Fall Hazard Awareness for the Construction Industry

alliance
An OSHA Cooperative Program

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Course Outline

Course Objectives

Introduction

Identifying Fall Hazards

- Scaffolds
- Ladders
- Roofs

Analyzing Fall Hazards

Preventing Fall Hazards

OSHA Resources Addressing Fall Hazards

Summary and Closing

Appendices

COURSE OBJECTIVES

The goal of this course is to provide small construction employers and employees with information on recognizing potential fall hazards at their work sites and suggest ways to avoid, minimize, control or prevent them whenever possible. Specifically, this course will:

- Identify factors that contribute to common fall hazards.
- Explain how to analyze work areas for fall hazards.
- Discuss hierarchy of controls for fall hazards.
- Describe OSHA regulations and resources addressing fall protection.

INTRODUCTION

We have all heard the expression - 'it's not the fall that's hurts but the sudden stop at the end'. Think of a fall as *"…a sudden, unanticipated descent in space driven by gravity".* Although this may not *sound* severe, the consequences are often disabling - or deadly. It takes most people about 1/3 of a second to become aware of a fall. It takes another 1/3 of a second for the body to react. A person can fall up to 7 feet in 2/3 of a second.

Each year in the U.S. falls consistently account for the greatest number of fatalities in the construction industry. In 2004, the Bureau of Labor Statistics (BLS) reported that 1,224 construction workers died on the job, with 36 percent of those fatalities resulting from falls. In addition, the cost of care for injuries related to falls is a financial burden for the entire construction industry.

Events surrounding fall accidents often involve a number of factors, including unstable working surfaces, misuse of fall protection equipment, environmental factors and human error. Studies have shown that the use of guardrail systems, fall arrest systems, safety nets, covers, and restraint and positioning device systems can prevent many deaths and injuries from falls.

In this course, we will look at some of the factors that cause fall accidents and fatalities in the construction industry. We will also look at how to analyze the work area for fall hazards and provide suggestions to prevent fall accidents, injuries and fatalities.

This course is designed to assist you in identifying, evaluating, preventing and protecting your employees from the harmful results of exposure to fall hazards at your construction work sites. This course focuses on falls to a lower level not falls to the same level resulting from slips and trips.

Identifying Fall Hazards

A fall hazard is anything in the workplace that could cause an unintended loss of balance or bodily support and result in a fall to a lower level. Fall hazards cause accidents such as the following:

- A worker walking near an unprotected leading edge trips over the edge of a protruding board.

- A makeshift scaffold collapses under the weight of four workers and their equipment.
- A worker carrying a sheet of plywood on a flat roof steps into a skylight opening.

Fall hazards are foreseeable. You can identify them, eliminate exposure to them, eliminate them or control them before they result in injuries or death. Some of the factors that contribute to fall accidents and fatalities include: scaffolds; ladders; roofs; and other elevated work surfaces.

Scaffolds - an average of 89 workers are killed from scaffolds each year. The majority of the workers injured in scaffold accidents attribute the accident to factors like the planking or support giving way, or to employees slipping or being struck by a falling object. OSHA's most frequently cited serious[1] scaffold violations include lack of fall protection; scaffold access; use of aerial lifts without body belts and lanyards, and platform construction.

Ladders - BLS data show that each year falls from ladders account for approximately 100 fatalities each year. Factors that contribute to falls from ladders are ladder slip (top or bottom), overreaching, slipping on rung/steps, defective equipment, and improper ladder selection for a given task. One of the most frequently cited OSHA ladder violation includes not securing a portable ladder or having it extend 3 feet above the landing before workers use it to reach an upper level.

Roofing - falls are the leading cause of roofing injuries and fatalities. Falls from roofs are responsible for approximately 120 deaths each year in the construction industry. Roofing, siding, and sheet metal work have the highest rate of occupational injuries and illnesses for a non-manufacturing industry. One of the most frequently cited serious OSHA violation involving roofing and fall protection is unprotected sides and edges.

Falls from a Floor (One Level to the Next) – falls to a lower level is one of the major causes of fatalities in construction. Factors such as improperly covered/protected floor holes are a common fall hazard. It is very easy to step backwards into them or step into them when carrying something that blocks one's forward view.

Review

As a review, look at these slides and see how many hazards that you can identify in the photos. Don't worry if you can't identify all of them, we will provide additional information as we proceed in this course.

[1] OSHA 's Most Frequently Cited Serious Violations in Construction – FY 2005

Analyzing Work Areas for Fall Hazards

Now that we have described some factors that may cause fall hazards, let's focus on analyzing the work area.

Analyzing the work area is another important step in fall hazard prevention. Analyzing the work area may include: reviewing blueprints before work begins; anticipating upcoming fall hazards as work progresses; reviewing current hazards on the site, and developing a pre-planning checklist.

Review Blueprints Before Work Begins

One of the first steps in analyzing the work area should be the review of the blueprints before work **ever** begins on the site. By addressing fall hazards at this stage, the employer will be better prepared to provide fall protection to the employees. The following are suggestions to assist employers in identifying those areas to address.

- At any stage of the job will there be unprotected sides/edges, floors, roof, vertical faces, and open sided floors where a fall hazard exists, if so, here are some options:
  - Change sequence to remove hazards or exposures
  - Restrict employees from area
  - Can guardrails be used?
  - Can safety nets be used?
  - If guardrails or nets cannot be used, will personal fall arrest or restraining systems, controlled accessed zones, monitoring systems, warning line systems, and positioning device systems be employed?

- Will employees be exposed to floor, or roof opening? If so, will protection be provided?

- Is there the possibility of employees being struck by falling objects, if so, will protection be provided?

- Are scissors or aerial lifts required? And is there a system in place to ensure proper inspection and maintenance of these systems?

- Are operations such as sheathing, roofing, HVAC installation, etc., addressed ahead of time in order to provide fall protection?

- Is there a fall protection system in place for the installation of exterior sheathing such as:
    - Vertical life lines
    - Other work methods such as installation from aerial lifts

- Are there structural member adequate to meet the requirements for anchor points with personal fall arrest systems?

- Additionally, unique fall hazards should be addressed before any exposure.

Anticipate Upcoming Fall Hazards as Work Progresses

The safety director or site fall protection competent person never wants to be caught off guard with surprise hazards or exposures. To avoid, what is known as putting out fires, these individuals must always be prepared. One method is to review the job for the fall hazards that will be present in the future. The following should assist in addressing this issue:

1. Review the blueprints for upcoming processes/hazards.

2. Discuss the work process with the project manager, superintendents, architect and workers to identify where new hazards may develop.

3. Ask the foreman for assistance in recognizing what hazards may develop in the future.

Review for Current Hazards on Site

If the job has already progressed beyond the point where review of the blueprints will not be effective, then the site must be reviewed for current hazards. The review for current hazards will allow the fall protection competent person to address the fall exposures in order to eliminate or minimize the hazard.

Pre-Planning Checklist

An important aspect of fall hazard prevention is planning. An assessment of all fall hazards, even *potential* fall hazards, must be done before appropriate corrective measures are considered. In addition, a fall hazard assessment can also determine training needs and fall rescue methods.

If proper planning isn't done at the onset, time and materials will be wasted and, consequently, unexpected costs will rise. More importantly, fatalities and severe injuries have resulted from simply not making the time or effort to effectively identify and control fall hazards.

The following is a checklist to assist you in your efforts to pre-plan for fall prevention/protection and can be used at any stage of the construction process. It is preferable that this checklist be used before any designing or work begins to be most effective in eliminating falls and related hazards.

1. Begin the process by identifying those areas where exposure to falls will or already do exist such as:

    - Scaffolds
    - Ladders
    - Roof (low/steep sloped) and roof openings including skylights
    - Open sided floors and floor openings
    - Structural framing
    - Bridge building
    - Aerial lift platforms
    - Permanent and temporary working platform
    - Excavations
    - Leading edge
    - Overhand bricklaying
    - Hoist areas
    - Ramps, runways and walkways
    - Wall opening
    - Stairways
    - Working over dangerous equipment
    - Potential for falling objects
    - Formwork
    - Installation of exterior sheeting/siding
    - Precast and lift slab erection
    - Housekeeping concerns

2. Do you or the contractor have a written fall protection program?

3. If the work has not begun, or is in progress, have you surveyed the jobsite to identify where/what the fall hazards are on the job?

4. Review the blueprints for fall hazards that are present and likely to develop into a hazard.

5. Is it possible to provide or install fall prevention/protection measures before there is an exposure? Some possible examples include:

a. Install guardrails before allowing workers on the floor.
b. Install safety nets, stanchions, lifelines to structural steel before members are lifted into place.
c. Don't cut floor opening until prepared to fill with specified object.
d. Sheath exterior walls before standing on upper levels.
e. Attach a self-retracting lanyard to the top of a column before standing the column.

6. If possible, specify fall prevention/protection measures when ordering materials, some examples include:

   a. Order stair systems, ramps or walkways with guardrails included.
   b. Have the architect locate, specify, design and have installed adequate anchor points for personal fall arrest systems.
   c. Order structural steel members with holes for required perimeter cable rail system.

7. Is there a competent person on site for fall protection?

   - Does the person understand the fall protection standard, trained to select the proper fall protection measures/systems, and understand the differences between the following systems and their use:

     - Fall prevention.
     - Fall protection.
     - Active fall protection.
     - Passive fall protection.

8. Will there be a need for a qualified person? For example, in the development of a job built horizontal lifeline system.

9. Are subcontractors selected on their ability to safely complete the task with a proven track record of providing effective fall protection?

10. Were requirements for fall protection measures on the site made clear to all contractors in contracts and at pre-job and pre-bid meetings?

11. Is there an adequate fall protection-training program in place to train employees in the fall protection measures/systems in place on the site?

12. For personal fall arrest systems, are anchor points identified and capable of supporting 5,000 pounds per worker or two times the intended impact load (determined by a qualified person)? Additionally, have swing hazards been addressed in the anchor point location?

13. Has an enforcement policy been established, and if so, is it communicated universally, accepted and enforced?

14. Have fallen worker rescue methods and procedures been addressed?

15. Are employees selected and trained to work at heights safely?

16. Have other work methods been proposed or implemented such as:

    a. Connecting steel or concrete from aerial or scissor lifts.
    b. Assembling structures on the ground and lifting them into place, minimizing exposure.
    c. Installing safety nets under work level or self-retracting lanyards, vertical and horizontal lifelines materials to be hoisted aloft before the pieces leave the ground and workers are exposed.
    d. Installing clamp-on guardrails around roof edge instead of using a warning line system.

17. Have free fall considerations been addressed including:

    a. Total free fall clearances are adequate for system in use.
    b. Employees will not strike lower objects in the event of a fall.
    c. Employees will not be exposed to forces greater than 1,800 foot pounds in a full body harness

Review

Again let's review briefly review what we discussed about analyzing the work area, look at these slides, could exposure to these hazards been prevented by analyzing the work area? Explain.

Fall Hazard Prevention

The hierarchy[2] of fall hazard control includes: elimination of fall hazards, prevention of falls, and control of falls.

Elimination of fall hazards is the first and best line of defense against falls from heights. This requires a careful assessment of the workplace and the work process itself. The idea is to combine safety and health into the work process, and not simply try to add safety as an afterthought to an inherently unsafe work procedure.

The prevention of fall hazards is the second line of defense when fall hazards cannot be entirely eliminated. This involves making changes to the workplace to preclude the need to rely on the employee's behavior, and personal protective equipment to prevent falls. Examples include use of stairs, guardrails, and barriers to prevent the employee from direct and unprotected exposure to the fall hazard. These techniques prevent the fall before the onset.

Control of falls is the last line of defense. It should be considered only after determining that the fall hazard cannot be eliminated or prevented. Fall controls include fall protection such as safety nets or harnesses, and fall arrests. These controls reduce the risk of injury resulting from a fall.

Look at this slide, is this the correct order for fall protection.

The following eight step approach not only focuses on actual or potential fall hazards that may be anticipated but also allows an evaluation strategy of fall prevention rather than fall protection.

An Eight Step Approach to Fall Protection

Step 1 Determine walking/working surfaces are structurally safe

Step 2 Conduct a fall hazard assessment

Step 3 Eliminate the need for fall protection, if possible

Step 4 Select the appropriate type of fall protection system

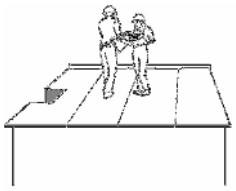
[2] Fall Awareness in Construction Education and Training, Construction Education Foundation, OSHA Grant 46C-HT10.

Step 5 Develop rescue/retrieval procedures

Step 6 Develop an equipment inspection, maintenance and storage program

Step 7 Provide fall protection training

Step 8 Monitor the fall protection program



Step 1 Determine if walking/working surfaces are structurally sound

Does the walking/working surface have the strength and structural integrity to safely support all employees and their equipment?

- Consider older buildings or buildings with wooden roofs
- Consider during demolition work

Employees should not be permitted to work on building roofs and other walking/working surfaces until the employer has determined that the surfaces are structurally sound.

Step 2 Conduct a Fall Hazard Assessment

Fall hazards are present everywhere simply because any walking or working surface can provide them. In addition, many workers are working at various levels of elevation increasing the severity of injury.

Knowing what can immediately contribute to a fall can help in assessing the risk. Working near unguarded edges, roofing on a steep pitch, lacking safe access, or walking on a slippery surface are some common examples. A fall hazard assessment greatly helps identify and evaluate these physical fall hazards.

- Determine which specific jobs, activities or areas expose employees to fall hazards
- Determine the type of work performed
- Determine if employees will be exposed to any of the following:
    - Unprotected sides and edges
    - Leading edges
    - Floor holes
    - Wall openings and hoisting areas
    - Slippery surfaces
    - Formwork or reinforcing steel
    - Ramps, runways and other walkways
    - Portable ladders and stairways
    - Excavations
    - Working above dangerous equipment
    - Obstructions (materials)
    - Overhead bricklaying and related work
    - Roofing work (low-slope and steep)
    - Precast concrete erection
    - Aerial lifts
    - Scaffolds
- Determine the frequency the work is being performed
- Determine if workers require horizontal and/or vertical movement
- Determine the number of workers exposed to a fall hazard (other trades)
- Determine the type of walking/working surface
- Determine the distance to lower levels
- Determine if the edge of the building or the working surface is protected by a guardrail system or parapet wall. If yes, is it adequate?
- Determine if employees could be exposed to other types of health and/or safety hazards. Can it affect selection or use of fall protection systems?

The person conducting the assessment should have some education and/or relevant experience in order to recognize and evaluate all fall hazards. Furthermore, this person should also have practical knowledge and understanding of OSHA's fall protection standard (1926, Subpart M) and other related fall protection requirements.

This person is called a **competent person**. A competent person is someone who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are hazardous or dangerous to employees, **and** has authorization to take prompt corrective measures to eliminate them.

Various sources of information can be used when conducting the hazard assessment including:

- Survey employees exposed to the fall hazards
- Survey affected supervisors & managers
- Review previous inspections
- OSHA 300 & 301 records
- Injury and incident reports
- Safety committee minutes

Remember - involving employees and supervisors in the hazard assessment is essential. They can provide valuable information about where and when fall protection is necessary and ideas to possibly eliminate or better prevent fall hazards. Obtaining their input will also encourage employees and supervisors to take ownership.

Step 3 Eliminate the Need for Fall Protection if Possible

If the hazard assessment indicates the need for fall protection, the next step is to determine if the fall hazard(s) can be eliminated through engineering controls and/or alternative work methods.

- Redesign the process or job task
- Work at lower heights
- Use equipment that prevents fall hazards
    - platforms that provide built-in fall protection
- Use tool extensions and work from ground level
- Lower equipment and tools to ground level
- Use appropriate aerial lifts

- Design buildings and other walking/working surfaces to eliminate/reduce exposure
- Use equipped contractors

Planning Comes First!

Eliminate

– Work from ground
– Walls/enclosures
– Covers

Prevent

– Railings
– Aerial lifts
– Fences/barricades
– Parapets

Arrest

– Personal fall arrest systems
– Personal fall restraint systems
– Nets
– Positioning devices
– Roof brackets/slide guards

Control

– Safety monitors
– Warning lines
– Controlled decking zones
– Positioning devices
– Roof brackets/slide guards
– Controlled decking zones

Step 4 Select the Appropriate Type of Fall Protection System

Prevention vs. Protection

A textbook definition of fall protection could read: "A method to prevent a person from falling or by reducing the distance of a fall to limit physical damage." Most would agree the first part of the above definition addresses fall prevention and is the more preferred strategy.

However, reality shows us prevention methods are not always available and in many situations fall protection is our only option. If the fall hazards cannot be eliminated, the next approach is to select the appropriate fall protection system.

Of course, no single fall protection system provides adequate fall protection for all job activities. As the type of system will vary from job to job, we must always assess each job and activity to determine the proper type of fall protection.

Consider the following factors when selecting fall protection systems:

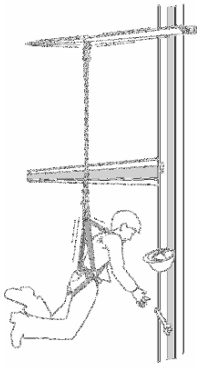
- The distance to lower levels
- The types of activities requiring fall protection and the specific requirements of each activity
- The specific types of equipment and components needed with each fall protection
- How much vertical and horizontal movement employees will need to perform each activity
- Environmental conditions (i.e. wind, rain, extreme heat/cold) in which fall protection equipment will be used
- The potential difficulty of using fall protection systems to perform normal and/or non-routine job activities
- The need for anchorage points of suitable design and strength
- The presence of chemical, electrical, and welding hazards
- How employees will recover or be rescued from fallen positions
- The presence of sharp or rough surfaces and edges

Fall Protection Systems and Methods

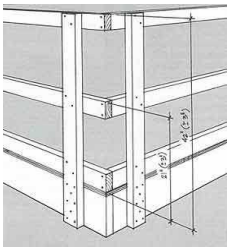
A fall protection system refers to equipment designed to control fall hazards. All fall-protection systems either **prevent** a fall from occurring or safely **arrest** a fall. Typical fall protection systems include the following:

- Personal fall-arrest systems
- Guardrail systems
- Safety-net systems
- Fall restraint system
- Positioning-device systems
- Warning-line systems
- Safety-monitoring systems
- Controlled-access zones

Personal fall-arrest systems – consists of an anchor, connectors, and a body harness that work together to stop one from falling and to minimize the arrest force. Other system components may include a lanyard, a deceleration device, and a lifeline. However, the personal fall-arrest system is effective only if you know how all of the components work together to arrest the fall.

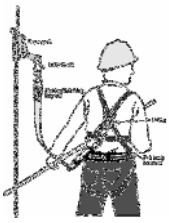


Guardrail systems are vertical barriers consisting of top rails, midrails, and intermediate vertical members. Guardrail systems can also be combined with toe-boards, which are barriers that prevent materials and equipment from dropping to lower levels.



Safety net systems consist of mesh nets, panels, and connecting components. They are typically used as protection for those who work 25 feet or more above lower levels.

Fall-restraint system consists of an anchor, connectors, and a body harness or a body belt. Unlike the personal fall-arrest system (designed to stop a fall), the fall-restraint systems prevent a fall. The fall-restraint system's anchor must support at least 3,000 pounds. Otherwise, it must be designed, installed, and used under the supervision of a qualified person.



Position-device system enables the worker to work with both hands free on a surface such as a wall or other vertical structure. They are typically used as protection for concrete form work and placing rebar. The difference between a positioning-device system and a personal fall-arrest system is that the positioning device system supports the worker on an elevated surface and limits a fall to two feet.

Warning-line systems consist of ropes, wires or chains, and supporting stanchions that form a barrier to warn those who approach an unprotected roof side or edge. The lines mark off an area which one can do roofing work without using guardrails or safety nets.

Safety-monitoring system is a set of procedures assigned to a competent person for monitoring or warning workers who may be unaware of fall hazards. Safety-monitoring systems are appropriate for roofing operations on low-slope roofs less than 50 feet wide. A safety monitoring system used in conjunction with a controlled access zone and a fall-protection plan is also appropriate in situations where conventional fall protection is not feasible.

Controlled-access zones is a work area designated and clearly marked in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems – guardrail, personal arrest or safety net – to protect the employees working in the zone.

Step 5 Develop Rescue/Retrieval Procedures

When using a personal fall arrest system, employers must provide for prompt rescue in case of a fall or assure that employees are able to rescue themselves. Rescue comes down to planning and preparing. Some important points to consider:

- Train your rescuers in rescue techniques and practice rescue attempts
- Ensure available equipment is readily available
- Arrange and communicate with other contractors on site
- Arrange and communicate with outside services, if available
- Designate someone to summon them upon arrival
- Plan a route and establish lines of communication

Step 6 Develop an equipment inspection, maintenance and storage program

First and foremost, when it comes to equipment inspection and maintenance - follow manufacturer's recommendations!

All fall protection equipment, including harnesses, lanyards, and other connectors must be visually inspected before each use.

Inspect for:

- Cuts, tears, rips, snags, punctures, abrasions, mold, or stretching
- Alterations or additions which might effect the system's efficiency
- Damage caused by acids, corrosives
- Distorted hooks or faulty hook springs
- Cracked, broken, or deformed D-Ring, carabiners, grommets, and snaphooks
- Loose, damaged or non-functioning mountings and parts
- Wearing or any internal deterioration in the ropes
- Color fading possibly indicating UV exposure

Periodic inspections by a competent person for wear, damage, or corrosion should be a part of your safety inspection program.

Defective equipment must be immediately taken out of service and tagged/marked as unusable, or destroyed. Do not return to use until a competent person determines no damage was done. ***Best Practice - destroy when subjected to any significant damage or loading.***

Basic care of the equipment will prolong the durable life and will contribute toward the performance of its vital safety function. Proper storage and maintenance after use are as important as the pre-use inspections.
Clean the equipment of dirt, corrosives, or other contaminants. Storage areas should be clean, dry, and free from exposure to fumes or corrosive elements. Synthetic materials should always be away from strong sunlight and extreme temperatures which could degrade the materials (color fading may indicate UV exposure).

Step 7 Provide fall protection training

Each employee who may be exposed to fall hazards must be trained on how to recognize fall hazards and the procedures they need to follow to minimize these hazards.

The construction standard requires the person providing the training be a "competent person" qualified in the following:

- Nature of fall hazards in work area
- Correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems
- Use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems
- The limitations on the use of mechanical equipment during the performance of roofing work on low-slope roofs
- Correct procedures for the handling and storage of equipment and materials and the erection of overhead protection
- Employees role in fall protection plans
- The Subpart standards

Bottom line: The trainer must be knowledgeable of fall protection systems and his/her ability to train employees on how to recognize fall hazards and how to properly use, inspect and maintain fall protection equipment.

Training must be provided whenever:

- Employees are assigned to work where fall hazards exist
- Responsibilities change or new methods are used
- There is a new fall hazard
- The fall protection program is inadequate
- Additional training is necessary
- Employees have not acquired or retained adequate understanding

The standard does not specify the required length or format of the training program. Consider both classroom instruction and hands-on training on the proper use of the fall protection equipment.

Employers must prepare a written certification that identifies the employee. It must contain:

- Name of the employee(s)
- Dates (s)
- Signature of the trainer or employer

See **Appendix A** for a sample training certification form.

Step 8 Monitor the Fall Protection Program

Continuously monitor the effectiveness of the program to ensure that the required elements are being followed by supervisors and employees at the jobsite.

The following are suggested ways to monitor a fall protection program:

- Conduct periodic inspections to ensure that employees are properly using fall protection
- Take immediate corrective action including the use of disciplinary action
- Conduct a formal audit of the entire fall protection program at least annually
  - Document and communicate the results of the audit to everyone
  - Compare the results with previous audits
- Conduct a formal audit of the entire fall protection program at least annually
- Conduct periodic inspections of equipment storage areas
- Require employees to notify their supervisor if they have any problems with the use and/or maintenance of their equipment
- Require employee to notify their supervisor if they are involved in any fall incident/accident
  - Promptly and thoroughly investigate and document
- Hold managers/supervisors accountable for their crew.

Reward your efforts - Promote your fall protection plan!

Managers, supervisors, and other staff personnel need to actively promote the proper use of fall protection equipment and encourage employee involvement and support of the program.

The following are suggested ways to promote a fall protection program

- Provide positive feedback to employees who use fall protection properly

- Display posters and distribute information sheets to employees who reinforce the importance of fall protection
- Conduct safety meetings with employees about fall protection
- Respond in a timely matter to suggestions for improving the program and/or equipment
- Encourage union representatives and safety committee members to actively support the program
- Collect and distribute "success stories" about injuries prevented by the use of fall protection
- Formally recognize employees, supervisors, and all involved!

Review

We have covered a lot of material in this section. Let's review some of the concept of the eight step approach to fall protection by having participants do the case studies on fall prevention that are provided in the Appendix. Have participants discuss and analyze these case studies using the guidelines in the eight step approach. Have available various types of fall protection equipment to help in the analysis and discussion. Participants may want to try on and discuss the features of this equipment.

OSHA Resources Addressing Fall Protection

There is a variety of information and resources on fall protection that is available at OSHA's website, www.osha.gov. Let's review some of the material that is available on the website:

Compliance Assistance – this is a fairly new web page that OSHA is providing to describe OSHA's compliance assistance efforts. It features the compliance assistance specialists and a list of compliance assistance materials including eTools, factsheets, publications, and small business tools. It provides links to the OSHA Act and regulations. It also provides a summary of OSHA's cooperative programs including Alliances, Partnerships, and Voluntary Protections. There is also a set of frequently asked questions.

Consultation Program – this is a free consultation service largely funded by OSHA where employers can: find out about potential hazards at their worksites; improve their occupational safety and health management systems; and even qualify for a one-year exemption from routine OSHA inspections. The service is delivered by state governments using well-trained professional staff. Most consultations take place on-site, though limited services away from the worksite are available.

The program is primarily targeted for smaller businesses and is completely separate from the OSHA inspection effort. In addition, no citations are issued or penalties proposed. Your name, your firm's name, and any information you provide about your workplace, plus any unsafe or unhealthful working conditions that the consultant uncovers, will not be reported routinely to the OSHA inspection staff.

Your only obligation will be to commit yourself to correcting serious job safety and health hazards -- a commitment which you are expected to make prior to the actual visit and carry out in a timely manner. Because consultation is a voluntary activity, you must request it. Your telephone call or letter sets the consulting machinery in motion. The consultant will discuss your specific needs with you and set up a visit date based on the priority assigned to your request, your work schedule, and the time needed for the consultant to adequately prepare to serve you.

Electronic Compliance Assistance Tools (eTools) - eTools are "stand-alone," interactive, web-based training tools on occupational safety and health topics. There are construction eTools on preventing fatalities, scaffolding, and steel erection. The eTools can be downloaded and printed.

Laws and Regulations – this web page has for example, OSHA's regulations including the OSHA Act, OSHA regulations, interpretations of the regulations, *Federal Register*, and compliance directives. OSHA's fall protection regulations are found in the 1926 Construction Standard, particularly subparts, L, M, R, and X. Other fall protection requirements are found in the 1910 General Industry Standards.

My OSHA – this web page helps you create a personalized link to OSHA online resources. You choose the content to personalize your own OSHA page. You choose from a pre-selected link (such as Construction or General Industry) to customized your page.

Sample Programs – There are various sample programs available on the website. There is a sample fall protection program. The sample programs provide examples of written programs. The programs are not intended to supersede the requirements in OSHA standards. You should consult the applicable OSHA standards for the specific requirements applicable to your workplace. You can use these sample programs as guidance when developing your own customized program.

Safety and Health Topics– there are over 160 plus subject-specific pages on: industries, hazards and controls. Several topic pages are devoted to fall protection including gone for construction and general industries, These pages provide links to OSHA information such as standards, directives, training

materials, etc. In addition there are links government agencies, trade associations, etc.

Small Business - this page provides access to the most popular materials for small businesses, from free on-site consultation to interactive computer software to technical information to easy-to-follow guides for specific OSHA standards. It also includes links to OSHA local offices and the Small Business Administration.

Training Resources – this page provides information on OSHA training. It includes the schedule and catalog courses offered by the OSHA Training Institute in Arlington Heights, Illinois; information about the OSHA Training Institute Education Centers; training materials; and information about other OSHA training initiatives such as the outreach program and training grants.

You are encouraged to refer to the OSHA website frequently about the latest information on fall hazards and prevention.

Review

As a review of this section, show participants the OSHA website. Show them how to access the information. Point out some of the pages listed below. Let them demonstrate how to find information related to fall hazards. Ask them do they have questions about this site. Encourage them to go the website frequently since it is often updated with new information.

Course Summary and Closing

In this course, we have provided the following information to you:

- Identified factors that contribute to common fall hazards.
- Explained how to analyze work areas for fall hazards.
- Discussed the hierarchy of controls for fall hazards.
- Describe OSHA regulations and resources addressing fall protection.

We hope that this information will help you prevent fall accidents and injuries at your worksite. Additional information is provided in the **Appendices** to this course. Good luck and thanks for your participation.

APPENDICES

APPENDIX A

Overview of Subpart M, Fall Protection

INTRODUCTION

In the construction industry in the U.S., falls are the leading cause of worker fatalities. Each year, on average, between 150 and 200 workers are killed and more than 100,000 are injured as a result of falls at construction sites. OSHA recognizes that accidents involving falls are generally complex events frequently involving a variety of factors. Consequently the standard for fall protection deals with both the human and equipment-related issues in protecting workers from fall hazards. For example, employers and employees need to do the following:

- Where protection is required, select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Use safe work procedures.
- Train workers in the proper selection, use, and maintenance of all protection systems.

SCOPE AND APPLICATION

OSHA has revised its construction industry safety standards (29 Code of Federal Regulations, Subpart M, Fall Protection, 1926.500, 1926.501, 1926.502, and 1926.503) and developed systems and procedures designed to prevent employees from falling off, onto, or through working levels and to protect employees from being struck by falling objects (Federal Register, August 9, 1994, pp. 40672-40753). The performance-oriented requirements make it easier for employers to provide the necessary protection.

The rule covers most construction workers except those inspecting, investigating, or assessing workplace conditions prior to the actual start of work or after all work has been completed.

The rule identifies areas or activities where fall protection is needed. These include, but are not limited to, ramps, runways, and other walkways; excavations; hoist areas; holes; formwork and reinforcing steel; leading edge work; unprotected sides and edges; overhand bricklaying and related work; roofing work; precast concrete erection; wall openings; residential construction; and other walking/working surfaces. The rule sets a uniform threshold height of 6 feet (1.8 meters), thereby providing consistent protection. This means that construction employers must protect their employees from fall hazards and falling objects whenever an affected employee is 6 feet (1.8 meters) or more above a lower level. Protection must also be provided for construction workers who are

exposed to the hazard of falling into dangerous equipment.

Under the new standard, employers will be able to select fall protection measures compatible with the type of work being performed. Fall protection generally can be provided through the use of guardrail systems, safety net systems, personal fall arrest systems, positioning device systems, and warning line systems, among others.

The OSHA rule clarifies what an employer must do to provide fall protection for employees, such as identifying and evaluating fall hazards and providing specific training. Requirements to provide fall protection for workers on scaffolds and ladders and for workers engaged in steel erection of buildings arc covered in other subparts of OSHA regulations.

PROVISIONS OF THE STANDARD

The new standard prescribes the duty to provide fall protection, sets the criteria and practices for fall protection systems, and requires training. It covers hazard assessment and fall protection and safety monitoring systems. Also addressed are controlled access zones, safety nets, and guardrail, personal fall arrest, warning line, and positioning device systems.

DUTY TO HAVE FALL PROTECTION

Employers are required to assess the workplace to determine if the walking/working surfaces on which employees are to work have the strength and structural integrity to safely support workers. Employees are not permitted to work on those surfaces until it has been determined that the surfaces have the requisite strength and structural integrity to support the workers. Once employers have determined that the surface is safe for employees to work on, the employer must select one of the options listed for the work operation if a fall hazard is present.

For example, if an employee is exposed to falling 6 feet (l .8 meters) or more from an unprotected side or edge, the employer must select a guardrail system, safety net system, or personal fall arrest system to protect the worker. Similar requirements are prescribed for other fall hazards as follows.

Controlled Access Zones

A controlled access zone is a work area designated and clearly marked in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems—guardrail, personal arrest or safety net—to protect the employees working in the zone.

Controlled access zones are used to keep out workers other than those

authorized to enter work areas from which guardrails have been removed. Where there are no guardrails, masons are the only workers allowed in controlled access zones.

Controlled access zones, when created to limit entrance to areas where leading edge work and other operations are taking place, must be defined by a control line or by any other means that restrict access. Control lines shall consist of ropes, wires, tapes or equivalent materials, and supporting stanchions, and each must be:

- Flagged or otherwise clearly marked at not more than 6-foot (1.8 meters) intervals with high-visibility material;
- Rigged and supported in such a way that the lowest point (including sag) is not less than 39 inches (1 meter) from the walking/working surface and the highest point is not more than 45 inches (1.3 meters)—nor more than 50 inches (1.3 meters) when overhand bricklaying operations are being performed—from the walking/working surface;
- Strong enough to sustain stress of not less than 200 pounds (0.88 kilonewtons). Control lines shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.
- Control lines also must be connected on each side to a guardrail system or wall.

When control lines are used, they shall be erected not less than 6 feet (1.8 meters) nor more than 25 feet (7.6 meters) from the unprotected or leading edge, except when precast concrete members are being erected. In the latter case, the control line is to be erected not less than 6 feet (1.8 meters) nor more than 60 feet (18 meters) or half the length of the member being erected, whichever is less, from the leading edge.

Controlled access zones when used to determine access to areas where overhand bricklaying and related work are taking place are to be defined by a control line erected not less than 10 feet (3 meters) nor more than 15 feet (4.6 meters) from the working edge. Additional control lines must be erected at each end to enclose the controlled access zone. Only employees engaged in overhand bricklaying or related work are permitted in the controlled access zones.

On floors and roofs where guardrail systems are not in place prior to the beginning of overhand bricklaying operations, controlled access zones will be enlarged as necessary to enclose all points of access, material handling areas, and storage areas. On floors and roofs where guardrail systems are in place, but need to be removed to allow overhand bricklaying work or leading edge work to take place, only that portion of the guardrail necessary to accomplish that day's

work shall be removed.

Excavations

Each employee at the edge of an excavation 6 feet (1.8 meters) or more deep shall be protected from falling by guardrail systems, fences, barricades, or covers. Where walkways are provided to permit employees to cross over excavations, guardrails are required on the walkway if it is 6 feet (1.8 meters) or more above the excavation.

Formwork and Reinforcing Steel

For employees, while moving vertically and/or horizontally on the vertical face of rebar assemblies built in place; fall protection is not required when employees are moving. OSHA considers the multiple hand holds and foot holds on rebar assemblies as providing similar protection as that provided by a fixed ladder; consequently, no fall protection is necessary while moving point to point for heights below 24 feet (7.3 meters). An employee must be provided with fall protection when climbing or otherwise moving at a height more than 24 feet (7.3 meters), the same as for fixed ladders.

Hoist Areas

Each employee in a hoist area shall be protected from falling 6 feet (1.8 meters) or more by guardrail systems or personal fall arrest systems. If guardrail systems (or chain gate or guardrail) or portions thereof must be removed to facilitate hoisting operations, as during the landing of materials, and a worker must lean through the access opening or out over the edge of the access opening to receive or guide equipment and materials, that employee must be protected by a personal fall arrest system.

Holes

Personal fall arrest systems, covers, or guardrail systems shall be erected around holes (including skylights) that are more than 6 feet (1.8 meters) above lower levels.

Leading Edges

Each employee who is constructing a leading edge 6 feet (1.8 meters) or more above lower levels shall be protected by guardrail systems, safety net systems, or personal fall arrest systems. If the employer can demonstrate that it is infeasible or creates a greater hazard to implement these systems, he or she must develop and implement a fall protection plan that meets the requirements of 29 CFR 1926.502(k).

Overhand Bricklaying and Related Work

Each employee performing overhand bricklaying and related work 6 feet (1.8 meters) or more above lower levels shall be protected by guardrail systems, safety net systems, or personal fall arrest systems, or shall work in a controlled access zone. All employees reaching more than 10 inches (25 cm) below the level of a walking/working surface on which they are working shall be protected by a guardrail system, safety net system, or personal fall arrest system.

Precast Concrete Erection and Residential Construction

Each employee who is 6 feet (1.8 meters) or more above lower levels while erecting precast concrete members and related operations such as grouting of precast concrete members and each employee engaged in residential construction, shall be protected by guardrail systems, safety net systems, or personal fall arrest systems. Where the employer can demonstrate, however, that it is infeasible or creates a greater hazard to use those systems, the employer must develop and implement a fall protection plan that meets the requirements of 29 CFR 1926.502(k).

Ramps, Runways, and Other Walkways

Each employee using ramps, runways, and other walkways shall be protected from falling 6 feet (1.8 meters) or more by guardrail systems.

Roofing

Low-slope Roofs

Each employee engaged in roofing activities on low-slope roofs with unprotected sides and edges 6 feet (1.8 meters) or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems or a combination of a warning line system and guardrail system, warning line system and safety net system, warning line system and personal fall arrest system, or warning line system and safety monitoring system. On roofs 50 feet (15.24 meters) or less in width, the use of a safety monitoring system without a warning line system is permitted.

Steep Roofs

Each employee on a steep roof with unprotected sides and edges 6 feet (1.8 meters) or more above lower levels shall be protected by guardrail systems with toeboards, safety net systems, or personal fall arrest systems.

Wall Openings

Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet (1.8 meters) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 meter) above the walking/working surface must be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system.

FALL PROTECTION SYSTEMS CRITERIA AND PRACTICES

Guardrail Systems

If the employer chooses to use guardrail systems to protect workers from falls, the systems must meet the following criteria. Toprails and midrails of guardrail systems must be at least one-quarter inch (0.6 centimeters) nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for toprails, it must be flagged at not more 6 feet intervals (1.8 meters) with high-visibility material. Steel and plastic banding cannot be used as toprails or midrails. Manila, plastic, or synthetic rope used for toprails or midrails must be inspected as frequently as necessary to ensure strength and stability.

The top edge height of toprails, or (equivalent) guardrails must be 42 inches (1.1 meters) plus or minus 3 inches (8 centimeters), above the walking/working level. When workers are using stilts, the top edge height of the top rail, or equivalent member, must be increased an amount equal to the height of the stilts.

Screens, midrails, mesh, intermediate vertical members, or equivalent intermediate structural members must be installed between the top edge of the guardrail system and the walking/working surface when there are no walls or parapet walls at least 21 inches (53 centimeters) high. When midrails are used, they must be installed at a height midway between the top edge of the guardrail system and the walking/working level. When screens and mesh are used, they must extend from the top rail to the walking/working level and along the entire opening between top rail supports. Intermediate members, such as balusters, when used between posts, shall not be more than 19 inches (48 centimeters) apart.

Other structural members, such as additional midrails and architectural panels, shall be installed so that there are no openings in the guardrail system more than 19 inches (48 centimeters).

The guardrail system must be capable of withstanding a force of at least 200 pounds (890 newtons) applied within 2 inches of the top edge in any outward or downward direction. When the 200 pound (890 newtons) test is applied in a downward direction, the top edge of the guardrail must not deflect to a height

less than 39 inches (1 meter) above the walking/working level.

Midrails, screens, mesh, intermediate vertical members, solid panels, and equivalent structural members shall be capable of withstanding a force of at least 150 pounds (667 newtons) applied in any downward or outward direction at any point along the midrail or other member.

Guardrail systems shall be surfaced to protect workers from punctures or lacerations and to prevent clothing from snagging.

The ends of top rails and midrails must not overhang terminal posts, except where such overhang does not constitute a projection hazard.

When guardrail systems are used at hoisting areas, a chain, gate, or removable guardrail section must be placed across the access opening between guardrail sections when hoisting operations are not taking place.

At holes, guardrail systems must be set up on all unprotected sides or edges. When holes are used for the passage of materials, the hole shall have not more than two sides with removable guardrail sections. When the hole is not in use, it must be covered or provided with guardrails along all unprotected sides or edges.

If guardrail systems are used around holes that are used as access points (such as ladderways), gates must be used or the point of access must be offset to prevent accidental walking into the hole.

If guardrails are used at unprotected sides or edges of ramps and runways, they must be erected on each unprotected side or edge.

Personal Fall Arrest Systems

These consist of an anchorage, connectors, and a body belt or body harness and may include a deceleration device, lifeline, or suitable combinations. If a personal fall arrest system is used for fall protection, it must do the following:

- Limit maximum arresting force on an employee to 900 pounds (4 kilonewtons) when used with a body belt;
- Limit maximum arresting force on an employee to 1,800 pounds (8 kilonewtons) when used with a body harness;
- Be rigged so that an employee can neither free fall more than 6 feet (1.8 meters) nor contact any lower level;
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07 meters); and

- Have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet (1.8 meters) or the free fall distance permitted by the system, whichever is less.

As of January 1, 1998, the use of a body belt for fall arrest is prohibited.

Personal fall arrest systems must be inspected prior to each use for wear damage, and other deterioration. Defective components must be removed from service. Dee-rings and snaphooks must have a minimum tensile strength of 5,000 pounds (22.2 kilonewtons). Dee-rings and snaphooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kilonewtons) without cracking, breaking, or suffering permanent deformation.

Snaphooks shall be sized to be compatible with the member to which they will be connected, or shall be of a locking configuration.

Unless the snaphook is a locking type and designed for the following connections, they shall not be engaged (a) directly to webbing, rope or wire rope; (b) to each other; (c) to a dee-ring to which another snaphook or other connecter is attached; (d) to a horizontal lifeline; or (e) to any object incompatible in shape or dimension relative to the snaphook, thereby causing the connected object to depress the snaphook keeper and release unintentionally.

OSHA considers a hook to be compatible when the diameter of the dee-ring to which the snaphook is attached is greater than the inside length of the snaphook when measured from the bottom (hinged end) of the snaphook keeper to the inside curve of the top of the snaphook. Thus, no matter how the dee-ring is positioned or moved (rolls) with the snaphook attached, the dee-ring cannot touch the outside of the keeper, thus depressing it open. As of January 1, 1998, the use of nonlocking snaphooks is prohibited.

On suspended scaffolds or similar work platforms with horizontal lifelines that may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline.

Horizontal lifelines shall be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall arrest system that maintains a safety factor of at least two. Lifelines shall be protected against being cut or abraded.

Self-retracting lifelines and lanyards that automatically limit free fall distance to 2 feet (0.6 l meters) or less shall be capable of sustaining a minimum tensile load of 3,000 pounds (13.3 kilonewtons) applied to the device with the lifeline or lanyard in the fully extended position.

Self-retracting lifelines and lanyards that do not limit free fall distance to 2 feet (0.61 meters) or less, ripstitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kilonewtons) applied to the device with the lifeline or lanyard in the fully extended position.

Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body belts and body harnesses shall be made of synthetic fibers.

Anchorages shall be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall arrest system that maintains a safety factor of at least two, i.e., capable of supporting at least twice the weight expected to be imposed upon it. Anchorages used to attach personal fall arrest systems shall be independent of any anchorage being used to support or suspend platforms and must be capable of supporting at least 5,000 pounds (22.2 kilonewtons) per person attached.

Lanyards and vertical lifelines must have a minimum breaking strength of 5,000 pounds (22.2 kilonewtons).

Positioning Device Systems

These body belt or body harness systems are to be set up so that a worker can free fall no farther than 2 feet (0.6 meters). They shall be secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds (13.3 kilonewtons), whichever is greater. Requirements for snaphooks, dee-rings, and other connectors used with positioning device systems must meet the same criteria as those for personal fall arrest systems.

Safety Monitoring Systems

When no other alternative fall protection has been implemented, the employer shall implement a safety monitoring system. Employers must appoint a competent person to monitor the safety of workers and the employer shall ensure that the safety monitor:

- Is competent in the recognition of fall hazards;
- Is capable of warning workers of fall hazard dangers and in detecting unsafe work practices;
- Is operating on the same walking/working surfaces of the workers and can see them;
- Is close enough to work operations to communicate orally with workers and has no other duties to distract from the monitoring function.

Mechanical equipment shall not be used or stored in areas where safety monitoring systems are being used to monitor employees engaged in roofing operations on low-sloped roofs.

No worker, other than one engaged in roofing work (on low-sloped roofs) or one covered by a fall protection plan, shall be allowed in an area where an employee is being protected by a safety monitoring system.

All workers in a controlled access zone shall be instructed to promptly comply with fall hazard warnings issued by safety monitors.

Safety Net Systems

Safety nets must be installed as close as practicable under the walking/working surface on which employees are working and never more than 30 feet (9.1 meters) below such levels. Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. The maximum size of each safety net mesh opening shall not exceed 36 square inches (230 square centimeters) nor be longer than 6 inches (15 centimeters) on any side, and the openings, measured center-to-center, of mesh ropes or webbing, shall not exceed 6 inches (15 centimeters). All mesh crossings shall be secured to prevent enlargement of the mesh opening. Each safety net or section shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds (22.2 kilonewtons). Connections between safety net panels shall be as strong as integral net components and be spaced no more than 6 inches (15 centimeters) apart.

Safety nets shall be installed with sufficient clearance underneath to prevent contact with the surface or structure below.

When nets are used on bridges, the potential fall area from the walking/working surface to the net shall be unobstructed.

Safety nets must extend outward from the outermost projection of the work surface as follows:

Vertical distance from working level to horizontal plane of net.	Minimum required horizontal distance of outer edge of net from the edge of the working surface**.**
Up to 5 feet (1.5 meters)	8 feet (2.4 meters)
More than 5 feet (1.5 meters) up to 10 feet (3 meters)	10 feet (3 meters)
More than 10 feet (3 meters)	13 feet (3.9 meters)

Safety nets shall be capable of absorbing an impact force of a drop test consisting of a 400-pound (180 kilogram) bag of sand 30 inches (76 centimeters) in diameter dropped from the highest walking/working surface at which workers are exposed, but not from less than 42 inches (1.1 meters) above that level.

Items that have fallen into safety nets including—but not restricted to, materials, scrap, equipment, and tools—must be removed as soon as possible and at least before the next work shift.

Warning Line Systems

Warning line systems consist of ropes, wires, or chains, and supporting stanchions and are set up as follows:

- Flagged at not more than 6-foot (1.8 meters) intervals with high-visibility material;
- Rigged and supported so that the lowest point (including sag) is no less than 34 inches (0.9 meters) from the walking/working surface and its highest point is no more than 39 inches (1 meter) from the walking/working surface.
- Stanchions, after being rigged with warning lines, shall be capable of resisting, without tipping over, a force of at least 16 pounds (71 newtons) applied horizontally against the stanchion, 30 inches (0.8 meters) above the walking/working surface, perpendicular to the warning line and in the direction of the floor, roof, or platform edge;
- The rope, wire, or chain shall have a minimum tensile strength of 500 pounds (2.22 kilonewtons) and after being attached to the stanchions, must support without breaking, the load applied to the stanchions as prescribed above.
- Shall be attached to each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in the adjacent section before the stanchion tips over.

Warning lines shall be erected around all sides of roof work areas. When mechanical equipment is being used, the warning line shall be erected not less than 6 feet (1.8 meters) from the roof edge parallel to the direction of mechanical equipment operation, and not less than 10 feet (3 meters) from the roof edge perpendicular to the direction of mechanical equipment operation.

When mechanical equipment is not being used, the warning line must be erected not less than 6 feet (1.8 meters) from the roof edge.

Covers

Covers located in roadways and vehicular aisles must be able to support at least twice the maximum axle load of the largest vehicle to which the cover might be subjected. All other covers must be able to support at least twice the weight of

employees, equipment, and materials that may be imposed on the cover at any one time. To prevent accidental displacement resulting from wind, equipment, or workers' activities, all covers must be secured. All covers shall be color coded or bear the markings "HOLE" or "COVER."

PROTECTION FROM FALLING OBJECTS

When guardrail systems are used to prevent materials from falling from one level to another, any openings must be small enough to prevent passage of potential falling objects. No materials or equipment except masonry and mortar shall be stored within 4 feet (1.2 meters) of working edges. Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear of the working area by removal at regular intervals.

During roofing work, materials and equipment shall not be stored within 6 feet (1.8 meters) of a roof edge unless guardrails are erected at the edge, and materials piled, grouped, or stacked near a roof edge must be stable and self-supporting.

Canopies

When used as protection from falling objects canopies must be strong enough to prevent collapse and to prevent penetration by any objects that may fall onto them.

Toeboards

When toeboards are used as protection from falling objects, they must be erected along the edges of the overhead walking/working surface for a distance sufficient to protect persons working below. Toeboards shall be capable of withstanding a force of at least 50 pounds (222 newtons) applied in any downward or outward direction at any point along the toeboard. Toeboards shall be a minimum of 3.5 inches (9 centimeters) tall from their top edge to the level of the walking/working surface, have no more than 0.25 inches (0.6 centimeters) clearance above the walking/working surface, and be solid or have openings no larger than l inch (2.5 centimeters) in size.

Where tools, equipment, or materials are piled higher than the top edge of a toeboard, panelling or screening must be erected from the walking/working surface or toeboard to the top of a guardrail system's top rail or midrail, for a distance sufficient to protect employees below.

TRAINING

Employers must provide a training program that teaches employees who might be exposed to fall hazards how to recognize such hazards and how to minimize them. Employees must be trained in the following areas: (a) the nature of fall hazards in the work area; (b) the correct procedures for erecting, maintaining, disassembling,

and inspecting fall protection systems; (c) the use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems; (d) the role of each employee in the safety monitoring system when the system is in use; (e) the limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs; (f) the correct procedures for equipment and materials handling and storage and the erection of overhead protection; and, (g) employees' role in fall protection plans.

Employers must prepare a written certification (**see sample certification form**) that identifies the employee trained and the date of the training. The employer or trainer must sign the certification record. Retraining also must be provided when necessary

SAMPLE TRAINING CERTIFICATION

Fall Protection training Date _____ **Location** _____

Trainee certification. I have received training on the subjects listed below: This training has provided me adequate opportunity to ask questions and practice procedures to determine and correct skill deficiencies. I understand that performing these procedures/practices safely is a condition of employment. I fully intend to comply with all safety and operational requirements discussed. I understand that failure to comply with these requirements may result in progressive discipline (or corrective actions) up to and including termination.

_____ _____

Employee Name Signature Date

The following instruction was conducted:

__ Overview of the company's fall protection requirements & purpose of the fall protection program
__ Anticipated fall hazards expected in my task/work area
__ Calculating fall distances using a personal fall arrest system
__ Rescue methods when using personal fall arrest

The following procedures were practiced:

__ Donning and doffing a full body harness
__ Inspecting full body harness, lanyards, lifelines, anchor points
__ Selecting, inspecting, and maintenance of personal fall arrest and position devices
__ Use and operation of guardrail systems, personal fall arrest, safety nets, warning lines, safety monitoring system, personal fall restraint, slide guards, positioning devices, etc.
__ Correct procedures for the handling and storage of equipment and materials and the erection of overhead protection

Trainer certification. I have conducted instruction/on-the-job training to the employee listed above. I have explained related procedures, practices and policies. He/She was given the opportunity to ask questions and practice procedures taught under my supervision. Based on his/her performance, I have determined that he/she has adequate knowledge and skill to safely perform these procedures/practices.

_____ _____

Trainer Name Signature Date

Training Validation. On _____(date), I have observed the above employee successfully applying the knowledge and skills learned during the training.

_____ _____

Supervisor Name Signature Date

APPENDIX B

FALL PROTECTION CATEGORIES

All fall protection products fit into four functional categories: fall arrest; positioning; suspension; and retrieval.

Fall Arrest

A fall arrest system is required if any risk exists that a worker may fall from an elevated position, as a general rule, the fall arrest system should be used anytime a working height of six feet or more is reached. Working height is the distance from the walking/working surface to a grade or lower level. A fall arrest system will only come into service should a fall occur. A full-body harness with a shock-absorbing lanyard or a retractable lifeline is the only product recommended. A full-body harness distributes the forces throughout the body, and the shock-absorbing lanyard decreases the total fall arresting forces.

Positioning

This system holds the worker in place while keeping his/her hands free to work. Whenever the worker leans back, the system is activated. However, the personal positioning system is not specifically designed for fall arrest purposes.

Suspension

This equipment lowers and supports the worker while allowing a hands-free work environment, and is widely used in window washing and painting industries. This suspension system components are not designed to arrest a free fall, a backup fall arrest system should be used in conjunction with the suspension system.

Retrieval

Preplanning for retrieval in the event of a fall should be taken into consideration when developing a proactive fall management program.

Fall Protection Systems

Listed below are different types of fall safety equipment and their recommended usage.

Class 1	Body belts (single or double D-ring) are designed to restrain a person in a hazardous work position and to reduce the possibility of falls. They should not be used when fall potential exists; positioning only.
Class 2	Chest harnesses are used when there are only limited fall hazards (no vertical free fall hazard), or for retrieving persons such as removal of persons from a tank or a bin.
Class 3	Full body harnesses are designed to arrest the most severe free falls.
Class 4	Suspension belts are independent work supports used to suspend a worker, such as boatswain's chairs or raising or lowering harnesses.
Rope Lanyard	Offers some elastic properties for all arrest; used for restraint purpose.
Web Lanyard	Ideal for restraint purposes where fall hazards are less than 2 feet.
Cable Positioning Lanyards	Designed for corrosive or excess heat environments and must be used in conjunction with shock absorbing devices.
Shock Absorbers	When used, the fall arresting force will be greatly reduced if a fall occurs.
Rope Grabs	A deceleration device which travels on a lifeline, used to safely ascend or descend ladders or sloped surfaces and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee.
Retractable Lifeline Systems	Gives fall protection and mobility to the user when working at height or in areas where there is a danger of falling.
Safety Nets	Can be used to lesson the fall exposure when working where temporary floors and scaffolds are not used and the fall distance exceeds 25 feet.
Rail Systems	When climbing a ladder, rail systems can be used on any fixed ladder as well as curved surfaces as a reliable method of fall prevention.

Effective January 1, 1998, body belts are not acceptable as part of a personal fall arrest system. (Note: the use of a body belt in a positioning device system is acceptable and is regulated under paragraph (e) of 29 CFR 1926.502). An employee who uses a body belt as a personal fall arrest system is exposed to hazards such as falling out of the belt, serious internal injuries, and technical asphyxiation through prolonged suspension.

Inspection and Maintenance

To maintain their service life and high performance, all belts and harnesses should be inspected frequently. Visual inspection before each use should

become routine, and also a routine inspection by a competent person. If any of the conditions listed below are found the equipment should be replaced before being used.

Harness Inspection

1. Belts and Rings: For harness inspections begin at one end, hold the body side of the belt toward you, grasping the belt with your hands six to eight inches apart. Bend the belt in an inverted "U." Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage. Check D-rings and D-ring metal wear pads for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90 degree angle with the long axis of the belt and should pivot freely.

Attachments of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles. Rivets should be tight and unremovable with fingers. Body side rivet base and outside rivets should be flat against the material. Bent rivets will fail under stress.

Inspect frayed or broken strands. Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut or burnt stitches will be readily seen.

2. Tongue Buckle: Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their socket. Rollers should turn freely on the frame. Check for distortion or sharp edges.

3. Friction Buckle: Inspect the buckle for distortion. The outer bar or center bars must be straight. Pay special attention to corners and attachment points of the center bar.

Lanyard Inspection

When inspecting lanyards, begin at one end and work to the opposite end. Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention. Hardware should be examined under procedures detailed below.

Hardware

Snaps: Inspect closely for hook and eye distortion, cracks, corrosion, or pitted surfaces. The keeper or latch should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper rocks must provide the keeper from opening when the keeper closes.
Thimbles: The thimble (protective plastic sleeve) must be firmly seated in the eye

of the splice, and the splice should have no loose or cut strands. The edges of the thimble should be free of sharp edges, distortion, or cracks.

Lanyards

Steel Lanyards: While rotating a steel lanyard, watch for cuts, frayed areas, or unusual wear patterns on the wire. The use of steel lanyards for fall protection without a shock-absorbing device is not recommended.

Web Lanyard: While bending webbing over a piece of pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Due to the limited elasticity of the web lanyard, fall protection without the use of a shock absorber is not recommended.

Rope Lanyard: Rotation of the rope lanyard while inspecting from end to end will bring to light any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period. When a rope lanyard is used for fall protection, a shock-absorbing system should be included.

Shock-Absorbing Packs
The outer portion of the shock-absorbing pack should be examined for burn holes and tears. Stitching on areas where the pack is sewn to the D-ring, belt or lanyard should be examined for loose strands, rips and deterioration.

Visual Indication of Damage to Webbing and Rope Lanyards

Heat

In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed and should not be used above 180 degrees Fahrenheit.

Chemical

Change in color usually appears as a brownish smear or smudge. Transverse cracks appear when belt is bent over tight. This causes a loss of elasticity in the belt.

Ultraviolet Rays

Do not store webbing and rope lanyards in direct sunlight, because ultraviolet rays can reduce the strength of some material.

Molten Metal or Flame

Webbing and rope strands may be fused together by molten metal or flame. Watch for hard, shiny spots or a hard and brittle feel. Webbing will not support combustion, nylon will.

Paint and Solvents

Paint will penetrate and dry, restricting movements of fibers. Drying agents and solvents in some paints will appear as chemical damage.

Cleaning of Equipment

Basic care for fall protection safety equipment will prolong and endure the life of the equipment and contribute toward the performance of its vital safety function. Proper storage and maintenance after use are as important as cleaning the equipment of dirt, corrosives or contaminants. The storage area should be clean, dry and free of exposure to fumes or corrosive elements.

Nylon and Polyester

Wipe off all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather with a vigorous back and forth motion. Then wipe the belt dry with a clean cloth. Hang freely to dry but away from excessive heat.

Drying

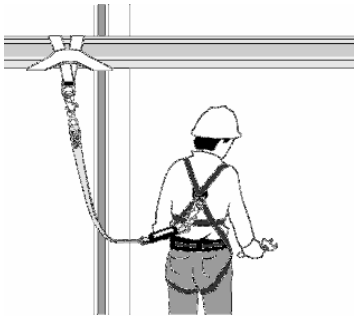
Harness, belts and other equipment should be dried thoroughly without exposure to heat, steam or long periods of sunlight.

APPENDIX C

Personal Fall Arrest Systems[3]

Anchorage

An **anchorage point** is a secure point of attachment for lifelines, lanyards, deceleration devices, or self retracting lanyards.



The anchorage point can be a single attachment to a substantial structure above the surface from which the employee is working, or it can be one to two attachments used to anchor a vertical or horizontal lifeline.

Remember - The anchorage point for fall arrest systems must be capable of supporting **5000 lb.** for each worker or used as part of a complete PFAS which maintains a safety factor of at least two and under the supervision of a qualified person.

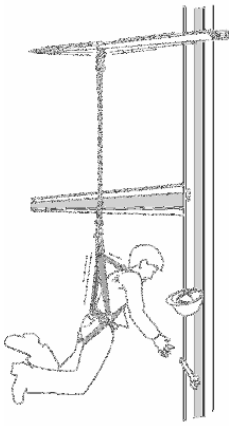
A **qualified person** is defined as one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge,

[3] Oregon OSHA Fall Protection Workshop Materials, 2004

training and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work, or the project.

Full Body Harness

The impact of the fall is imposed on the trunk of the body which distributes the maximum arresting force (MAF) to a larger area than the safety belt, reducing the potential for damage to the body.



OSHA allows a maximum of **1800 lbs.** MAF when using a full body harness. OSHA prohibits the use of a safety belt for personal fall arrest.

The attachment point (D-Ring) must be located in the center of the wearer's back near shoulder level.

Connector

Connector means a device which is used to connect parts of the PFAS and positioning devices together. Connectors include everything between your harness and anchor.

Connectors include lanyards, snaphooks, carabiners, D-Rings, lifelines, and deceleration devices.

- **Lanyards** are devices which connect the worker to the anchorage point
  - used to connect the two front D-Rings to the anchorage point for positioning
  - secured at one end to the worker's harness D-Ring and the other end to the anchorage point for fall arrest
- Lanyards must be made from synthetic material and have a minimum breaking strength of 5000 lbs.
- Only locking-type *snaphooks* and *carabiners* can be used
- The following connections are prohibited (unless the locking-type snaphook is designed for it):
  - engaged directly to webbing, rope, or wire rope
  - engaged to another snaphook
  - engaged to a D-Ring to which another snaphook/carabiner is attached
  - engaged to a horizontal lifeline
  - engaged to any object which is incompatibly shaped or dimensioned such that unintentional disengagement can occur (roll out)

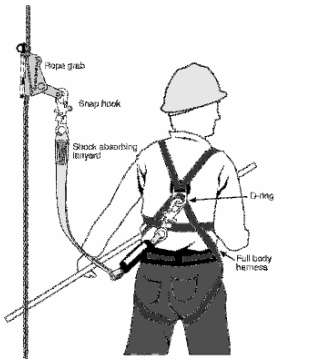
Deceleration Device

Deceleration device means any mechanism which dissipates a substantial amount of energy imposed on an employee during fall arrest. Deceleration devices include rope grabs, rip-stitch/tearing lanyards, and self-retractable lanyards.

Remember - maximum arresting forces on an employee during a fall arrest must be less than 1800 lbs.

Lifelines are flexible lines which connect to an anchorage point at one end to hang vertically, or at both ends to stretch horizontally.

Vertical lifelines are designed to be used by only one person and with a rope grab.



Horizontal lifelines can be used only as part of a complete PFAS which maintains a safety factor of at least two, **and** when designed, installed, and used under the supervision of a qualified person.

Personal Fall Arrest Systems - The Fall[4]

We have all heard the expression - 'it's not the fall that's hurts but the sudden stop at the end'. Think of a fall as *"…a sudden, unanticipated descent in space driven by gravity".* Although this may not *sound* severe, the consequences are often disabling - or deadly. The free fall velocity at impact when falling 12 feet is nearly 20 mph. Put another way, a person will hit the ground in just under one second after falling this distance.

A free fall is defined as the act of falling before a personal fall arrest system begins to apply force to arrest the fall. When a fall is experienced using a PFAS, the fall is referred to as a free fall up until the system starts to arrest the fall to stop the fall.

OSHA regulations allow no more than a **six** foot free fall distance.

When the fall does come to a complete stop, the action is referred to as the fall arrest. Tremendous force is imposed on the body during the fall arrest. This force imposed during the arrest is known as the ***arrest force***. Forces imposed in a fall greatly depend on the type of system you are using and the free fall distance.

For example: A 220 lb. worker:

Free falling 2 ft. using a wire rope lanyard (without a deceleration device) = approx. 3917 lbs.

Free falling 4 ft. using a nylon rope lanyard (without a deceleration device) = approx. 2140 lbs.

Free falling 6 ft. using a synthetic web lanyard (with a deceleration device) = <900 lbs.

OSHA sets limits on the Maximum Arrest Force (MAF). The law prohibits the use of a safety belt for fall arrest and allows a maximum of **1800 lbs.** when using a full body harness. **ARREST FORCE = the force imposed when the stop occurs.**

[4] Oregon OSHA Fall Protection Workshop Materials, 2004

APPENDIX D

Fall Job Hazard Analysis Checklists [5]

Fall Job Hazard Analysis Checklists			
Yes	**No**	**Scaffolding Checklist**	**Notes**
		1. Is a competent person present during the erection, alteration, movement, and disassembly of the scaffold system?	
		2. Are all scaffold systems inspected on a regular basis?	
		3. Are all scaffold systems erected in accordance with manufacturers' recommendations?	
		4. Is equipment being used for ways it was not intended?	
		5. Is the scaffold base erected in a firm foundation, or adequate sill/pad?	
		6. Is the scaffold system, plumb, level, rigid and square?	
		7. Are all cross/support braces properly installed?	
		8. Are all scaffolds components compatible with each other?	
		9. Are all pins, clips and locking mechanisms installed and operating correctly?	
		10. If required, is the scaffold system secure/tied to the wall or structure at the proper interval? (30' horizontal/24' vertical)	
		11. Are outriggers installed on freestanding scaffolds, which exceed 4 times their minimum base width vertically (in some states plans it is 3 times the base width), and are they locked into place?	
		12. Is a safe means of access provided to working level via a ladder, ramp, or stairway?	
		13. Are guardrails or other forms of fall provided when are exposed to falls in excess of the Subpart "L" standard?	
		14. Is the working surface properly planked/decked with scaffold grade material?	
		15. Are the working surface, guardrails, and access/egress maintained in a clean and non-slippery condition to avoid slip hazards?	
		16. Is the scaffold system overloaded?	
		17. For suspended scaffolds, are the pulley, motor, anchors and fall protection systems in place and operating correctly?	
		18. Is rigging correct on the suspended scaffold system?	
		19. Are the tiebacks sized, installed, anchored and inspected to ensure their effectiveness?	

[5] Construction Safety Council, Fall Protection Hazard Awareness Guide, 2000.

		20. Are all inspection requirements recommended by the manufacturer being performed?	
		21. Are heavy loads placed over bearing portions of the scaffold assembly, and not in the center of the work surface?	
		22. Are all defective scaffold components tagged and immediately removed from service to be repaired or destroyed?	
		23. Are employees trained on scaffold use, erection and inspection?	
Yes	**No**	**Ladders Checklist**	**Notes**
		1. Is the correct ladder for the job been used?	
		2. Are ladders inspected before use?	
		3. Are metal ladders prohibited near electrical sources?	
		4. Are stepladders being placed against the wall, in a closed position, which can cause them to slide out underneath a worker?	
		5. Are extension ladders secured at the top, and bottom if possible?	
		6. Is the extension ladder installed at the correct angle (the 1 to 4 rule)	
		7. Do side rails extend 3' above the working surface?	
		8. Are ladders being overloaded?	
		9. Is the extension ladder overloaded?	
		10. Are materials being hoisted by a line, and not by the individual climbing the ladder?	
		11. Is the three-point-contact rule being followed? (i.e., both feet and one hand or both hands and one foot)	
		12. Never allow two ladders to be tied together!	
		13. Are all damaged ladders immediately tagged and repaired or destroyed?	
		14. Are ladder feet placed on a firm foundation?	
		15. Are proper climbing/working procedures being followed?	
		16. Never allow an individual to "bounce" or walk a stepladder to move it!	
		17. Are stepladders used in the fully open position only?	
		18. Are individuals working on the correct side of a stepladder?	
		19. Are all hinges, spreaders, locks and feet on in serviceable condition?	
		20. Never allow any ladder to be used in the horizontal position as a scaffold plank or work! Platform	
		21. Are ladders with broken or missing rungs or split side rails, tagged and taken out of service or destroyed?	

		22. Are access/egress areas around the top and bottom of the ladder kept clear?	
		23. Are all ladders inspected regularly?	
		24. Are filler blocks placed between the cleats of job made ladders?	
		25. Where simultaneous two-way traffic can be inspected, is there a double cleat ladder installed?	
		26. Does the design and assembly of the job built ladder meet the requirements of ANSI Standard A14.4?	
Yes	**No**	**Roofing (Including Skylights) Checklist**	**Notes**
		1. Are all skylights/roof openings protected by covers or guardrails? Note: Most glass or plastic covers on skylights will not meet the structural requirements of a cover, check with manufacturer. To be safe, the installation of a proper cover or guardrail is recommended.	
		2. Is there a warning line in place?	
		3. Is there a safety monitor in visual/verbal range of employees?	
		4. Is all mechanical equipment kept inside the warning line?	
		5. Is the hoist area protected with a guardrail system?	
		6. Are employees below the hoist area protected from falling objects/material?	
		7. Are guardrails, safety nets or personal fall arrests systems in use on roofs that exceed a 41/2 pitch?	
		8. Are employees working on surfaces, which are hazardous because of poor footing due to frost, ice, or mildew?	
		9. Are employees working in hazardous conditions such as high winds, poor visibility or inclement weather?	
		10. Is there a safe/secure access to the roof via stairs or a secured ladder?	
Yes	**No**	**Falls From A Floor (One Level to the Next) Checklist**	**Notes**
		1. Are all holes covered with structurally appropriate, marked and secured covers?	
		2. Are all exposed edges protected with a guardrail system?	
		3. When guardrails are not installed, are personal fall arrest, safety nets or fall restraining systems in place and being used?	
		4. Are windows or wall openings, where the lower sill is below 39 inches from the walking/working surface, protected with a guardrail system?	
		5. Are removable sections of the guardrails for incoming materials replaced and structurally sound after materials are loaded?	

		6. When guardrails are removed for incoming materials, are alternate fall protection measures being used (i.e., personal fall restraint or safety nets)?	
		7. Are toe boards installed to protect employees below from falling objects?	

APPENDIX E

Fall Protection Case Studies[6]

Case Study 1 - Laborer Killed in Fall Through Roof

A 40-year old laborer/helper died when he fell through an opening in a warehouse roof. He fell approximately 27 feet to the flow below.

The employer was demolishing the roof of the warehouse portion of a commercial building. Work was done at night because the coal tar on the roof would release hazardous gases if disturbed in the heat of the day. The site had adequate halogen lighting. None of the workers on the job were using fall protection.

After the roofing material was removed, 4x8 foot sheets of plywood were exposed. Any damaged sheet needed to be replaced. The helper's job was to follow the workers who were replacing the plywood, and to pick up damaged sheets of plywood they had removed. He disposed of them in a chute.

On this evening, one worker had removed a sheet of damaged plywood, but had run out of nails to attach the replacement plywood. He walked away to get more nails. The opening where the damaged plywood had been was left unguarded. The crew was not informed that it was temporarily unguarded. The opening was covered by silver-colored insulation inside the roof.

The helper came along, picked up the sheet of damaged plywood, and headed for the chute. He stepped into the opening, ripped through the insulation, and fell.

What should have been done to prevent this accident?

Case Study 2 - Ironworker Dies After Falling Off Beam

A 42-year-old structural ironworker foreman died when he fell off a steel beam in an incomplete warehouse roof. He fell about 38 feet to the floor below.

The employer was installing the final structural beam (bar hoist) in the roof of a new cold storage warehouse under construction. After a crane lifted the beam into place, it was not quite straight and the ironworker foreman wanted to use a hammer to straighten it.

[6] These case studies are based on actual incidents that occurred in California. For details, refer to California Dept. of Health Services, Occupational Health Branch, Fatality Assessment and Control Evaluation.

The area where the foreman needed to work had been barricaded with wire rope safety lines on all four sides, but he removed these lines to gain access. He was not using fall protection equipment.

The foreman was standing on a portion of roof decking that had already been completed. To get to the beam, he reached his left foot out over an open, undecked area of the roof. He rested his left foot on the nearest joist girder. As he was preparing to strike a blow with the hammer, his foot slipped off the girder. His hands caught the bar joist, but he couldn't hold on and fell.

What should have been done to prevent this accident?

Case Study 3 – Sheet Metal Worker Dies After Fall from Ladder

A 46-year old sheet metal worker died when he fell off an 8-foot stepladder and struck his head on the edge of a metal floor plate.

The worker was doing sheet metal work on a hospital addition. He and two co-workers were adding a fire damper (a fire safety device) to previously installed metal duct.

The job was difficult, and the sheet metal worker had his right foot on the 5th step of the ladder, at a height of 4 feet, 9 inches. His left foot was on the step above. According to a co-worker, the ladder spun around and tangled his legs in the steps. He fell head first to the concrete floor, striking his head on a metal floor plate.

One co-worker said the sheet metal worker might have extended himself out too far from the ladder, or lost his balance.

What should have been done to prevent this accident?

Case Study 4 – One Killed, Three Injured in Scaffold Accident

A 29-year-old hod carrier died and three co-workers were injured when they fell from the fourth story of a pump house building that was under construction at a reservoir.

The hod carrier and other had been spraying fireproof insulation onto the structural frame of the building. They used a rolling tower scaffold to gain access to the structural steel overhead.

Putlogs (types of trusses) had been added to the sides of the rolling tower scaffold, and an extension platform had been built there. This platform was used to reach the outer side of the structural steel.

On this day, a supervisor said a guardrail was needed on the scaffold. The hod carrier joined three co-workers on the scaffold. The hod carrier joined three co-workers on the extension platform to help install the guardrail. Their combined weight caused the scaffold to tip. They were all thrown to the concrete deck 44 feet below.

The scaffold had not been engineered for the extension platform. No counterweights, anchorage, or bracing were used. Neither the hod carrier nor his co-workers were wearing personal fall protection. The scaffold and platform had been constructed using parts from different manufacturers.

What should have been done to prevent this accident?

APPENDIX F

Summary of Studies on Fall Fatalities in Construction (June 2006)

Table of Contents

I. Introduction

Falls from elevation have consistently been one of the leading causes of fatalities in the construction industry. This appendix summarizes or provides links to selected studies on this issue conducted by various government agencies and other organizations, including BLS, NIOSH, the University of Tennessee, OSHA, the National Association of Home Builders, and the Center to Protect Workers' Rights. It also summarizes a number of journal articles that include statistics and other analysis on fall fatalities and injuries in construction.

This appendix summarizes or links to selected information from existing studies and journal articles – it is not a comprehensive survey or analysis of falls in construction.

II. Bureau of Labor Statistics (BLS)

A. Fall Fatalities in Construction, 1994-2004

	Total Construction Fatalities	**Fall Fatalities***	**% fatalities from falls**
2004	1,234	445	36
2003	1,126	361	32
2002	1,125	374	33
2001	1,225	387	34
2000	1,155	374	32
1999	1,191	379	32
1998	1,174	384	33
1997	1,107	380	34
1996	1,047	419	40
1995	1,055	332	32
1994	1,028	331	32

*BLS defines "falls" to include falls on the same level, falls to a lower level, and jumps to a lower level.

B. Additional BLS Data

In 2004, there were 445 fall fatalities in construction, up significantly from 361 in 2003. In 2004, roofers suffered 94 fatalities, up from 55 in 2003.

The 2004 fall fatalities included:

- Fall from roof: 159
- Fall from roof edge: 62
- Fall through skylight: 27

- Fall from scaffolding, staging: 74
- Fall from ladder: 79
- Fall from nonmoving vehicle: 20

In 2003, 32% of construction fatalities were from falls. The percentages of fatalities from falls for the major construction industry segments were:

- Construction of buildings: 42%
- Heavy and civil engineering construction: 10%
- Specialty trade contractors: 37%

In 2001, the following were the leading causes of fatalities from falls to a lower level:

- Fall from roof: 35%
- Fall from scaffolding, staging: 17%
- Fall from ladder: 17%
- Fall from building girder: 9%
- Fall from floor, dock, or ground level to lower level: 6%
- Other: 17%

In 2001, falls were the leading cause of fatalities in the following construction occupations:

- Laborers: 27% of fatalities from falls
- Carpenters: 63%
- Roofers: 73%
- Structural metal workers: 88%
- Painters: 55%
- Welders and cutters: 30%

For more information, see BLS's Web site at: http://www.bls.gov/bls/safety.htm.

III. National Institute for Occupational Safety and Health (NIOSH)

A. Worker Death by Falls (2000)

Citation: Worker Death by Falls: A Summary of Surveillance Findings and Investigative Case Reports, NIOSH Publication No. 2000-116 (Sept. 2000). See http://www.cdc.gov/niosh/00-116pd.html.

Summary: The report summarizes surveillance data and investigative reports of fatal work-related falls from elevation. Data source: NIOSH's National Traumatic Occupational Fatalities (NTOF) surveillance system. The study provides an overview of fall hazards, identifies common risk factors and exposures, and recommended elements for an effective fall prevention program. The report also includes summaries of all 90 Fatality Assessment and Control Evaluation (FACE) fall investigation reports prepared by NIOSH between 1982 and 1997.

B. NIOSH Alerts

NIOSH has issued several Alerts concerning falls in construction, including:

1. Alert: Preventing Falls of Workers through Skylights and Roof and Floor Openings, NIOSH Publication No. 2004-156 (Aug. 2004). See http://www.cdc.gov/niosh/docs/2004-156/.

2. Alert: Preventing Injuries and Deaths From Falls During Construction and Maintenance of Telecommunication Towers, NIOSH Publication No. 2001-156 (July 2001). See http://www.cdc.gov/niosh/2001156.html.

3. Alert: Preventing Worker Injuries and Deaths Caused by Falls From Suspension Scaffolds, NIOSH Publication No. 92-108 (Aug. 1992). See http://www.cdc.gov/niosh/92-108.html.

C. Worker Health Chartbook (2004)

Citation: Worker Health Chartbook, 2004, NIOSH Publication No. 2004-146. See http://www.cdc.gov/niosh/docs/chartbook/.

Summary: The Chartbook is a descriptive epidemiologic reference on occupational morbidity and mortality in the United States. It includes a section on the construction trades. (See Chapter 4 at http://www2a.cdc.gov/niosh-Chartbook/ch4/ch4-2.asp.) This section includes detailed information on workplace fatalities and injuries/illnesses for the following trades: brickmasons, carpenters, drywall installers, electricians, ironworkers, laborers, operating engineers, painters, plumbers, roofers, truck drivers, and welders and cutters.

IV. University of Tennessee Annual Analysis of Construction Fatalities

The Construction Industry Research and Policy Center at the University of Tennessee prepares annual reports entitled “An Analysis of Fatal Events in the Construction Industry.” The reports are funded by OSHA and use IMIS data supplied by OSHA. They analyze all OSHA-inspected fatal construction accidents, including fatalities in state plan states.

The reports are available at:
http://bus.utk.edu/cirpc/Research/ConstructionFatalityReports.htm

According to the report, falls have consistently been the leading cause of construction fatalities. In 2004, the study analyzed 785 fatalities. The following

were the number and percentage of fatalities from various classifications of falls in 2004:

- Fall from/through roof: 109 fatalities (13.8% of construction fatalities)
- Fall from/with structure (other than roof): 63 fatalities (8.0%)
- Fall from/with ladder: 41 fatalities (5.2%)
- Fall through opening (other than roof): 26 fatalities (3.3%)
- Fall from/with scaffold: 24 fatalities (3.1%)
- Fall from/with platform or catwalk: 20 fatalities (2.3%)
- Fall from /with bucket (aerial lift/basket): 15 fatalities (1.9%)
- Fall, other or unknown: 3 fatalities (0.4)
- Fall from highway vehicle/construction equipment: 2 fatalities (0.3%)

These figures are similar to the averages for 1991-2003, which are:

- Fall from/through roof: 71.3 fatalities (11.3% of construction fatalities)
- Fall from/with structure (other than roof): 52.8 fatalities (8.4%)
- Fall from/with ladder: 25.8 fatalities (4.1%)
- Fall from/with scaffold: 21.2 fatalities (3.4%)
- Fall through opening (other than roof): 16.6 fatalities (2.6%)
- Fall from/with platform or catwalk: 14.4 fatalities (2.3%)
- Fall from /with bucket (aerial lift/basket): 13.2 fatalities (2.1%)
- Fall from highway vehicle/construction equipment: 5.4 fatalities (0.9%)
- Fall, other or unknown: 4.7 fatalities (0.7%)

V. National Association of Home Builders Study

Citation: Residential Construction Fall Fatality Study, NAHB, 1998.
Data source: OSHA IMIS database: all fatal falls in the construction industry from 1992 to 1995.

Summary: NAHB commissioned this study to determine whether a significant number of falls regulated under 29 CFR 1926, Subpart M occur in residential construction relative to non-residential construction or construction as a whole. The study found that of those fatal falls regulated under Subpart M, 22% occurred in residential construction. From 1992 to 1995, the fall fatality rate for residential construction was 7.8 per million workers, while for non-residential construction it was 19.8 per million workers. The study concluded that the risk of death from a fall regulated under Subpart M is significantly lower on residential sites compared with non-residential sites.

The report also includes breakdowns of fatalities by SIC code (residential and non-residential), fatalities by state, fall fatalities and single-family building permits by state, and employment in residential construction.

VI. Center to Protect Workers' Rights

CPWR is the research, development, and training arm of the Building and Construction Trades Department, AFL-CIO. CPWR has done several studies related to construction falls, including the following.

Center to Protect Workers' Rights, "The Construction Chart Book, Third Edition (Sept. 2002). See http://www.cpwr.com/chartbook.htm.

McCann M, "Causes of Roofer Deaths" (1999). See http://www.cpwr.com/pulications/krroofers.PDF.

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VII. Journal Articles

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APPENDIX G

Glossary

“Anchorage" means a secure point of attachment for lifelines, lanyards or deceleration devices, and which is independent of the means of supporting or suspending the employee.

"Body belt" means a strap with means both for securing it about the waist and for attaching it to a lanyard. Lifeline or deceleration device.

"Body harness" means a design of straps which may be secured about the employee in a manner to distribute the fall arrest forces over at least the thighs, pelvis. waist, chest and shoulders with means for attaching it, to other components of a personal fall arrest system.

"Buckle" means any device for holding the body belt or body harness closed around the employee's body.

"Competent person" means a person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as in their application and use with related equipment.

"Connector" means a device which is used to couple (connect) parts of the system together. It may be an independent component of the system (such as a carabiner), or an integral component of part of the system (such as a buckle or dee-ring sewn into a body belt or body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

“Controlled access zone “ is a work area designated and clearly marked in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems – guardrail, personal arrest or safety net – to protect the employees working in the zone.

"Deceleration device" means any mechanism, such as a rope grab, ripstitch lanyard, specially woven lanyard, tearing or deforming lanyard, or automatic self retracting-lifeline/lanyard, which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on an employee during fall arrest.

"Deceleration distance" means the additional vertical distance a falling employee travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body belt or body harness attachment point at the moment of activation (at the onset of fall

arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.

"Equivalent" means alternative designs materials or methods which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials or designs specified in the standard.

"Free fall" means the act of falling before the personal fall arrest system begins to apply force to arrest the fall.

"Free fall distance" means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, lifeline and lanyard elongation but include any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.

"Lanyard" means a flexible line of rope, wire rope, or strap which is used to secure the body belt or body harness to a deceleration device, lifeline, or anchorage.

"Lifeline" means a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

"Personal fall arrest system" means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these.

"Qualified person" means 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.

"Rope grab" means a deceleration device which travels on a lifeline and automatically frictionally engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/lever locking, or both.

"Self-retracting lifeline/lanyard" means a deceleration device which contains a drum wound line which may be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

"Snap-hook" means a connector comprised of a hookshaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object. Snap-hooks are generally one of two types:

1. The locking type with a self-closing, self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection, or

2. The non-locking type with a self-closing keeper which remains closed until pressed open for connection or disconnection.

"Tie-off' means the act of an employee, wearing personal fall protection equipment, connecting directly or indirectly to an anchorage. It also means the condition of an employee being connected to an anchorage.

APPENDIX H

References

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