welding tasks assigned to him earlier that morning. A co-worker (fork lift operator) was moving wheel sets (steel axles with steel wheels attached) inside the building where the victim was welding.

The co-worker had just off-loaded a wheel set when he noticed that the fork carriage (assembly to which the forks or other attachments are mounted) was jamming on the mast (upright steel assembly consisting of hydraulic cylinders, inner channels, telescoping outer channels, chains, and guide rollers) (see Figure). The co-worker and victim decided to solve the problem without removing the fork truck from service, a violation of company maintenance procedures.

They backed the fork lift (i.e., a 1979 V225 diesel-powered fork truck with an 11-ton lifting capacity) out of the work area, set the brakes, blocked the wheels, raised the fork carriage up the mast to the point where it jammed, and shut off the engine.

The victim noticed that a wear guard strip, attached to the side of the telescoping channel on the mast, had come loose and was binding against the guide roller. This caused the top of the fork carriage to jam

approximately 8 feet from the ground. The victim, carrying a cutting torch, climbed up the carriage and stood on an angled, 6-inch-wide steel support to cut out a section of the wear guard strip as the co-worker observed. The victim then used a pry bar to move the wear guard strip away from the guide roller. As the strip dislodged from the roller guide, the carriage dropped approximately 1 foot.

Due to the jerking motion of the carriage, the victim fell from the angled steel support headfirst onto a concrete pad. The local emergency medical service (EMS) was summoned and arrived approximately 4-5 minutes later. Approximately 35 minutes thereafter, the victim was air-evacuated to the hospital where he died 2 days later.

CAUSE OF DEATH

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

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should review, revise where applicable, and enforce current safety programs.

Discussion: Although the company has a written safety program, including maintenance procedures for fork trucks, the procedure was not followed. If the victim and co-worker had informed the jobsite foreman of the fork lift problem, according to procedure, the truck could have been moved to the maintenance shop and repaired according to company maintenance procedures, thereby avoiding the incident. Employers should review, revise where applicable, and enforce the current safety program. The program should be clear and should emphasize the importance of following established operating procedures.

Recommendation #2: Employers should ensure that employees are aware of, and fully understand the risks associated with, failing to comply with established operating procedures.

Discussion: Unscheduled maintenance by unauthorized personnel can and does lead to injury and even death. Apparently the two workers (the victim and co-worker) did not perceive the 8-foot distance as a hazard associated with working on the fork lift, and a fatality resulted. If the standard operating procedure had been followed, this incident may have been avoided. Employers should ensure that all employees are aware of, and fully understand, the risks associated with not complying with established operating procedures.



Figure. Fork Truck Components: 1) fork carriage (assembly to which the forks or other attachments are mounted, and 2) mast (steel upright assembly consisting of hydraulic cylinders, inner channels, telescoping outer channels, chains, and guide rollers).

FACE 90-35: Electrical Lineman Dies After Falling 35 Feet to the Ground from a Burning Aerial Bucket in South Carolina

SUMMARY

An electrical lineman died 5 days after attempting to jump from a burning aerial bucket and falling 35 feet to the ground. The lineman was adjusting the slack in the middle phase of a three-phase, 14,200-volt powerline. The hydraulic hose attached to the impact wrench he was using burst. Hydraulic fluid spraying from the hose ignited, covering part of the aerial bucket in flames. As the lineman was rotating the aerial bucket away from the powerlines, he lost power to the controls. He attempted to escape the intensifying fire by jumping laterally from the bucket's edge to an adjacent earthen bank approximately 15 feet away. However, his foot caught on the lip of the bucket, and he fell 35 feet straight down to the ground. The investigation revealed that the metal-reinforced hydraulic hose used for the impact wrench attachment was simultaneously in contact with two phases of the powerline. The heat generated in the hose caused it to melt and burst at one of the points of contact with the powerlines. NIOSH investigators concluded that, to prevent future similar occurrences, employers and/or equipment, tool, and hose manufacturers, should:

- *ensure that metal-reinforced hydraulic hoses are not installed on any part of the boom, aerial bucket, or hydraulic attachments on aerial bucket trucks that may be used near powerlines*
- *ensure that fluids used to power hydraulic hand tools are fire resistant*
- *install all hydraulic hoses for impact attachments in such a manner that the flow of hydraulic oil can be stopped by the worker in the aerial bucket during an emergency*
- *label or color code hydraulic hoses to identify hoses that may be used on an aerial bucket*
- *design a hydraulic coupling system that would ensure that any hydraulic hoses unsuitable for use on booms, aerial buckets, or aerial bucket attachments, could not be connected to these components of aerial bucket systems*
- *provide task-specific training to workers that includes training in the identification and control of potential hazards*
- *stress the importance of adherence to established safe work procedures.*

INTRODUCTION

On June 30, 1990, a 37-year-old lineman died of injuries sustained on June 25, 1990, when he attempted to jump from a burning aerial bucket, and fell 35 feet to the ground. On July 16, 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 August 9, 1990, a safety specialist and a public health intern traveled to the incident site to conduct an investigation. The incident was reviewed with employer representatives, the county sheriff's office, and the county coroner. Photographs of the incident site were obtained.

The employer in this incident is an electrical contractor who has been in business for 44 years and employs 550 workers, including 100 electrical linemen. The contractor employs three full-time safety officers and has a written safety policy, a comprehensive written safety program, and a worker training program. A comprehensive safety manual is provided to each employee. Daily safety tailgate meetings are held at the jobsite, and weekly safety meetings are held at the office. During weekly safety meetings, a section of the safety manual is read and discussed and all personnel are required to sign a statement documenting their attendance. The employer maintains a video library of safety films dealing with all aspects of powerline construction. These films are shown in the field, and in the office on days that operations are canceled due to inclement weather. Supervisors are required to complete a daily safety checklist for each job completed.

INVESTIGATION

The employer was contracted to upgrade an existing electrical system by installing new utility poles parallel to an existing three-phase electrical system, and transferring the 12,400-volt powerlines to the new utility poles.

On the day of the incident, the victim and a co-worker were transferring the energized powerlines to the last new utility pole in the system. As each phase was transferred, it was "dead-ended" (attached at the pole without further connection to the rest of the power system). Once all three phases were attached, they were "sagged" (the slack was adjusted) by the lineman. The center phase was sagged first, then the two outside phases. The center phase was sagged a second time to take out additional slack. The conductor was held in place by a come-along during attachment to the insulators on the utility pole. A hydraulic impact wrench was used to tighten connectors around the powerline and insulator.

As the lineman was tightening the center phase connectors, the hydraulic hose supplying fluid to the impact wrench burst. The hydraulic fluid spraying from the ruptured hose ignited, covering part of the aerial bucket with flames. The lineman rotated the aerial bucket away from the utility pole. When the bucket was approximately 12 feet away from the utility pole, the lineman lost power to the controls as additional hydraulic hoses burst and burned. The lineman attempted to jump laterally to an earthen bank approximately 15 feet away. However, his foot caught on the lip of the bucket and he fell 35 feet to the ground, landing on his head and chest. The victim rose to his feet but was lowered back to the ground by the co-worker. The co-worker radioed the company dispatcher from the truck and requested the emergency medical squad (EMS). The victim was transported to the hospital where he died 5 days later from injuries sustained in the fall. The bucket burned for approximately 20 minutes until a second line crew de-energized the powerlines and the fire department extinguished the fire.

Investigation revealed that a field mechanic had installed a metal-reinforced hydraulic hose on the impact wrench 5 months prior to the incident. When the hose simultaneously contacted two of the energized phases, electrical continuity was established through the hose's metal reinforcement. The heat generated by the resistance to the phase-to-phase current melted the hose, and partially melted the metal in the hose. When the hose ruptured, the spraying hydraulic fluid contacted the hot metal and ignited.

Standard employer practice required the use of common hydraulic hoses (without metal reinforcement) on any area of the boom or aerial bucket that might be placed near energized powerlines. The mechanic told investigators that he knew he was installing the wrong type of hose, but did not understand the potential hazards involved. The electrical contractor had the hydraulic hoses on all aerial bucket trucks inspected and no other metal-reinforced hoses were found in the bucket area. However, when informed of the cause of

the fire, the local electric utility company inspected its aerial bucket trucks and found metal-reinforced hydraulic hoses on several.

CAUSE OF DEATH

The attending physician listed trauma-closed head injury as the cause of death.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should instruct maintenance and mechanical personnel not to install metal-reinforced rubber hydraulic hoses on any part of the boom, aerial bucket, or hydraulic attachments of aerial bucket trucks that may be used to work on or near energized high-voltage powerlines.

Discussion: As seen in this case, electrical continuity established between two powerline phases or powerline phase-to-ground through a metal-reinforced hydraulic hose, can generate heat sufficient to rupture the hose and cause a fire. Current flowing through the metal reinforcement could also be conducted to the truck chassis, creating an electrocution hazard. All hydraulic tools used on or near energized lines or equipment must be equipped with nonconducting hoses, according to 29 CFR 1926.951(f)(3).

Recommendation #2: Employers should ensure that fire-resistant hydraulic fluid is used to power hand tools that may be exposed to ignition sources.

Discussion: Fluids used in hydraulic-powered tools must be approved, fire-resistant fluids according to 29 CFR 1926.302(d)(1). In this case, use of a fire-resistant hydraulic fluid could have prevented the ensuing fire.

Recommendation #3: Employers should ensure that hydraulic hoses for impact attachments are installed so that the flow of hydraulic fluid can be stopped by the worker in an aerial bucket during an emergency.

Discussion: A control valve incorporated into the hydraulic system of the aerial bucket would allow a worker in the bucket to immediately stop the flow of hydraulic fluid to any attachment. In the event of a fire, the control valve would enable a worker in a bucket to shut off the supply of hydraulic fluid fueling the fire. Although use of a metal-reinforced hose was a primary cause of fire in this instance, this safeguard should be incorporated for all hydraulic hoses due to the potential that any type of hydraulic hose could burst.

Recommendation #4: Employers should label or color code hydraulic hoses to identify those that are appropriate for specific applications on certain areas of machinery (such as aerial buckets).

Discussion: A method or system for labeling or color coding hydraulic hoses might prevent the hazards introduced when different types of hoses, designed for use in different applications, are used interchangeably.

Recommendation #5: Equipment and tool manufacturers should cooperatively design an independent coupling system, utilizing a new variation of matched connection components, that could be incorporated into aerial bucket system designs.

Discussion: Such an independent coupling system would ensure that any hydraulic hoses unsuitable for use on booms, aerial buckets, or aerial bucket attachments could not be connected to these components of aerial bucket systems.

Recommendation #6: Employers should provide task-specific training to workers that correlates steps in the task with control of the identified potential hazards.

Discussion: In this instance, the field mechanic was aware that he was installing the incorrect type of hose; however, he was not aware of the fire hazard associated with the use of a metal-reinforced rubber hose near energized high-voltage powerlines.

Recommendation #7: Employers should ensure that workers are aware of the importance of adherence to established safe work procedures.

Discussion: Employers should continually stress the importance of adherence to established safe work procedures. Established safe work procedures required covering energized powerlines in the immediate work area with insulated line hoses prior to the start of any work. It is not known, however, if insulated line hoses would have prevented the ignition of the hydraulic fluid in this case.

REFERENCES

1. 29 CFR 1926.951(f)(3) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register. pg. 286.
2. 29 CFR 1926.302(d)(1) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register. pg. 133.

FACE 91-30: Tree Trimmer Dies After Falling 65 Feet From Tree in Virginia

SUMMARY

A 34-year-old male tree trimmer died after falling 65 feet from a tree. The victim was limbing and topping the three forks of a large oak tree with a chain saw in preparation for felling the tree. The victim had limbed and topped two of the forks and had started on the third. As the limbs fell to the ground, the victim's brother and a general contractor were cutting them into pieces. The victim's cousin looked up to check on the victim, then began to cut the branches when he noticed the victim's belt rope falling. He looked up to see the victim falling to the ground. The victim's climbing cradle had failed. An investigation revealed that the connectors on both ends of the climbing cradle rope were fastened with wire and electrical tape. NIOSH investigators concluded that, in order to prevent similar occurrences, employers should:

- *ensure that proper fastenings are used at the connectors for all climbing cradle ropes*
- *ensure that workers inspect all fall protection equipment each day prior to use*
- *evaluate the feasibility of a redundant fall-arresting system.*

INTRODUCTION

On September 3, 1991, a 34-year-old tree trimmer died after falling 65 feet from a tree. On September 5, 1991, officials of the Virginia Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On September 18, 1991, a DSR safety specialist traveled to the incident site to conduct an investigation. The incident was reviewed with the investigating police officers, the county coroner, and the OSHA compliance officer. Photographs of the site were obtained during the investigation.

The victim was employed full time as a tree trimmer by a tree care service. However, during off-duty hours, the victim and his brother performed tree trimming and tree removal jobs on their own. There were no written safety rules or safe work procedures for the work that the victim and his brother were performing on their own time.

INVESTIGATION

The victim, with his brother, had been contracted by a general contractor to remove a large oak tree from the yard of a private residence on their own time during a weekend.

The large tree had three main forks. The victim decided that he would limb and top each of the forks before felling the tree, while the victim's brother and the contractor would remain on the ground and cut up the limbs as they fell. The victim climbed the first fork and tied a rope around it near the top. He would use this rope to assist him as he made his way up the fork, cutting off the limbs as he went. The victim wore a body harness, tree climbers, and a climbing cradle (a length of rope with connectors on each end that is placed around the tree and snapped to the "D" rings on each side of the body harness) as he ascended the tree. The climbing cradle assisted the victim while climbing and held him in place while he made his cuts with the chain saw. The victim also had a tool rope hanging from the harness with which he could raise and lower tools.

At the time of the incident, the victim had completed work on the first two forks and was approximately three quarters finished with the third fork (60 feet above ground). The contractor looked up to check on the victim, then began to cut branches on the ground. The contractor then noticed a rope falling to the ground and looked up to see the victim falling to the ground. The victim landed on his head and right shoulder. The owner of the residence immediately called the emergency medical service (EMS). EMS personnel arrived 5 minutes after being dispatched and transported the victim to the hospital, where he was pronounced dead by the attending physician.

Investigation into the incident revealed that the connectors on both ends of the climbing cradle ropes were fastened with wire and electrical tape. While the victim was leaning back making a cut, the pressure caused the rope to pull loose and the victim fell to the ground. The connector was still attached to the D-ring on the harness.

CAUSE OF DEATH

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

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that proper fastenings are used at the connectors for all climbing cradle ropes.

Discussion: All rope connectors should be interwoven or mechanically clamped in compliance with manufacturer's recommendations to ensure that the integrity of the connections is continually maintained.

Recommendation #2: Employers should ensure that workers inspect all fall protection equipment for defects each day prior to use.

Discussion: In this instance, the victim, working as a self employed tree trimmer, did not inspect the connectors on the climbing harness prior to use. If a visual inspection of the harness had been conducted, the loose connector might have been identified and could have been repaired. Any defective equipment should be immediately repaired or removed from service.

Recommendation #3: Employers should evaluate the feasibility of a redundant fall-arresting system.

Discussion: In this instance, the victim relied solely on the climbing cradle as the fall arresting system. When the connector on the cradle failed, there were no other system components present to prevent the fall. The victim had tied a rope to the top of the forks prior to beginning the limbing work. This rope could have doubled as a lifeline. A lanyard attached to the body harness and the rope would have provided a second suspension point.

[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 kind 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 cradle connector failed.]

FACE 94-02: Stocker/Order Picker Dies After 12-Foot Fall From An Elevated Pallet--South Carolina

SUMMARY

A 25-year-old male stocker/order picker (the victim) died after falling 12 feet to a concrete floor. The victim was re-stocking the third tier of a row of 36-inch-wide steel shelving units while working from a 47 1/2-inch-long by 40-inch wide-pallet supported by a cherry picker. A co-worker, facing away from the victim, was opening boxes of merchandise at floor level on the same row. The victim was wearing a safety belt, and a permanently affixed 5-foot nylon lanyard was attached to the cherry picker's falling-object protective structure, above the victim; however, the victim had not attached the lanyard to his safety belt. As the victim was stepping from the shelving to the pallet, he lost his balance and fell backward off the pallet, 12 feet to the concrete floor below, landing on his back and striking his head. The co-worker, hearing the victim fall, ran to him and found him semiconscious but breathing. The co-worker alerted the shift supervisor, who summoned the emergency medical service (EMS) by phone. The EMS transported the victim to the local hospital where he died 5 days later. NIOSH investigators concluded that, to prevent similar occurrences, employers should:

- *ensure that workers continually adhere to the safe work practices that have been established by the employer*
- *encourage all employees to actively participate in workplace safety*
- *routinely conduct scheduled and unscheduled worksite safety inspections.*

INTRODUCTION

On September 15, 1993, a 25 year-old male stocker/order picker died from injuries he received in a 12-foot fall from an elevated pallet on September 10, 1993. On September 30, 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 December 21, 1993, a DSR safety specialist conducted an investigation of this incident. The incident was reviewed with employer representatives, the coroner, and the SCOSHA compliance officer assigned to the case. Photographs of the incident site taken immediately following the incident were reviewed during the investigation.

The employer was a multistate retail merchandise distributor that had been in operation for 40 years and employed 16,000 employees. Two hundred thirty-five workers were employed at the facility where the incident occurred, including 11 stocker/order pickers. The employer had a comprehensive safety program. Each new employee received an employee handbook and a "Think Safety" pamphlet that contained general safety rules. New employee orientation was conducted under the direct supervision of the shift supervisor until such time that the supervisor felt the employee could perform the job correctly. Employees received training on such topics as the correct use of personal protective equipment and proper lifting techniques. Safety inspections were conducted daily by the shift supervisor on all three shifts, weekly safety meetings were conducted for all personnel, and all personnel received yearly hazard awareness training. Cherry picker operators received 3 days of specialized training from the shift supervisor before operating the machines on their own. The victim had been employed at the facility for 2 months. This was the first fatality experienced by the employer.

INVESTIGATION

The retail distribution center operated on three shifts--7 a.m. to 3:30 p.m., 2:30 p.m. to 10:30 p.m., and 10:30 p.m. to 6 a.m. Goods, such as non-perishable foods, household items, and various other items were received from the manufacturer and warehoused. The merchandise was stored on rows of 3-tiered steel shelving. The top shelf was 12 feet above floor level and the rows were located 102 feet apart. When orders were received, the merchandise was pulled from the warehouse, transferred to a truck, and then shipped to the desired destination.

On the day of the incident, the victim and a co-worker were re-stocking shelves on the 10:30 p.m. to 6 a.m. shift. They began the shift by loading the first batch of merchandise brought to the warehouse on pallets. Two sizes of pallets were used (472" by 40" and 30" by 38"). At approximately 1 a.m., they began to stock the shelves. The co-worker raised the victim on a loaded pallet to the top shelf using a cherry picker, then left the cherry picker and began to load more pallets at floor level. The victim was wearing a safety belt that was required, by company policy, to be attached to a 5-foot nylon lanyard that was permanently affixed to the cherry picker's falling-object protective structure above him. A sign, warning workers to keep the lanyard attached to their safety belt at all times, was posted on the cherry picker. It could not be determined if the lanyard had been attached to the victim's safety belt at this time. The men continued this activity until the first batch of merchandise was warehoused.

At approximately 4 a.m. the men began to stock the second batch of merchandise. When the second batch of merchandise was warehoused, the co-worker raised the victim on an empty 472" by 40" pallet to the top shelf to pull goods to fill an order. He then turned away from the victim and began to load pallets on the same row, approximately 20 feet from the cherry picker. As the co-worker was loading a pallet he heard a sound and turned to see the victim lying on his back on the concrete floor. The co-worker ran to the victim and found him semiconscious but breathing. The co-worker alerted the shift supervisor, who called the emergency medical squad (EMS). The EMS arrived on the scene 12 minutes later and transported the victim to the local hospital where he died 5 days later.

The victim apparently lost his balance as he was loading the pallet and fell backward off the pallet. The victim was wearing his safety belt but was not attached to the lanyard. An examination of the lanyard showed it to be free from defects.

CAUSE OF DEATH

The attending physician listed the cause of death as closed head trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that workers continually adhere to established safe work procedures.

Discussion: Employers should continually stress the importance of adherence to established safe work procedures. In this instance, the victim was wearing a safety belt but did not attach the permanently affixed lanyard to it as required by company safe work procedures and as taught in new employee orientation.

Recommendation #2: 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 without being attached to the lanyard, in violation of established safety rules. 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.

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

Discussion: Although the shift supervisor conducted a safety inspection during each shift, additional scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that company safe work procedures are being followed. 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 and to the prevention of occupational injury. Competent 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.

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 94-14: Construction Foreman Dies After Falling From Aerial Lift Bucket Truck--South Carolina

SUMMARY

On June 20, 1994, a 46-year-old male construction foreman (the victim) fell 16 feet from the bucket of an aerial lift truck. He died the following day as a result of his injuries. He had been attempting to estimate the height of telephone and television cables that were stretched across a two-lane roadway. The roadway had been guarded against moving traffic by two other employees, but just prior to the incident, the victim reassigned the employees to a different job. The victim positioned himself in the one-man bucket of the hydraulically-operated, articulated-boom, aerial lift truck and raised the bucket about 16 feet above ground level without first donning a safety belt and lanyard and attaching it inside the bucket. As the victim was judging the height of the cables, a tractor-trailer attempted to drive under the outstretched cables. The top of the trailer caught the cable and pushed it toward the victim. The cable contacted the victim's abdomen, and knocked him out of the bucket causing him to fall to the concrete roadway. The victim was immediately rushed to the local hospital, then transferred to a trauma center. The victim died of internal hemorrhaging the following day. Although fall protection equipment (a safety belt and lanyard secured to an anchor point inside the bucket) was provided on the truck, the victim was not wearing the equipment as required by company policy.

NIOSH investigators concluded that, to prevent future 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*
- *review and revise, where applicable, existing safety programs*
- *encourage workers to actively participate in workplace safety.*

INTRODUCTION

On June 21, 1994, a 46-year-old male construction foreman (the victim) died as a result of injuries sustained after falling from the bucket of an aerial lift truck the previous day. On July 23, 1994, officials of the South Carolina Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. A DSR safety specialist traveled to the site on September 23, 1994, to conduct an investigation of the incident. During the investigation, the company's plant superintendent was interviewed, photographs of the site and vehicle were taken, and a copy of the death certificate was obtained.

The employer was a telephone cooperative that has been in operation for 42 years and employed 220 workers, 3 of whom were construction foremen. The company's plant superintendent managed field operations, as well as performing part-time safety responsibilities. The company maintained a written safety policy and safety rules, and employees received both formal classroom and on-the-job training. The company required pre-employment and random drug testing for employees required to drive company vehicles. Monthly safety meetings were held, quarterly safety films were shown, and speakers were hired semi-annually to present safety related topics. The victim, a journeyman line mechanic, worked as a foreman 8 of the 15 years he was employed by the company. This was the first fatality experienced in the company's history.

INVESTIGATION

The victim and four crew members had been assigned to replace a cracked wooden utility pole located alongside a two-lane roadway. The top of the pole was about 20 feet above ground. The pole supported two sets of telephone and television cables which were strung 16 feet above the roadway. One set of cables ran parallel with the roadway; the other set ran across the roadway to a pole on the opposite side (Figure).

On the day of the incident, the victim and four other crew members arrived at the jobsite shortly after lunch in preparation to perform the routine pole replacement. Two crew members were assigned to direct traffic around the jobsite, while two other crew members and the victim used an aerial lift bucket truck and a derrick truck to remove the cables from the cracked pole and the pole itself from the ground, respectively.

After the task was completed, the cables running across the roadway were supported, in absence of the cracked pole, by the telephone and television cables which ran parallel to the road. The victim instructed the two crew members directing traffic to cease their work and help with setting the new pole. The victim stated he was going to use the bucket truck to check the height of the cables running across the roadway. Without donning the fall protection equipment provided on the truck (safety belt and lanyard which secured to an anchor point in the inside of the bucket), he entered the bucket and raised it about 16 feet from ground level to a position adjacent to where the cables running across the roadway intersected the cables running parallel with the roadway. As the victim was occupied judging the height of the cables, a tractor-trailer attempted to drive under the outstretched cables. The top of the trailer caught the cables, which were about 13 feet 6 inches above ground at that point, and pushed them toward the victim. The cable contacted the victim's abdomen and knocked him out of the bucket, causing him to fall to the concrete roadway below. The local emergency medical squad (EMS) responded 5 minutes after notification by a paramedic who had witnessed the incident and provided first aid to the victim. The victim was transported by the EMS to a local hospital. He was later transported to a trauma center, where he died the following day.

CAUSE OF DEATH

The death certificate listed the cause of death as internal hemorrhage.

RECOMMENDATIONS/DISCUSSION

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 company had provided appropriate fall protection equipment on the aerial truck, a safety belt and lanyard to be secured to an anchor point inside the bucket. However, the victim was not wearing the safety equipment while inside the bucket as required by the Code of Federal Regulations 1926.556(b)(2)(v), which states "A body belt shall be worn and a lanyard attached to the boom or basket when working from the an aerial lift." Employers should ensure that workers follow established procedures for wearing fall protection equipment. Use of fall protection equipment may not have prevented the victim from being thrown out of the bucket, but it could have prevented his falling to the concrete roadway.

Recommendation #2: Employers should review and revise, where applicable, existing safety programs.

Discussion: Although the employer had a written safety program, there were no specific procedures regarding the management of traffic at jobsites. Prior to the incident, a temporary detour had been established around the jobsite by two workers. If the detour had been maintained by the workers, the incident may have been prevented. Consideration should be given to the review and possible revision of safety programs to include provisions that address all facets of traffic control at jobsites.

Recommendation #3: 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 incident, the victim boarded the aerial lift truck, entered the bucket, and raised the bucket without first donning a safety belt and lanyard and attaching it to the inside of the bucket. 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 should 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 1926.556 (b)(2)(v) Code of Federal Regulations, Washington, D.C.: U.S. Government Printing Office, Office of the Federal Register.

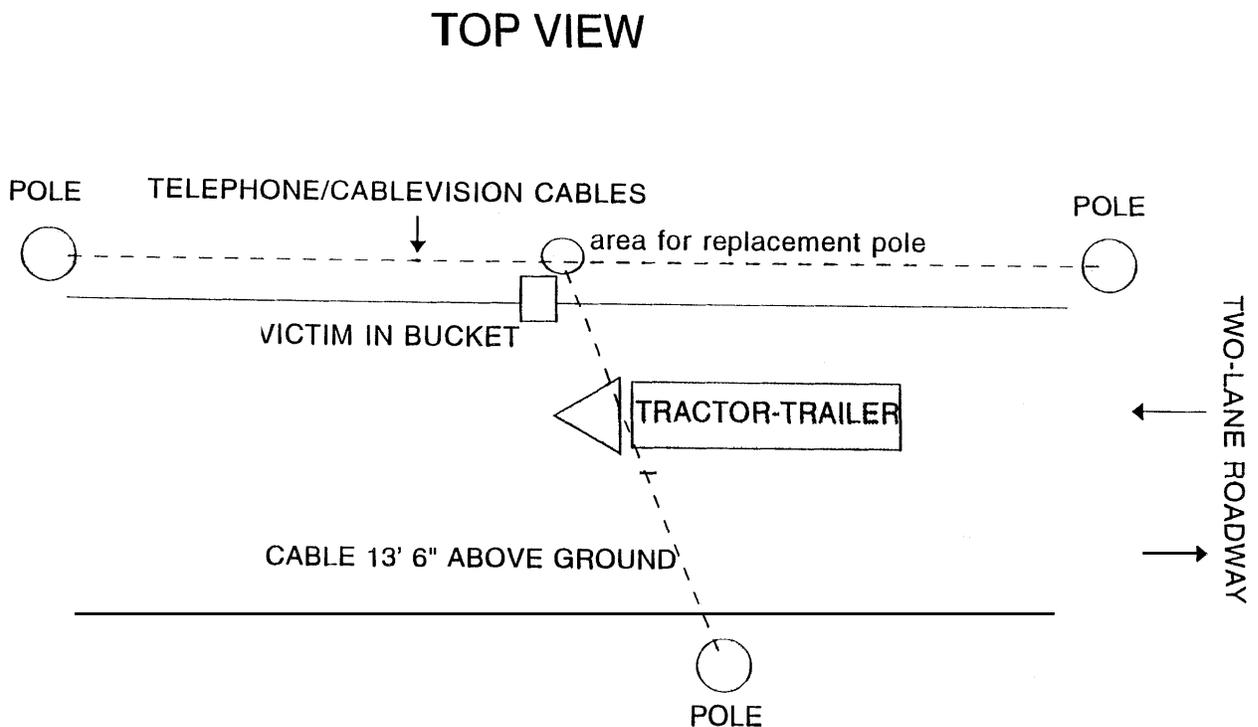


Figure. Incident Site Layout

FACE 95-20: Assistant Manager Dies After 15-Foot Fall From Forklift-Suspended Pallet—South Carolina

SUMMARY

On September 6, 1995, a 47-year-old male assistant warehouse manager (the victim) of an automotive tire and service center died after falling 15 feet from a forklift-suspended pallet and striking his head on a concrete floor. The victim was working with a forklift, pulling tires for orders and logging tire-inventory sheets. The men were pulling the tires from a section of bins, 4-bins high and 8-bins wide. The men set a 5-foot-square wooden pallet on the forks of the machine, then set a steel rack on top of the pallet to help secure the tires when loading and unloading. The steel rack was not attached to the pallet. The forklift driver then raised the victim, who was standing on the pallet but not wearing a safety belt or lanyard, to the top row of bins, approximately 16 3/4 feet above the concrete floor. The victim had placed 10 to 12 tires on the pallet when the forklift operator looked up and saw that the pallet and rack were unstable. The victim lost his balance and fell to the floor, striking his head. The forklift operator saw the victim try to stand and then saw him fall. He went to the front counter and told a worker to call the emergency medical service (EMS) then returned to the warehouse to assist the victim. The victim was found unconscious but breathing. The EMS responded within 8 minutes and transported the victim to the hospital. The victim was removed from life support 1 week later and pronounced dead. NIOSH investigators concluded that, in order to prevent similar incidents, employers should:

- *ensure that workers continually adhere to the safe work procedures that have been established by the employer*
- *provide workers with a firmly secured work surface*
- *encourage all employees to actively participate in workplace safety*
- *routinely conduct scheduled and unscheduled worksite safety inspections.*

INTRODUCTION

On June 6, 1995, a 47-year-old male assistant warehouse manager (the victim) of an automotive tire and service center died after falling 15 feet from a forklift-suspended pallet and striking his head on a concrete floor. On August 22, 1995, officials from the South Carolina Occupational Safety and Health Administration (SCOSHA) notified the Division of Safety Research (DSR) of this fatality, and requested technical assistance. On September 21, 1995, a DSR safety specialist conducted an investigation of the incident. The incident was reviewed with employer representatives and the SCOSHA compliance officer. Photographs of the scene taken immediately after the incident were reviewed during the investigation.

The employer in this incident was an auto and tire service center with a tire warehouse that had been in operation for 13 months under the present management and employed 6 workers. The company had written safe-work procedures which were presented to new employees during their orientation training. This training involved, but was not limited to, safety and environmental issues, proper use of personal protective equipment, and employee standards of conduct. Additional training was performed on the job. Forklift drivers attended company operator safety training. Warehouse managers and assistant managers completed monthly safety/quality inspection reports and were responsible for enforcing safety rules on work activities, use of PPE, and forklift safety in the warehouse. The victim had worked for the employer for 1 month. This was the first fatality experienced by the present management.

INVESTIGATION

Daily activities in the warehouse included the receipt and storage of bulk tires and auto parts. Inventory was then pulled and shipped to other stores or used to repair cars at the facility.

On the day of the incident, the victim was working with a forklift driver pulling tires for orders and logging tire inventory sheets. The men were pulling the tires from a section of bins, 4-bins high and 8-bins wide. Each bin was 5-foot-square by 67-inches high. Normal procedures directed the men to set a 5-foot-square wooden pallet on the forks of the machine, then set a steel rack measuring 5-foot-square by 69-inches high on top of the pallet to help secure the tires when loading and unloading. The pallet was not secured to the forks, nor was the steel rack secured to the pallet. After this was accomplished, the victim stood on the pallet and was raised approximately 16 3/4 feet above the concrete floor to the top row of bins by the driver. The victim was not wearing his safety belt or lanyard as required by company safety procedures.

The victim had placed 10 to 12 tires on the pallet when the driver looked up and noticed that the pallet and rack were becoming unstable as the victim reached into a bin. The pallet began to move and the victim lost his balance and fell to the floor, striking his head. The rack and tires followed the victim to the floor.

The driver saw the victim attempt to stand, then fall over, and ran to the front counter to tell a worker to call the emergency medical service (EMS). He then returned to the warehouse to assist the victim. He found the victim breathing but unconscious. The EMS personnel arrived within 8 minutes and transported the victim to the hospital. The victim was removed from life support 7 days later and declared dead.

CAUSE OF DEATH

The medical examiner listed the cause of death as skull fracture.

RECOMMENDATIONS/DISCUSSION

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

Discussion: Employers should continually stress the importance of adherence to established safe work procedures. In this instance, a safety belt and lanyard were provided, and required when work was performed above ground. During employee interviews it was learned that the workers often did not wear the safety belts and lanyards because the lanyard had to be wrapped around the forklift mast to tie off, restricting movement. Since the incident, the employer has attached an anchor point to the mast carriage that allows the employee to move freely when the lanyard is attached.

Recommendation #2: Employers should provide workers with a firmly secured work surface.

Discussion: In this incident, a pallet to be used as a work surface was placed unsecured on the forks of the lift and a steel rack was placed unsecured on the pallet. This created the potential for dislodging the pallet due to bumping by the tires when they were placed on the pallet, or uneven loading of the pallet, making the work surface unstable. In this instance, when the pallet became unstable, the victim lost his balance and fell, causing the rack and tires to fall. Since the incident, the employer has permanently anchored the rack to the pallet with bolts, providing for a more stable work surface. Additionally, 29 CFR 1926.602

(c)(1)(viii)(A) requires that whenever a truck is equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriage or forks for lifting personnel, a safety platform firmly secured to the lifting carriage and/or forks shall be used as an additional precaution for the protection of the personnel being elevated. Although this regulation pertains to construction activities, all work platforms should be secured to forklift forks to ensure worker safety.

Recommendation #3: Employers should encourage all employees 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, a supervisor, stepped on the pallet without attaching his lanyard, in violation of established safety rules. 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.

Recommendation #4: Employers should routinely conduct scheduled and unscheduled worksite safety inspections.

Discussion: Employers should be aware of any potential hazards or unsafe work conditions or practices in the workplace and should take an active role to eliminate them. Scheduled and unscheduled safety inspections should be conducted by a competent person¹ to ensure that the workplace is 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.

REFERENCES

29 CFR 1926.602 (c)(1)(viii)(A) 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.