

Construction Focus Four: Fall Hazards

Instruction for this session:

1. Ask the class if they can give an example of a hazard on a construction site that could cause a worker to fall. Discuss the examples with the class. Be sure that examples of the most common fall hazards (from unprotected edges, openings, scaffolds and ladders) are covered.
2. Discuss “Content” section.
3. Show PowerPoint® presentation with photos of fall hazards and have the class identify the hazards shown. Note: Slides with answers follow each hazard slide.
4. If time permits, conduct one of the following small group activities:
 - **Personal Fall Arrest Demonstration** – If the equipment is available, demonstrate the proper use of a personal fall arrest system, using the Personal Fall Arrest Checklist as a guide. (Refer to Appendix B)
 - **Ladder Safety Exercise** - Have the class read the Ladder Safety scenario, break into groups to answer the questions, and then discuss their answers with the entire class. (Refer to Appendix C)
5. Conduct the lesson test and discuss answers with the students

Topic 1: What is a fall hazard?

- A. Definition
- B. Examples
- C. Statistics

NOTES:

As an alternative, trainers can use their own photos in the hazard recognition presentation. If the presentation is used as provided, the trainer can use the activity files provided to add interactivity by having the students involved in note taking. To conduct the activity, locate and print the PDF files titled:
PPTinstrHazRecAlt_Falls_April2011.pdf and
PPTstudentHazRecAlt_Falls_April2011.pdf
Distribute copies of the “PPTstudentHazRecAlt_Falls_April2011.pdf” to the class.

Locate instructor and student copies of test in Appendix A.

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Content for Topic 1:

A. Definition

Fall hazards are present at most worksites and many workers are exposed to these hazards on a daily basis. A fall hazard is anything at your worksite that could cause you to lose your balance or lose bodily support and result in a fall. Any walking or working surface can be a potential fall hazard.

Any time you are working at a height of four feet or more, you are at risk. OSHA generally requires that fall protection be provided at four feet in general industry, five feet in maritime and **six feet in construction**. However, regardless of the fall distance, fall protection must be provided when working over dangerous equipment and machinery. The importance of fall protection cannot be stressed enough.

B. Examples

Fall hazard incidents are injuries produced by impact between the injured person and the source of injury when the motion producing contact was generated by gravity.

Fall hazards in construction cause accidents such as the following:

- A makeshift scaffold collapsed under the weight of four workers and their equipment, seriously injuring all four.
- A worker carrying a sheet of plywood on a flat roof stepped into a skylight opening and fell to the level below.
- A roofer, while attempting to remove a roof opening cover, fell approximately 21 feet to the concrete floor below and was killed.
- A construction worker was working from a carpenters' wall bracket scaffold without fall protection. The worker fell 19 feet to the ground, sustained blunt trauma to the head and later died.

NOTES:

Falls from heights are the leading cause of fatalities in construction, while falls on the same level (slips and trips) are one of the leading causes of injuries. This lesson focuses on falls from heights.

On scaffolds, fall protection is required at 10 feet.

In steel erection, workers on walking/working surfaces with unprotected sides or edges above 15 feet must be protected. (There are some exceptions for connectors and workers working in controlled decking zones for heights between 15 and 30 feet. See 1926.760)

Examples recorded as Falls:

- Falls from elevation or ground level to lower levels
- Falls through existing floor or roof openings (skylights, etc.)
- Falls through the floor or roof surface (floor/roof collapses)
- Fall on same level (point of contact was same level supporting individual)
- Jumps from structures and equipment

Provide examples of accidents related to the type of work your audience does. You can locate accident summaries on OSHA's website. Go to: <http://www.osha.gov/pls/imis/accidentsearch.html>

Within the keyword field, enter a keyword. For example, to obtain accident investigations involving scaffolds, enter the keyword scaffold. To view a list of key words, use the keyword list at the bottom of the Accident Investigation Search page.

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C. Statistics

BLS found the leading causes of worker deaths in the construction industry were: falls, struck-by object, caught-in or -between, and electrocution. These "Fatal [Focus] Four" were responsible for nearly three out of five (59%) construction worker deaths in 2009, BLS reports. In 2009, falls accounted for more than one-third of fatal occupational injuries in construction (34%). Nearly half (48%) of all fatal falls in private industry involved construction workers.

Data from a long-term study indicates the types of falls that are causing worker deaths. In the period 1992-2005, about one-third of the fatal falls in construction were from roofs, 18% were from scaffolding or staging, 16% were from ladders, and 8% were from girders or structural steel. The other 25% of fatal falls includes falls through existing floor openings, from nonmoving vehicles, from aerial lifts, etc.

Occupational fatalities caused by falls are a serious concern. This lesson will help you identify fall hazards at construction worksites so that you can be protected.

NOTES:

According to BLS, average hours worked at the national level fell by one percent in 2008, and some industries that have historically accounted for a significant share of worker fatalities, such as construction, experienced larger declines in employment or hours worked.

For the most current statistical data, or for more detail, see: <http://www.bls.gov/iif/>

The study data is from The Construction Chart Book, CPWR, The Center for Construction Research and Training, 4th edition.

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Topic 2. What are the major types of fall hazards in construction?

- A. Unprotected roof edges, roof and floor openings, structural steel and leading edges, etc.
 - Major hazards related to unprotected roof edges, roof and floor openings, structural steel and leading edges
 - Examples of accidents related to unprotected roof edges, roof and floor openings, structural steel and leading edges
- B. Improper scaffold construction
 - Major hazards related to scaffolds
 - Examples of accidents related to scaffolds
- C. Unsafe portable ladders
 - Major hazards related to ladders
 - Examples of accidents related to ladders

Content for Topic 2

Some of the working conditions that contribute to fall hazards include: unprotected edges of elevated work surfaces, including roofs; scaffolds; and ladders.

A. Unprotected roof edges, roof/floor openings, structural steel & leading edges

Major hazards:

Almost all sites have unprotected sides and edges, wall openings, or floor holes at some point during construction. If these sides and openings are not protected at your site, injuries from falls or falling objects may result, ranging from sprains and concussions to death.

Falls to a lower level are a major cause of fatalities in construction. Factors such as improperly covered or protected floor holes and openings are a common fall hazard. It's easy to step into a hole or opening when carrying something that blocks one's forward view.

NOTES:

For additional information on falls from elevations, see:

Preventing Fatal Falls in Construction, OSHA Page
<http://www.osha.gov/doc/falls/preventingfalls.html>

Falls from Elevations, NIOSH page
<http://www.cdc.gov/niosh/topics/falls/>

Aerial Lifts OSHA Quick Card (also available in Spanish)
http://www.osha.gov/OshDoc/data/HurricaneFacts/aerial_lifts_safety.pdf

Many fall hazards could be prevented by designing the hazards out. See:
<http://www.designforconstructionafety.org/>

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Roofing falls are the leading cause of roofing injuries and fatalities. 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 violations involving roofing and fall protection is unprotected sides and edges.

Workers involved in steel erection are exposed to fall hazards. According to *The Construction Chart Book* (CPWR, December, 2007), more ironworkers are killed from falls than workers in any other construction occupation. The rate of work-related deaths among ironworkers is 10 times higher than the construction average. The most frequently cited serious OSHA violations involving steel erection are fall protection, fall hazard training and fall protection for connectors.

Examples of accidents related to unprotected roof edges, roof and floor openings, structural steel and leading edges.



Classroom Exercise Roofs, Leading Edge, etc. Accidents

Discuss the following accidents and how each could have been prevented.

- An ironworker was standing on a tilt-up concrete wall, throwing out bridging. He was wearing a harness and lanyard but was not tied-off. He fell 30 feet to the ground and sustained crushing injuries to his spine, resulting in permanent paralysis below the chest.
- A worker was working on a second-story roof, which was stripped off of the original roofing clay tile, felt paper and existing skylights. He was preparing the roof for installation of new materials. While working, he stepped through the removed skylight opening, which was covered only with felt paper. He fell approximately 24 feet to a ceramic tile covered concrete floor and was hospitalized with a head fracture.

NOTES:

Go to: <http://www.osha.gov/pls/imis/accidentsearch.html> and search by keyword for additional examples.

The accident could have been prevented if the ironworker was properly tied off.

Holes, including skylights, must have covers that are capable of supporting, without failure, at least twice the weight of employees, equipment and materials that may be imposed on the cover at any one time.

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B. Improper scaffold construction

Major hazards:

Working with heavy equipment and building materials on the limited space of a scaffold is difficult. Without fall protection or safe access, it becomes hazardous. Falls from improperly constructed scaffolds can result in injuries ranging from sprains to death. Guardrails or personal fall arrest systems for fall prevention/protection are required for workers on platforms **10 feet** or higher.

The majority of the workers injured in scaffold accidents attribute the accident to factors like the planking or support giving way, or to lack of guardrails or other fall protection. OSHA's most frequently cited serious scaffold violations include lack of fall protection; scaffold access; use of aerial lifts without body belts and lanyards, platform construction and no worker training.



Classroom Exercise Scaffold Accidents

Discuss the following accidents and how each could have been prevented.

- A construction worker was working from a carpenters' wall bracket scaffold without fall protection. The worker fell 19 feet to the ground, sustained blunt trauma to the head, and later died.
- A worker preparing masonry fascia for removal from a building fell from the third level of a tubular welded-frame scaffold. No guarding system was provided for the scaffold. Further, the platform was coated with ice, creating a slippery condition.

NOTES:

For additional information on scaffolds, see:
Supported Scaffold Safety Tips
OSHA Quick Card
http://www.osha.gov/OshDoc/data_Hurricane_acts/supported_scaffold_tips.pdf

Supported Scaffold Inspection Tips
OSHA Quick Card
http://www.osha.gov/OshDoc/data_Hurricane_Facts/supported_scaffold_tips2.pdf

Go to: <http://www.osha.gov/pls/imis/accidentsearch.html> and search by keyword for additional examples

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C. Unsafe portable ladders

Major hazards:

You risk falling if a portable ladder is not safely positioned each time you use one. While you are on a ladder, it may move and slip from its supports. You can also lose your balance while getting on or off an unsteady ladder. Falls from ladders can cause injuries ranging from sprains to death.

BLS data show that falls from ladders account for over 100 fatalities each year. Factors that contribute to falls from ladders are ladder slip (top or bottom), overreaching, slipping on rungs/steps, defective equipment and improper ladder selection for a given task. Frequently cited OSHA ladder violations include not having a portable ladder extend 3 feet above the landing, no worker training, and improper use of the top of stepladders.



Classroom Exercise Portable Ladder Accidents

Discuss the following accidents and how each could have been prevented.

- A worker was climbing a 10 foot ladder to access a landing, which was 9 feet above the adjacent floor. The ladder slid down, and the worker fell to the floor, sustaining fatal injuries. Although the ladder had slip-resistant feet, it was not secured and the railings did not extend 3 feet above the landing.
- A worker fell approximately 11 feet from an unsecured 24-foot portable extension ladder, which he had leaned against the fascia board above the garage of a house under construction. The worker sustained left leg fracture injuries and was hospitalized.

NOTES:

For additional information on ladders, see:

Portable Ladder Safety Tips OSHA Quick Card
http://www.osha.gov/OshDoc/data/Hurricane_Facts/portable_ladder_qc.pdf

Go to: <http://www.osha.gov/pls/imis/accidentsearch.html> and search by keyword for additional examples

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Topic 3. How can I protect myself from fall hazards?

- A. Use fall protection equipment
 - Guardrail systems
 - Safety Net systems
 - Personal Fall Arrest systems
- B. Safe ladder use
- C. Training

CONTENT for Topic 3:

A. Use fall protection equipment

The three generally acceptable methods of protection for workers on a construction site who are exposed to vertical drops of 6 feet or more are guardrails, safety net systems and personal fall arrest systems.

- Guardrails are considered prevention systems, as they stop you from having a fall in the first place.
- Safety net systems are designed to catch you and break your fall. They must be placed as close as practicable under your working surface, but never more than 30 feet below.
- A personal fall arrest system consists of an anchorage, connectors, and a full-body harness that work together to break your fall.

In general, it is better to use fall prevention systems, such as guardrails, than fall protection systems, such as safety nets/fall arrest devices, because prevention systems provide more positive safety means.

Scaffold work requires guardrails or a personal fall arrest system on any platform 10 feet or higher. Also, do not climb cross-bracing as a means of access; safe access must be provided by your employer. Ensure that your fall protection equipment is right for the work you are doing, in good condition, and that you use it properly. Remember that your employer needs to provide you with protection to prevent falls at your worksite.

NOTES:

The anchorage for a worker's personal fall arrest equipment must be independent of any anchorage used to support or suspend platforms. It must be able to support at least 5,000 lbs. per worker attached to it.

When working next to a fall prevention barrier from an elevated position, such as a step ladder next to a guardrail, the guardrail no longer serves as a fall protection device. Additional protection is needed.

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Discuss the information on the Guardrail and Safety Net Systems and Personal Fall Arrest Systems Summaries.

B. Safe ladder use

Discuss the information in the *Preventing Ladder Falls* handout.

C. Training

Your employer must provide you with training if you are exposed to fall hazards. The training program must train you to recognize the hazards of falling and explain the procedures to be followed in order to minimize fall hazards. You must also be trained before working on scaffolds and when working with ladders.

Discuss the following:

Fall Protection Guidelines for Workers

1. Understand your company's written fall protection plan.
2. Attend and participate in fall prevention training.
3. Use fall protection equipment if required for the job. Be sure the equipment is right for the task, fits properly and is in good condition.
4. Inspect fall protection equipment and devices before each use.
5. Make sure that floor holes, open shafts and riser penetrations are protected by sturdy guardrails or covers.
6. Get specialized training before working on scaffolds, lifts or ladders.
7. When using scaffolds, make sure there is proper access, full planking, stable footing and guard railing.

NOTES:

Refer to: Handout #1 - Guardrail & Safety Net Systems Summary and Handout #2 - Personal Fall Arrest Systems Summary

Refer to: Handout #3 - Preventing Ladder Falls

These guidelines are from the Laborers' Health & Safety Fund of North America

Refer to: Handout #4 - Scaffold Work Can Be Dangerous: Know the Basics of Scaffold Safety

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8. Keep your feet firmly on the platform on a boom lift and tie-off at all times.
9. Choose the correct ladder for the task, read the instructions and be sure that the ladder is in good condition. Check for surrounding hazards, stable footing and the proper angle.
10. Identify skylights and make sure they are properly protected.
11. Contact your supervisor if you see fall hazards or have any questions about fall prevention. Do not work until unsafe conditions have been corrected.

NOTES:

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Topic 4. What is my employer required to do to protect workers from falls?

- A. Provide fall protection
- B. Ensure proper scaffold construction
- C. Ensure safe ladder use and condition
- D. Conduct worksite maintenance
- E. Provide training

CONTENT for Topic 4:

A. Provide fall protection

OSHA's fall protection standards require employers to provide fall protection for you when you are exposed to a fall hazard. The standards set the criteria and practices for fall protection systems and require training. The standards cover hazard assessment, fall protection and safety monitoring systems. Controlled access zones, safety nets, and guardrail, personal fall arrest, warning line and positioning device systems are also addressed.

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

For example, if you are exposed to falling 6 feet 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. There are similar requirements for other fall hazards.

NOTES:

See 29 CFR, Subpart M, Fall Protection, 1926.500, 1926.501, 1926.502, and 1926.503

Under 1926.502(d), OSHA requires that employers provide for "prompt rescue of employees in the event of a fall or shall assure that employees are able to rescue themselves."

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If personal fall protection systems are used, employers must pay particular attention to identifying attachment points and to ensuring that workers know how to properly don and inspect the equipment.

The following are some things your employer should do to prevent fall hazards at your worksite:

1. Develop a written fall protection plan.
2. Identify potential fall hazards prior to each project and during daily walk-arounds. Pay attention to hazards associated with routine and non-routine tasks.
3. Eliminate the need for fall protection where possible by rescheduling the task, isolating the task, or changing the task.
4. Ensure that fall protection equipment is appropriate to the task, in good condition and used properly.
5. Conduct general fall prevention training on a regular basis.
6. Train workers on the specific fall hazards identified and on the required personal protective equipment.
7. Conduct regular inspections of fall protection equipment in accordance with the manufacturer's recommendations and OSHA's requirements.
8. Emphasize fall hazards unique to the site, such as open floor holes or shafts, riser penetrations and skylights.

NOTES:

These guidelines are from the Laborers' Health & Safety Fund of North America

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B. Proper scaffold construction

Employers must construct all scaffolds according to the manufacturer's instructions. A "competent person" must supervise as scaffolds are erected, moved, taken apart or changed, and must inspect the scaffolding. A guardrail system or a personal fall arrest system is required for scaffolds more than 10 feet above a lower level. In addition, employers must provide safe access to scaffold platforms.

Discuss the information in the following:

Supported Scaffold Safety Tips OSHA Quick Card

http://www.osha.gov/OshDoc/data_Hurricane_Facts/supported_scaffold_tips.pdf

Supported Scaffold Inspection Tips OSHA Quick Card

http://www.osha.gov/OshDoc/data_Hurricane_Facts/supported_scaffold_tips2.pdf

C. Ladder use and condition

Employers are required to provide ladders where necessary and maintain the ladders in proper condition. Employers must also train workers to recognize ladder and stairway hazards.

For additional information, refer to:

Stairways and Ladders: A Guide to OSHA Rules, <http://www.osha.gov/Publications/osh3124.pdf>

D. Worksite Maintenance

Poor worksite maintenance can lead to clutter and debris on a construction site, creating additional slip, trip and fall hazards. Poor maintenance of ladders, scaffolds and fall protection equipment can also lead to serious injuries. Employers are required to keep worksites free of form and scrap lumber with protruding nails and other waste and trash, including combustible debris.

NOTES:

OSHA defines a "competent person" as "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to workers, and who has authorization to take prompt corrective measures to eliminate them."

See 29 CFR 1926.450 – 1926.454, Scaffold requirements

See 1926.1053, Ladders and 1926.1060, Training Requirements. 1926.1060 (a) states: *The employer shall provide a training program for each employee using ladders and stairways, as necessary. The program shall enable each employee to recognize hazards related to ladders and stairways, and shall train each employee in the procedures to be followed to minimize these hazards.*

See 29 CFR 1926.25, Housekeeping; 1926.28, Personal Protective Equipment; 1926.95, Criteria for Personal Protective Equipment; 1926.451, Scaffolds; 1926 Subpart X, Ladders

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E. Training

As discussed, your employer must provide you with training on fall hazards and the required personal protective equipment. OSHA also has specific standards that require your employer to train you when you work with scaffolds and ladders. If you see fall hazards or have any questions about fall prevention, contact your supervisor. Do not work until unsafe conditions have been corrected. If hazards are not corrected, you may contact OSHA and file a complaint.

Summary

During this lesson, you have been given an overview of major fall hazards, ways to protect yourself, and what employers must do to protect workers from fall hazards.

Conduct lesson test

Distribute student copies and allow time for students to complete the test. When they have finished, provide and discuss the correct answers with the class.

Thank participants for their time, attention, and involvement in the session.

NOTES:

See 1926.503, Fall Protection Training Requirements; 1926.454, Scaffolds Training Requirements; 1926.1060, Ladders Training Requirements. See also 29 CFR 1926.21(b)(2), OSHA's general training requirement: The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury.

Instructor answer key and student copies of the lesson test are provided in Appendix A.

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References/Sources

OSHA Website

BLS Website

CDC/NIOSH Website

The Construction Chart Book (CPWR, 2007)

Central New York COSH, 2007, *Construction Safety & Health Fall Hazards* Grantee module, Grant Number SH-16586-07-06-F-36 from OSHA

CDC/NIOSH in partnership with CPWR-The Center for Construction Research and Training, Hollywood, Health and Society, and the Spanish-language network Telemundo, <http://www.cdc.gov/Features/ConstructionFalls/>

Laborers' Health & Safety Fund of North America, *Preventing Falls in Construction*, an OSHA Alliance product

APPENDIX A

Appendix A: Fall Hazards Lesson Test

Instructor Copy - *answers provided separately*
See file: Falls_TestwAns_April2011.pdf

Student copy to distribute follows

APPENDIX A

Name: _____

Date: _____

1. In general, fall protection must be provided to construction workers who are working on surfaces with unprotected sides and edges which are _____ above the lower level:
 - a. 3 feet
 - b. 4 feet
 - c. 6 feet

2. What are the ways an employer can protect workers from falls?
 - a. Guardrails, safety net systems and safety belts
 - b. Guardrails and safety nets
 - c. Guardrails, safety net systems and personal fall arrest systems

3. For workers on scaffolds, fall protection must be provided if they are working _____ above a lower level.
 - a. 4 feet
 - b. 6 feet
 - c. 10 feet

4. Guardrails are often used by employers to protect workers from falls. How high must the top guardrail (the toprail) be above the working surface?
 - a. 24 inches, plus or minus 3 inches
 - b. 42 inches, plus or minus 3 inches
 - c. 60 inches, plus or minus 3 inches

5. A personal fall arrest system consists of:
 - a. An anchorage and a body belt
 - b. An anchorage, lanyard and connectors, and a body belt
 - c. An anchorage, lanyard and connectors, and a full body harness

6. The top of a ladder must extend at least _____ above the surface you are climbing onto.
 - a. 3 feet
 - b. 4 feet
 - c. 5 feet

APPENDIX B

Appendix B: Personal Fall Arrest System Checklist

Personal Fall Arrest Systems are one way to protect workers on construction sites where there are vertical drops of 6 or more feet. Systems must be set up so that a worker cannot fall more than 6 feet, nor come into contact with any lower level.

You should be able to answer **Yes** to each of the following.

1. Is your Personal Fall Arrest System made up of an anchorage, connecting device, and a full-body harness?
2. Are the components from the same manufacturer to ensure that the system works as it should? If not, has any substitution or change to a personal fall arrest system been fully evaluated or tested by a competent person to determine that it meets the standard?
3. Has your personal fall arrest system been inspected for damage each time before you wear it? [If there are defects, or if someone has taken a fall using the equipment, it must be removed from service.]
4. Is the attachment location of the body harness in the center of your back, near the shoulder level or above your head?
5. Do vertical lifelines or lanyards have a minimum breaking strength of 5,000 lbs? Are they protected against being cut or abraded?
6. Will each worker be attached to a separate vertical lifeline?
7. Is the webbing, [the materials used for ropes and straps of lifelines, lanyard and harnesses] made of synthetic fibers?
8. Is the anchorage for workers' personal fall arrest equipment independent of any anchorage used to support or suspend platforms? Is it able to support at least 5,000 lbs. per worker attached to it?
9. Are the connectors made from steel or equivalent materials, with a corrosion-resistant finish and smooth edges?
10. Do the D-rings and snaphooks have a minimum tensile strength of 5,000 lbs.?
11. Are snaphooks of a locking-type and designed to prevent the snaphook from opening and slipping off the connector?
12. Are the snaphooks not directly connected to the webbing, rope or wire, to each other, to a D-ring to which another snaphook or other connector is attached, to a horizontal lifeline, or to any other object that could cause the snaphook to open?

Source: Construction Safety & Health Fall Hazards, Central New York COSH, 2007, OSHA grant product

APPENDIX B

APPENDIX C

Appendix C: Ladder Safety Exercise

Instructor copy (Student copy follows)

LADDER SAFETY: What's Wrong with this Picture?

Instructor Notes are in Italics

Read the following scenario; ask participants to take on the roles of Mike, Joe and the foreman. After reading the story, participants should identify all the **wrong** things that the workers did when working with ladders; discuss the **RIGHT** way to work safely on a ladder.

Roles: Mike and Joe, the workers and Mr. Smith, the foreman

INTRODUCTION:

Joe and Mike are excited; they just got the call to work on the new residential construction project in the area. They don't have much experience, but the pay is good, and they want to use this job as a stepping stone to bigger and better jobs.

It's their first day on the job.

SCENE ONE: The foreman's office

Mr. Smith: So you know how to work on ladders, right guys?

Joe: Well, I haven't had a lot of experience, so maybe you could just go over the basics...

Mr. Smith: Well, I have to take this delivery, and I thought you told me you had lots of experience – where was your last job, anyway? We've got a deadline on this project, so....

Mike: Don't worry, Mr. Smith, I'll explain it all to him. I used ladders a lot on my last job.

Mr. Smith: Okay. First you need to paint the trim around the top of the building, and then, go inside and finish with the painting in the lobby. There are a couple of extension ladders out here, and a couple of step ladders inside. One of you should work out here, and the other start inside. Are you sure you know what to do? I asked them to find me some experienced guys, not rookies...

Mike: We're fine, Mr. Smith. We'll call you if we have any questions.



APPENDIX C

SCENE TWO: Mike and Joe are outside setting up.

Mike: So Joe, you work out here, and I'll do the inside work, okay?

Joe: Sure, but can you help me to set up here? Is this extension ladder okay, and how do I set it up?

Mike: Well, first you should inspect it. Of course the ladder needs to be long enough to reach the top, and it has to be able to hold you. So check the information on the ladder. It says it's a Type I – I'm not sure what that means, but I think it has something to do with your weight. How heavy are you?

Joe: About 260 pounds – I've been eating like a horse lately. I have to get back to the gym. *(All ladders should have duty ratings, which state how high the ladder can be placed, and how much weight it can hold. Type III: 200 lbs., Type II: 225 lbs., Type I: 250 lbs, Type IA: 300 lbs, Type IAA: 375 lbs. So a Type I will not sufficiently support*

Joe's weight. Also, remember to add the weight of Joe's tools and materials.)

Mike: Well, that should be good enough. And how long is the ladder, and how high to the roof?

Joe: It says it's a 24-foot ladder, and the building is about 20 feet tall. *(A ladder should extend at least 3 feet higher than the top of the surface you are stepping onto. This ladder is too short to do that. The reason it's too short is that a "24-foot" ladder is actually two 12-foot ladders. Since these ladders must overlap one another by at least three (3) feet in an extension ladder, the maximum actual length of a "24-foot" ladder is only 21 feet. This actual length (21 feet) will not allow the ladder to extend the required three (3) feet above the roof. Therefore, you would need a "28-foot" ladder – with an actual maximum length of 25 feet – if the building is 20 feet high.)*

Mike: Okay, that should work. Just be careful if you're climbing onto the roof.

Joe: Am I supposed to check the ladder before using it?

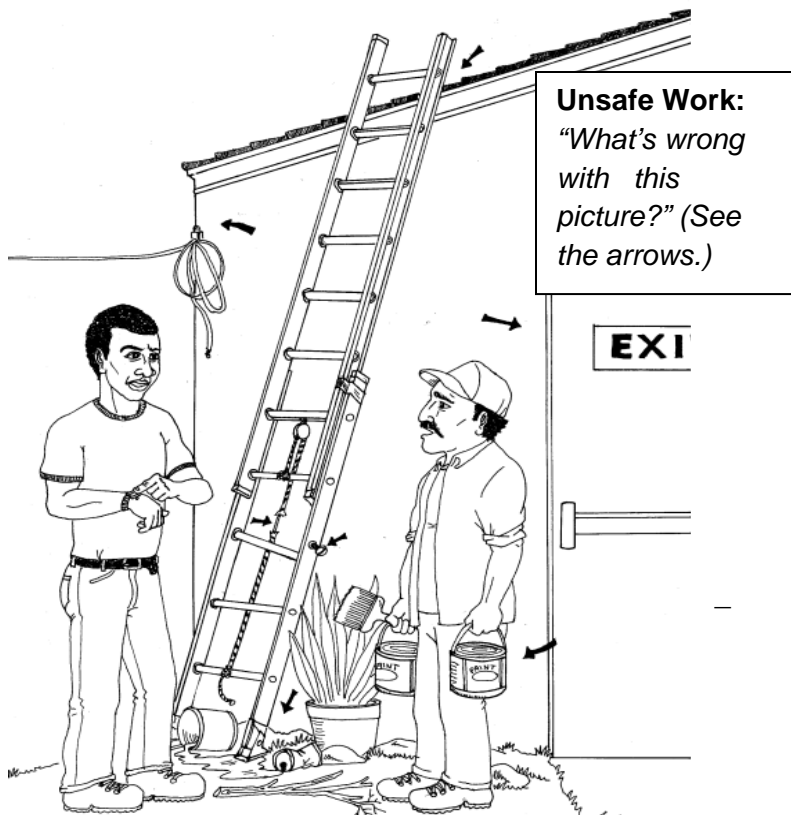
Mike: Yeah, but this one looks fine to me.

(Always need to do the inspection)

Joe: Well, the step pads are ripped, and there is no pad on one of the feet won't that make it uneven?

(Ladders need slip-resistant pads on the feet, and all parts of the ladders should be in good shape.)

Mike: Just wrap some of this tape around it to even it off. I don't want to be asking for too much on our first day, you know?



APPENDIX C

Joe: This bolt seems a bit loose, and the pulley rope is a bit frayed. I wonder how that happened...and the steps feel like they have some kind of slippery stuff on them...
(There should be no loose bolts, no frayed pulley ropes. If a ladder is defective in any way, it needs to be marked "Do Not Use" and taken out of service.)

Mike: So just wipe them off. Listen, we need to get started here...

Joe: Okay, okay, let's just set up then. Where should I start?

Mike: Start over by the doorway; it's early in the day, so not many people should be walking in and out. If you see anyone, just yell. And it's windy already, and it's supposed to get worse later on, so be careful.

(Never set up in an area where there is traffic, either pedestrian or vehicular. And don't work on a ladder when it is windy.)

Joe: Okay. The ground is pretty uneven here with all these rocks. And do I need to worry about those electrical wires? They seem like they are pretty close to the ladder.

(The ground must be even under the ladder. You must place the ladder at least 10 feet away from any power lines.)

Mike: Man, you ask a lot of questions, dude! Let's get this set up. Okay, you need to set this up at the right angle to make sure you don't fall. I remember that the ratio is 1 foot of length from the wall for every...every 5 feet of height, I think. So the building is 20 feet high, so put the ladder 4 feet from the wall.

(Ratio is 1 foot from the wall for every 4 feet of height. So here, the ladder should be 5 feet from the wall, not 4)

Joe: That seems a little steep, doesn't it?

Mike: No, that's right. And remember that if we do well on this job, we get another one with this company, so we need to move fast. I will be inside, so don't keep calling me to help you. Carry the paint up with you – try to bring up a couple of cans the first time up to save time.
(Don't carry too much weight – use a hoist when needed. Always use three-point contact.)

Joe: Should I try to tie the ladder to something so it doesn't move?

Mike: Don't worry about it moving at the top; just use this rope to tie the ladder to this bicycle stand.

(Ladder should be tied off at the top and at ground level when it could be displaced by work activities or traffic. Tie onto something sturdy, like a stake placed in the ground.)

Joe: And who left all these cans and plants around? Someone is going to trip on this stuff!
(Work areas should be kept free of debris.)

Mike: Yeah, yeah, don't worry about it; someone may be looking to use the stuff, so leave it there for now. I'm going inside to start on the lobby; I'll take one of these step ladders. See you later.

Joe: Yeah, see you.

APPENDIX C

SCENE THREE: Mike is inside, using the step ladder.

Mr. Smith: Hey Mike, how's it going?

Mike: Great, Mr. Smith, this is a great job.

Mr. Smith: Be careful, you should not be sitting on the ladder, and before I saw you standing on the top step.

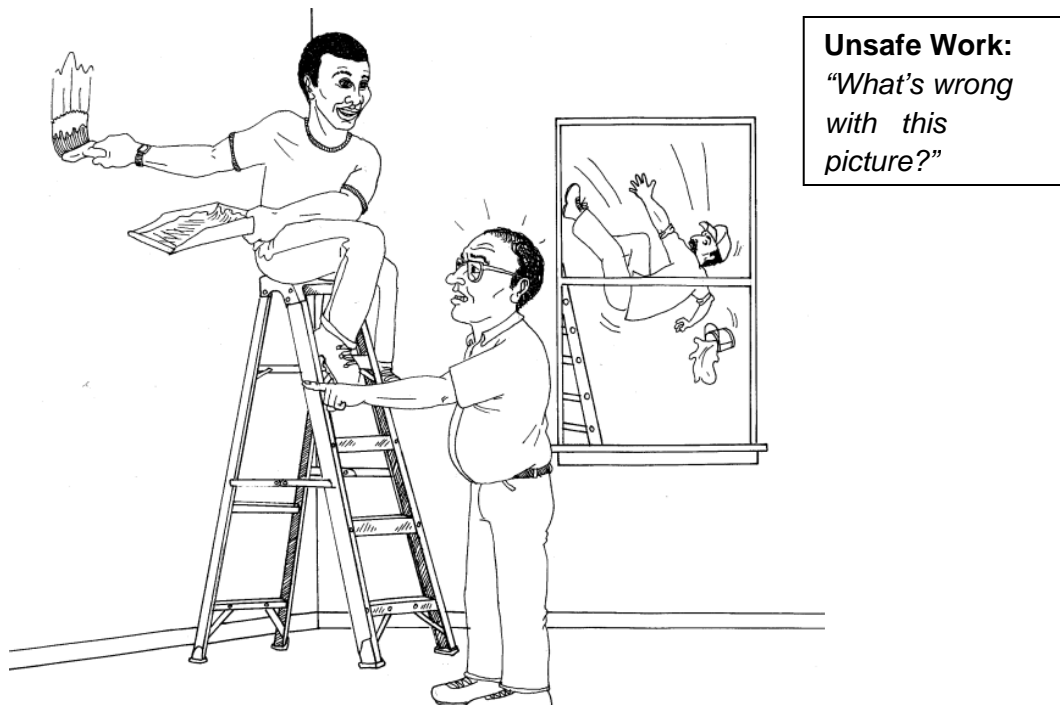
(Never sit on a ladder, or step on the top step – it's dangerous!)

Mike: Oh, don't worry, Mr. Smith, I can handle myself on a ladder – I've been working with my father for years doing this kind of work.

Mr. Smith: Okay, but try not to lean so far; just get down and walk the ladder closer, okay?

(Never lean on the ladder; stay centered. And never "walk" a ladder while you are standing on it – very dangerous!)

Mike: No problem, Mr. Smith, I'm a good worker, and I work fast. Suddenly, they hear Joe yelling from outside, and then they hear a "thud." They run outside to see what happened.



Unsafe Work: List the safety hazards inside and outside of the building.

Have students discuss the lists they compile. Instructor should add their own observations as well as provide guidance and structure to the discussion.

APPENDIX C

Have students complete this worksheet in their copy of this exercise.

1. Are there any problems with Joe's and Mike's ladder work?

Yes. They have not been trained in safe ladder use. As a result, there are problems with the ladder itself (type not sufficient for weight, too short, in disrepair, steps slippery), the set-up of the ladder (near doorway, ground uneven, close to power lines, incorrect angle, not tied off, debris near work area, etc.), and using the ladder (Joe carried paint cans up the ladder with him).

2. What could have been the reason for Joe's fall?

There are several possibilities. The ladder could have moved or slipped for some or all of the following reasons: it was a windy day; the ladder was not tied off; the slip resistant pad on one foot was missing and on the other it was ripped; the ladder was placed on uneven ground; and it was at the wrong angle. Also, someone could have come out of the doorway at the base of the ladder and either distracted Joe or hit the ladder. Joe could have slipped due to the slippery steps or the fact that he was carrying paint cans with him and could not hold onto the rails while climbing. The ladder also did not extend 3 feet above the roof, so if Joe was stepping onto the roof from the ladder (or from the roof onto the ladder), he had nothing to hold onto. If he was working on the roof, he should also be provided with fall protection.

3. Do you think Mike is working safely? Why or why not?

No, Mike was not working safely. He did not have sufficient training to work on ladders and he gave Joe wrong information about ladder safety. He was sitting on the ladder, standing on the top step, and leaning too far over (instead of moving the ladder to a closer location).

SOURCE: Construction Safety & Health Fall Hazards, Central New York COSH, 2007, OSHA grant product

APPENDIX C

LADDER SAFETY: What's Wrong with this Picture?

Student Copy

Read the following scenario; ask participants to take on the roles of Mike, Joe and the foreman. After reading the story, participants should identify all the **wrong** things that the workers did when working with ladders; discuss the **RIGHT** way to work safely on a ladder.

Roles: Mike and Joe, the workers and Mr. Smith, the foreman

INTRODUCTION:

Joe and Mike are excited; they just got the call to work on the new residential construction project in the area. They don't have much experience, but the pay is good, and they want to use this job as a stepping stone to bigger and better jobs. It's their first day on the job.

SCENE ONE: The foreman's office

Mr. Smith: So you know how to work on ladders, right guys?

Joe: Well, I haven't had a lot of experience, so maybe you could just go over the basics...

Mr. Smith: Well, I have to take this delivery, and I thought you told me you had lots of experience – where was your last job, anyway? We've got a deadline on this project, so....

Mike: Don't worry, Mr. Smith, I'll explain it all to him. I used ladders a lot on my last job.

Mr. Smith: Okay. First you need to paint the trim around the top of the building, and then, go inside and finish with the painting in the lobby. There are a couple of extension ladders out here, and a couple of step ladders inside. One of you should work out here, and the other start inside. Are you sure you know what to do? I asked them to find me some experienced guys, not rookies...

Mike: We're fine, Mr. Smith. We'll call you if we have any questions.



SCENE TWO: Mike and Joe are outside setting up.

Mike: So Joe, you work out here, and I'll do the inside work, okay?

Joe: Sure, but can you help me to set up here? Is this extension ladder okay, and how do I set it up?

Mike: Well, first you should inspect it. Of course the ladder needs to be long enough to reach the top, and it has to be able to hold you. So check the information on the ladder. It says it's a Type I – I'm not sure what that means, but I think it has something to do with your weight. How heavy are you?

Joe: About 260 pounds – I've been eating like a horse lately. I have to get back to the gym.

Mike: Well, that should be good enough. And how long is the ladder, and how high to the roof?

Joe: It says it's a 24-foot ladder, and the building is about 20 feet tall.

Mike: Okay, that should work. Just be careful if you're climbing onto the roof.

Joe: Am I supposed to check the ladder before using it?

Mike: Yeah, but this one looks fine to me.

Joe: Well, the step pads are ripped, and there is no pad on one of the feet – won't that make it uneven?

Mike: Just wrap some of this tape around it to even it off. I don't want to be asking for too much on our first day, you know?

Joe: This bolt seems a bit loose, and the pulley rope is a bit frayed. I wonder how that happened...and the steps feel like they have some kind of slippery stuff on them...



Scene Two continued

Mike: So just wipe them off. Listen, we need to get started here...

Joe: Okay, okay, let's just set up then. Where should I start?

Mike: Start over by the doorway; it's early in the day, so not many people should be walking in and out. If you see anyone, just yell. And it's windy already, and it's supposed to get worse later on, so be careful.

Joe: Okay. The ground is pretty uneven here with all these rocks. And do I need to worry about those electrical wires? They seem like they are pretty close to the ladder.

Mike: Man, you ask a lot of questions, dude! Let's get this set up. Okay, you need to set this up at the right angle to make sure you don't fall. I remember that the ratio is 1 foot of length from the wall for every...every 5 feet of height, I think. So the building is 20 feet high, so put the ladder 4 feet from the wall.

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Joe: Should I try to tie the ladder to something so it doesn't move?

Mike: Don't worry about it moving at the top; just use this rope to tie the ladder to this bicycle stand.

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Mike: Yeah, yeah, don't worry about it; someone may be looking to use the stuff, so leave it there for now. I'm going inside to start on the lobby; I'll take one of these step ladders. See you later.

Joe: Yeah, see you.

SCENE THREE: Mike is inside, using the step ladder.

Mr. Smith: Hey Mike, how's it going?

Mike: Great, Mr. Smith, this is a great job.

Mr. Smith: Be careful, you should not be sitting on the ladder, and before I saw you standing on the top step.

Mike: Oh, don't worry, Mr. Smith, I can handle myself on a ladder – I've been working with my father for years doing this kind of work.

Mr. Smith: Okay, but try not to lean so far; just get down and walk the ladder closer, okay?

Mike: No problem, Mr. Smith, I'm a good worker, and I work fast. Suddenly, they hear Joe yelling from outside, and then they hear a "thud." They run outside to see what happened.



Unsafe Work:

"What's wrong with this picture both inside and outside?"

Consider the Ladder Safety scenario to complete this worksheet.

1. Are there any problems with Joe's and Mike's ladder work?

2. What could have been the reason for Joe's fall?

3. Do you think Mike is working safely? Why or why not?

SOURCE: Construction Safety & Health Fall Hazards, Central New York COSH, 2007, OSHA grant product

APPENDIX D

Appendix D: Student Handouts

- Guardrail and Safety Net Systems Summary
- Personal Fall Arrest Systems Summary
- Preventing Ladder Falls
- Scaffold Work Can Be Dangerous

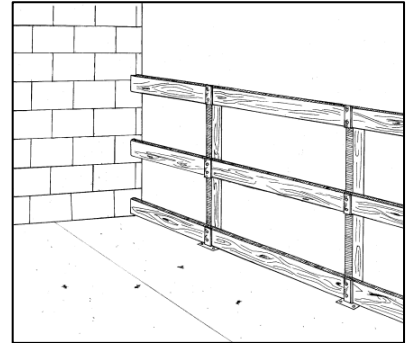
APPENDIX D

Guardrail and Safety Net Systems Summary

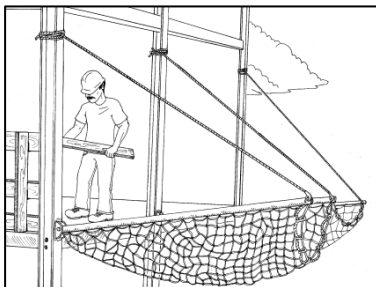
Guardrail and safety net systems are two ways to protect workers from falls on the job. If you are more than 6 feet above the lower surface, some type of fall protection must be used by your employer.

If your employer uses **guardrails**:

- Toprails must be at least $\frac{1}{4}$ inch thick to prevent cuts and lacerations; and they must be between 39 and 45 inches from the working surface;
- If wire rope is used, it must be flagged at least every six feet with highly visible materials;
- Midrails, screens or mesh must be installed when there are no walls at least 21 inches high. Screens and mesh must extend from the toprail to the working level.
- There can be no openings more than 19 inches;
- The toprail must withstand at least 200 lbs. of force; the midrail must withstand 150 lbs. of force;
- The system must be smooth enough to protect workers from cuts and getting their clothes snagged by the rail.
- If guardrails are used around holes at points of access, like a ladderway, a gate must be used to prevent someone from falling through the hole, or be offset so that a person cannot walk directly into the hole.



If your employer uses **safety nets**:



- The nets must be as close as practicable under the working surface, but never more than 30 feet below;
- The safety net must be inspected every week for damage;
- Each net must have a border rope with a minimum strength of 5,000 lbs.;
- The safety net must extend outward a sufficient distance, depending on how far the net is from the working surface (OSHA has a formula to follow);
- The safety net must absorb the force of a 400-pound bag of sand dropping on to the net ("the drop test");
- Items in the net that could be dangerous must be removed as soon as possible.

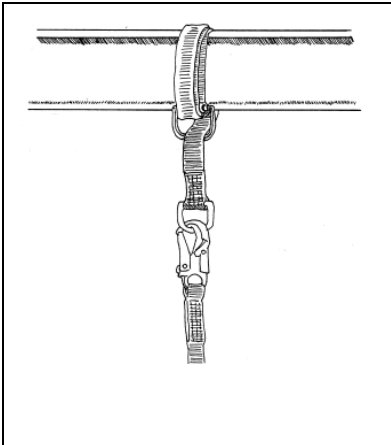
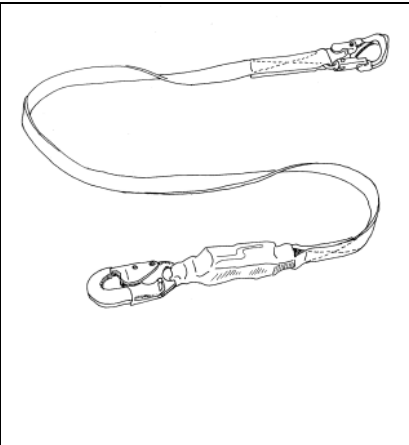
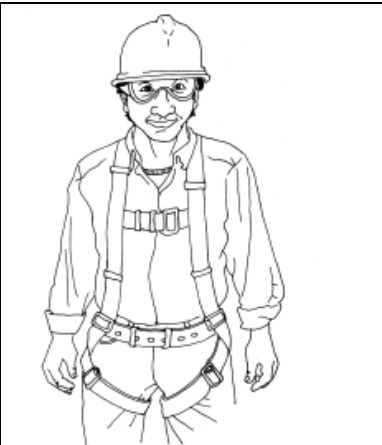
SOURCE: Construction Safety & Health Fall Hazards, Central New York COSH, 2007, OSHA grant product

Personal Fall Arrest Systems Summary

Personal fall arrest systems are one way to protect workers from falls. In general, workers must have fall protection when they could fall 6 feet or more while they are working.

OSHA **requires** workers to wear a full-body harness, (one part of a *Personal Fall Arrest System*) when they are working on a *suspended scaffold* more than 10 feet above the working surface, or when they are working in *bucket truck or aerial lift*. Employers may also choose to use a Personal Fall Arrest System, instead of a guardrail, when workers are working on a *supported scaffold* more than 10 feet above the working surface.

There are **three** major components of a Personal Fall Arrest System (PFAS):

		
● the anchor and the anchorage connector	● the connecting device, which is a lanyard or a retractable lifeline, with snaphooks	● the full-body harness

The following are some things to remember about personal fall arrest systems:

1. A personal fall arrest system is made up of an **anchorage, connecting device, and a full-body harness**. The connecting device may be a lanyard with snaphooks, or a self-retracting lifeline. A lanyard could also include a deceleration device. Make sure you are using components from the same manufacturer to ensure that the system works as it should. If not, any substitution or change must be evaluated or tested by a competent person to ensure that it meets the standard.
2. **Body belts cannot be used** for fall arresting service. However, a body belt is allowed as part of a positioning system. A positioning system is one way to prevent falls from occurring. It involves equipment for keeping your body in a position where you are not able to fall. For all situations where you could actually fall, you need to wear a full-body harness.
3. Your personal fall arrest system must be **inspected for damage** each time before you wear it. [If there are defects, or if someone has taken a fall using the equipment, it must be removed from service.]

4. The **attachment location** of the body harness must be in the center of your back, near the shoulder level or above your head.
5. **Vertical lifelines or lanyards** must have a minimum breaking strength of 5,000 lbs., and be protected against being cut or abraded.
6. Each worker must be attached to a **separate vertical lifeline**. [There is a special exception when constructing elevator shafts.]
7. The **webbing**, which is the materials used for ropes and straps of lifelines, lanyard and harnesses, must be made of **synthetic** fibers.
8. **An anchorage** for workers' personal fall arrest equipment must be **independent of any anchorage** used to support or suspend platforms, and it must be able to support at least 5,000 lbs. per worker attached to it.
9. **Connectors** must be made from **steel or equivalent** materials, with a corrosion-resistant finish and the edges must be smooth.
10. **D-rings and snaphooks** must have a **minimum tensile strength** of 5,000 lbs.
11. **Snaphooks** must be a **locking-type** (they are generally double-locking) and designed to prevent the snaphook from opening and slipping off the connector.
12. **Snaphooks cannot be directly connected** to the webbing, rope or wire, to each other, to a D-ring to which another snaphook or other connector is attached, to a horizontal lifeline, or to any other object that could cause the snaphook to open.

Preventing Ladder Falls - *Construction Safety*

Why construction falls?

Here are a few basic facts about falls in construction:

- Every day, four construction workers die on the job.
- Falls are the most common cause of fatal injuries to construction workers.
- The consequences of a fall affect not only the worker, but also his or her family and community.
- Construction falls can be prevented. Contractors and foreman can do many things to organize the worksite to be safer for their employees. But workers themselves can also make some inexpensive, simple changes to the way they work that can save their lives.
- Ladders are one of the most common pieces of equipment on a construction site. But that doesn't mean they are safe. There are construction workers who are injured or killed falling from a height every day. Using ladders more safely is one way to start preventing falls at your work site.



Set an example at work

Your co-workers can learn a lot from you. At first, you might be the only one who is concerned with safety at your worksite. But over time, other workers will see that the foreman will give you the time you need to be safe. They will see how many little things add up to big effects on safety. And they will see how they, too, can help to make your worksite safer.

So, set an example. Don't worry about being the first—they'll thank you for it later.

How can I prevent a fall from a ladder?

There are many ways you can prevent a fall from a ladder—here are just three suggestions to get you started.

- **Choose the right ladder for the job.**
- **Tie the top and bottom of the ladder to fixed points when necessary.**
- **Don't carry tools or other materials in-hand while climbing the ladder.**

1. Choose the right ladder for the job.

- First you need to make sure that a ladder is the best equipment for what you need to do. Would scaffolding or a mechanical lift be better?
- Many times, the ladder is the only physical support you have while you are working. If it fails, you can fall. That's why it is so important to find the right ladder when you do need to use one. The three main types of ladders—step ladders, straight ladders, and extension ladders—are used in different situations for different tasks.
- Before you start using a ladder, ask yourself two questions.
- **Is the ladder long enough?** It should be long enough for you to set it at a stable angle and still extend at the top to give you something to hold on to when you get

on the ladder to descend. Setting the ladder at the right angle helps you keep your balance on the ladder. It also helps keep the ladder from falling backwards.

- Make sure the ladder extends 3 feet (3 rungs; 0.9 meters) above the surface you will be working on.
 - Make sure the ladder is placed at a stable angle. For every four feet (1.2 m) high the ladder is, the base should be 1 foot (.3 m) out from the wall
 - For example, if you will be working on a 10 foot-high roof (3 m), you need a ladder that is at least 14 feet (4.25 m) long. The base should be 2 ½ feet (.75 m) from the wall.
- **Is the ladder in good working condition?** It shouldn't be missing pieces or be cracked or otherwise damaged. Check the duty rating on extension ladders – is it high enough for the weight you will be putting on it? Longer ladders don't always have higher duty ratings, so be sure to check. In construction, the most common ratings are:
- Heavy Duty (I) supports up to 250 pounds (113 kg).
 - Extra heavy duty (IA) supports up to 300 pounds (136 kg).
 - Special duty (IAA) supports up to 375 pounds (170 kg).

2. Tie the top and bottom of the ladder to fixed points when necessary: if it doesn't extend 3' above the landing, on slippery surfaces, and where it could be displaced by work activities or traffic.

- Tie both sides of the top of the ladder to a fixed point on the roof or other high surface near where you are working. The bottom should be tied to a fixed point on the ground. Securing the ladder in this way prevents the ladder from sliding side-to-side or falling backwards and prevents the base from sliding.
- Tying the ladder off at the beginning of the day and untying it at the end will only take you about 5 minutes. It can make all the difference for your safety. If you need to move the ladder around, allow extra time for this important step, or consider using something else, such as a scaffold.

3. Don't carry tools or other materials in-hand while climbing the ladder.

- Take precautions when you are going up or down a ladder. Instead of carrying tools, boards, or other materials in your hands, use a tool belt, install a rope and pulley system, or tie a rope around your materials and pull them up once you have reached the work surface. Ask for help if you need to use more than one hand to pull them up.
- Carrying tools or anything else in your hands as you climb the ladder can throw you off balance. When you climb a ladder, always use at least one hand to grasp the ladder when going up or down.

Source: CDC/NIOSH in partnership with CPWR-The Center for Construction Research and Training, Hollywood, Health and Society, and the Spanish-language network Telemundo.

Scaffold Work Can Be Dangerous: Know the Basics of Scaffold Safety

There are thousands of scaffold-related injuries – and about 40 scaffold-related deaths – every year in the U.S. If you are doing work on scaffolds, know how to work on them safely – it could save your life!

Here are some rules about scaffolds that must be followed if you want to work safely:



1. A **competent person** must be available to direct workers who are constructing or moving scaffolds. The competent person must also train workers, and **inspect** the scaffold and its components **before every work shift, and after any event that could affect the structural integrity of the scaffold**. The competent person must be able to identify unsafe conditions, and be authorized by the employer to take action to correct unsafe conditions, to make the workplace safe. And a **qualified person**, someone who has very specific knowledge or training, must actually design the scaffold and its rigging.
2. Every **supported** scaffold and its components must **support, without failure, its own weight and at least four times the intended load**. The intended load is the sum of the weights of all personnel, tools and materials that will be placed on the scaffold. Don't load the scaffold with more weight than it can safely handle.
3. On **supported** scaffolds, working platforms/decks must be planked close to the guardrails. Planks are to be overlapped on a support at least 6 inches, but not more than 12 inches.
4. Inspections of **supported** scaffolds must include:
 - Checking metal components for bends, cracks, holes, rust, welding splatter, pits, broken welds and non-compatible parts.
 - Covering and securing floor openings and labeling floor opening covers.
5. Each rope on a **suspended** scaffold must support the scaffold's weight and at least **six times** the intended load.
6. Scaffold **platforms** must be at least **18 inches wide**, (**there are some exceptions**), and guardrails and/or personal fall arrest systems must be used for fall protection any time you are working 10 feet or more above ground level. **Guardrails** must be between 39 and 45 inches high, and **midrails** must be installed approximately halfway between the toprail and the platform surface.
7. OSHA standards require that workers have **fall protection when working on a scaffold 10 or more feet above the ground**. OSHA requires the following:

- The use of a **guardrail OR a personal fall arrest system** when working on a *supported scaffold*.
- **BOTH a guardrail AND a personal fall arrest system** when working on a *single-point or two-point suspended scaffold*.
- A **personal fall arrest system** when working on an *aerial lift*.

8. Your lifeline must be tied back to a **structural anchorage** capable of withstanding **5,000 lbs** of dead weight **per person** tied off to it. Attaching your lifeline to a guardrail, a standpipe or other piping systems will not meet the 5,000 lbs requirement and is not a safe move.

9. Wear hard hats, and make sure there are toeboards, screens and debris nets in place **to protect other people from falling objects**.

10. **Counterweights** for *suspended scaffolds* must be able to resist at least **four times the tipping moment**, and they must be made of materials that cannot be easily dislocated (no sand, no water, no rolls of roofing, etc.). [This would be calculated by the *qualified person* who designs the scaffold.]

11. Your employer must provide safe access to the scaffold when a platform is more than two (2) feet above or below the point of access, or when you need to step across more than 14 inches to get on the platform. **Climbing on cross braces is not allowed!** Ladders, stair towers, ramps and walkways are some of the ways of providing safe access.

12. All workers must be **trained** on:

- how to use the scaffold, and how to recognize hazards associated with the type of scaffold they are working on;
- the maximum intended load and capacity;
- how to recognize and report defects;
- fall hazards, falling object hazards and any other hazards that may be encountered, including electrical hazards (such as overhead power lines); and,
- having proper fall protection systems in place.

SOURCE: Construction Safety & Health Fall Hazards, Central New York COSH, 2007, OSHA grant product