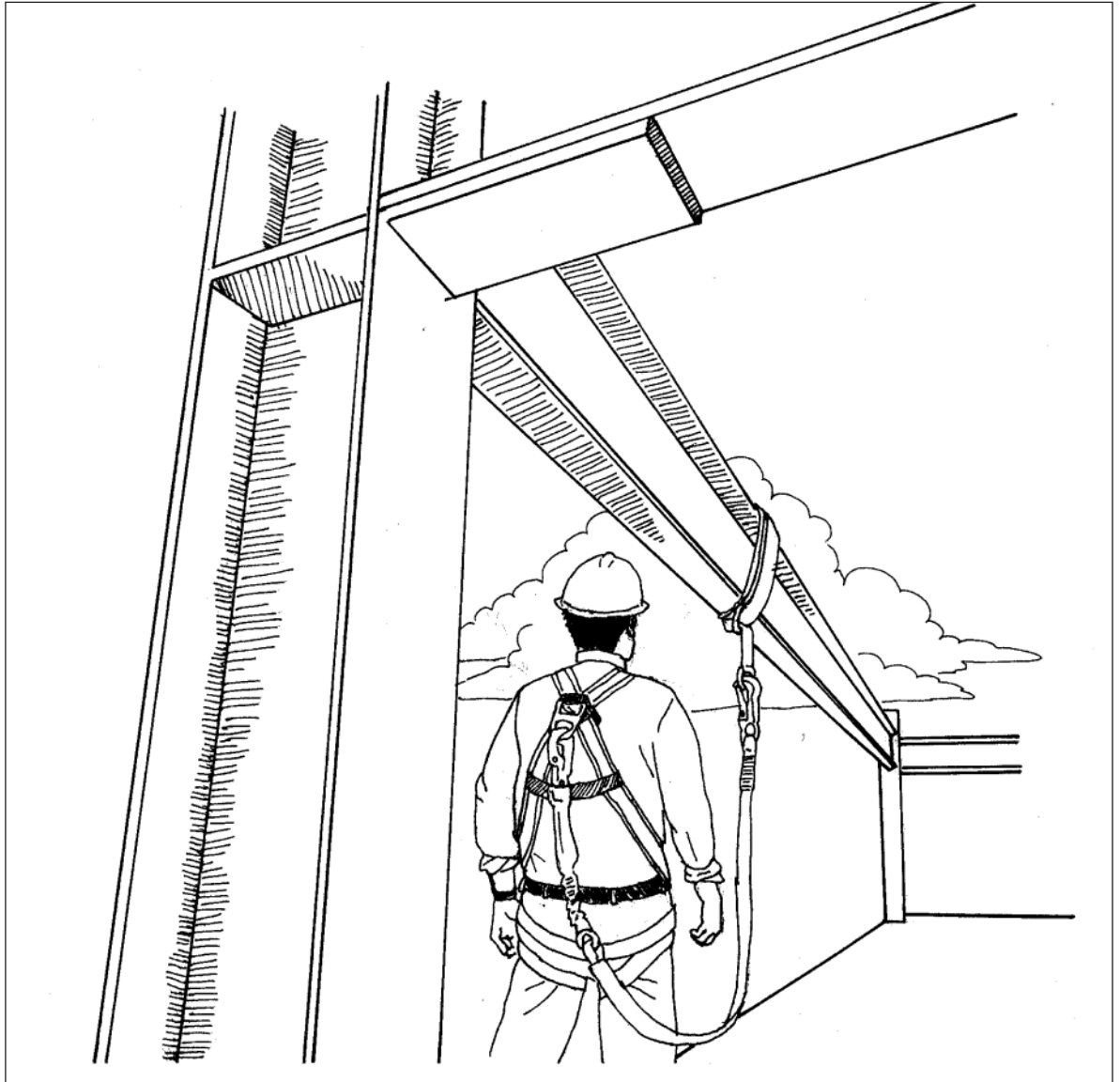


FOCUS 4

CONSTRUCTION SAFETY & HEALTH



'Fall' Hazards

Trainer Guide

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ACTIVITY 1: FALLS FROM HEIGHTS – INTRODUCTION

Working in construction can be very dangerous. More workers die while working on construction than in than in any other industry. Construction workers make up about 5 percent of the workers in the U.S., but they account for about 20 percent of the worker deaths.

Falls are the **most common** cause of death for construction workers, as they account for more than 33 percent of all construction deaths. More than 700 workers died from falls on the job in the past year.

A **hazard** is a condition that is likely to cause injury, illness or death to a worker. What are the hazards that exist on a construction job that could cause a worker to fall?

List and discuss.

1.

2.

3.

4.

THERE ARE LAWS THAT PROTECT WORKERS

The Occupational Safety and Health Administration (OSHA) sets rules for workers to protect them from dangerous falls. These rules are called standards, and employers, by law, are required to follow all standards to protect their workers. If the standards are not followed, OSHA can make your employer fix the hazard and will also fine your employer. OSHA has standards that are specifically for construction workers and they have standards that apply to other “general industry” workers.

How Can We Protect Ourselves From Falls?

OSHA says that there are three major ways to protect workers from falls from elevations:

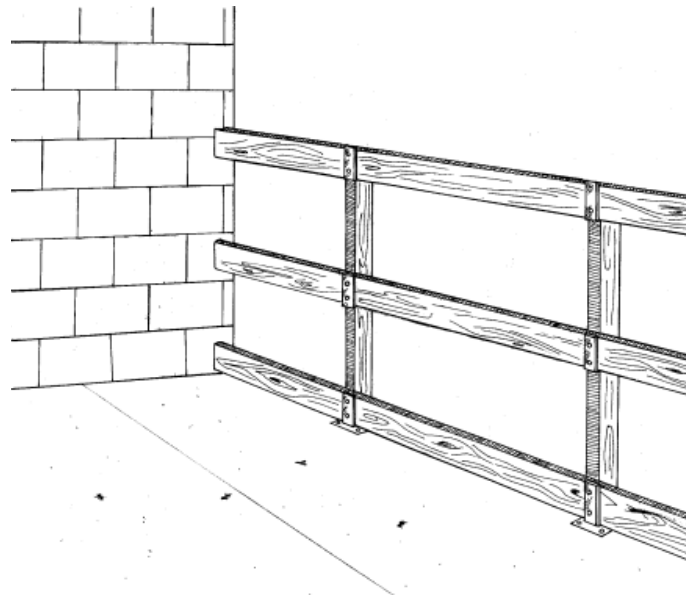
Guardrails, Safety Nets, Personal Fall Arrest Systems

OSHA requires that employers provide these protections to workers when they are needed.

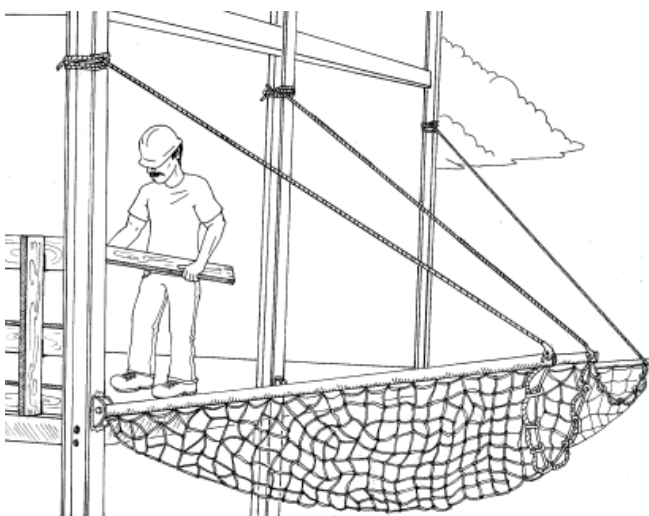
OSHA requires employers to:

1. Develop a written fall protection plan;
2. Identify potential fall hazards prior to each project and during daily walk-around inspections;
3. Ensure that your fall protection equipment is right for the work you are doing, that it is in good condition, and that it is used properly;
4. Conduct regular trainings on fall hazards and on the required personal protective equipment.

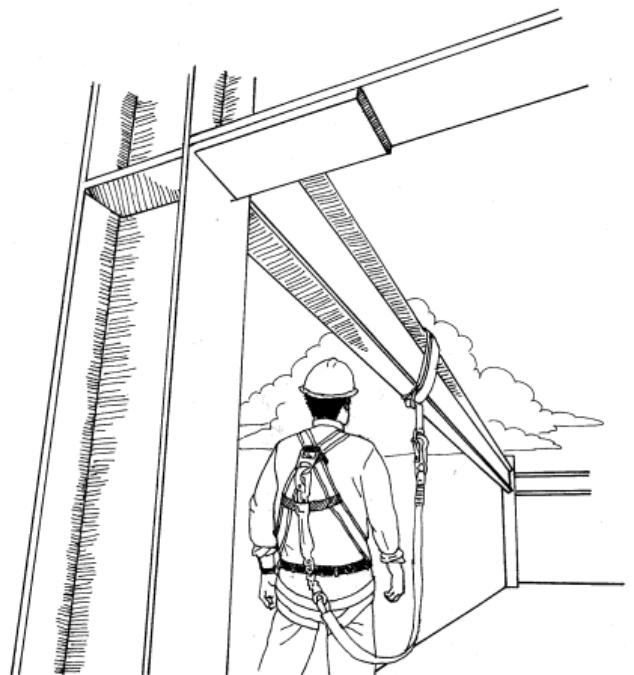
Take the short introductory quiz to understand some basic ideas about these fall protection methods. Remember, your employer needs to provide you with protections to prevent falls from occurring at your workplace.



Safe Work: Wood guardrail has a toprail, midrail and toeboard.



Safe Work: This safety net extends outward at least eight (8) feet, for a vertical fall that doesn't exceed five (5) feet from the working level to the horizontal plane of the net.



Safe Work: Beam strap, lanyard and a full body harness.

Want Some Basic Information On OSHA's Fall Protection Standard? Take The Quiz!

Work with your classmates to come up with the correct answers to these 20 questions. This is not a test, but just a chance to give you some basic information on OSHA's fall protection rules and requirements for employers. Note that these are not all the rules for fall protection, but just some of the basic concepts. More details on each topic will be provided later.

1. Workers in the construction industry, who are working on surfaces with unprotected sides or edges which are _____ or more above the lower level, must be protected from falls by their employer.

- a. 3 feet
- b. 6 feet
- c. 9 feet

ANSWER: Six feet is the *general rule* for the Construction Industry, i.e. it's the threshold when no specific rule applies. (No fall protection is required until *10 feet* when working on scaffolds.)

NOTE: Fall protection must be provided regardless of height if you're working above sharp objects (like exposed ends of rebar for concrete) or working above dangerous equipment (that you wouldn't want to fall into).

2. On the other hand, under OSHA's general industry standard, workers who are working _____ or more above the lower level must be protected from falls by their employer.

- a. 4 feet
- b. 10 feet
- c. 6 feet

ANSWER: Four feet is the fall protection trigger height in General Industry.

3. What are all the ways that an employer can protect workers from falls?

- a. Guardrails, safety net systems and safety belts
- b. Guardrails and safety net systems
- c. Guardrails, safety net systems and personal fall arrest systems with full-body harnesses

The answer is c. These are the three methods that OSHA prefers. However, there are a couple of other methods used in special situations. You need not discuss them, but they include warning line systems and use of controlled access zones.

4. Guardrails are often used by employers to protect workers from falls. How high must the top guardrail, called the "toprail", be above the walking/working level?

- a. 24 inches, plus or minus 3 inches
- b. 42 inches, plus or minus three inches
- c. 60 inches, plus or minus three inches

ANSWER: 42 inches, i.e. the toprail must be 39 to 45 inches above the working surface. OSHA also requires a midrail, so workers can't fall through the guardrail.

5. **The guardrail system must be capable of withstanding a force of at least _____ at the toprail.**
- a. 100 lbs.
 - b. 200 lbs.
 - c. 300 lbs.

ANSWER: It's 200 lbs. for the toprail. The midrail must withstand 150 pounds.

6. **According to OSHA, safety nets must be installed as close as possible to the walking/working surface of the worker, and never more than _____ below these levels.**
- a. 10 feet
 - b. 30 feet
 - c. 60 feet

ANSWER: 30 feet is the maximum fall allowed into a safety net. That's why the border rope around the outside of a safety net must withstand *5,000 lbs.*

7. **Safety nets must be able to absorb an impact force of a drop test consisting of a _____ bag of sand**
- a. 200 lb.
 - b. 400 lb.
 - c. 750 lb.

ANSWER: 400 lbs. of sand for the drop test: the sand bag is dropped the distance of the fall to the net, but no more than 30 feet. Additionally, the sand bag must be dropped a *minimum* distance of 42 inches.

8. **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 (sometimes with a built-in shock absorber) and connectors, and a full body harness

The answer is c. The connecting device is generally (but not always) a lanyard made of webbing, with locking snap hooks on each end for connection to the anchor and the D-ring on back of the *full body harness*. Sometimes a worker clips into a self-retracting lifeline, often consisting of a wire rope (steel cable). In that case, you really need a shock absorber if someone falls the full six feet maximum fall distance allowed.

9. An anchorage for a personal fall arrest system shall be capable of supporting _____ of dead weight for each worker tied off to it.
- a. 200 lbs.
 - b. 5,000 lbs.
 - c. 1,800 lbs.

ANSWER: It's 5,000 lbs. per worker. Also, each worker has his/her own *independent* lifeline with an *independent* anchor.

10. If you use a personal fall arrest system for fall protection, you must rig it so that a worker can fall no more than _____ nor contact any level.
- a. 6 feet
 - b. 12 feet
 - c. 24 feet

ANSWER: Six feet of free fall is the maximum fall allowed while using a personal fall arrest system. As of January 1, 1998, a full body harness is required for fall arresting service. (Prior to that date, a *safety belt* was legal for this purpose.)

11. The maximum *fall arresting force* that can be transmitted to the body of a worker through a full body harness is:
- a. 200 lbs.
 - b. 5,000 lbs.
 - c. 1,800 lbs.

ANSWER: 1,800 lbs. of force can be transmitted to the worker's body through the required full body harness. However, this force is distributed over a large area by the harness straps. The straps pass around the worker's legs and the harness is designed so that most of the force is passed on to the worker's buttocks and thighs, as well as some force to the shoulders, chest and waist.

12. A personal fall arrest system must stop a worker taking the maximum fall of 6 feet within a deceleration distance of no more than:
- a. 4 feet (48 inches)
 - b. 3.5 feet (42 inches)
 - c. 6 feet (72 inches)

ANSWER: 3.5 feet (42 inches) is the maximum *deceleration distance* allowed by OSHA. In other words, after taking the maximum allowable free fall of six feet, OSHA requires that the fall be stopped within 3.5 feet (for a total of 9.5 feet, not including any stretch or slack). In practice, shock absorbers are built to *elongate* up to 42 inches. The most common type of shock absorber has webbing woven or stitched together. These pieces of webbing rip apart, or the stitches rip out, in a fall, thereby absorbing excess force.

13. When the height of a *supported* scaffold (a scaffold with legs) is more than _____ its narrowest base dimension, it must be tied to a structure.
- a. 2 times
 - b. 6 times
 - c. 4 times

ANSWER: 4 times – a *supported* scaffold is considered to be inherently unstable when its height exceeds four times its width. At that height, the scaffold must be tied to the structure with guys, ties or braces. These must be installed in accordance with manufacturers’ recommendations. For scaffolds more than three (3) feet wide, additional tie-ins are required every 26 vertical feet above that, but no more than 20 feet from the top of a structure; and, also every 30 feet horizontally. For scaffolds three (3) or less in width, these tie-ins are required at every 20 vertical feet.

14. Each leg of a supported *scaffold* must support the weight of the scaffold and _____ what you intend to put on the scaffold.
- a. 4 times
 - b. 6 times
 - c. 10 times

ANSWER: 4 times the intended load for *supported* scaffold components, i.e. each leg.

15. If you paint wooden scaffold planks,
- a. The wood will probably last longer
 - b. You won’t be able to see any cracks or defects in the wood
 - c. Workers are more likely to slip on the planks

The answer is b. You can’t see defects in the wood if opaque paint is used.

16. Fall protection on a two-point *suspended* scaffold requires:
- a. Tying your full body harness to the scaffold
 - b. A guardrail
 - c. Both a guardrail and a personal fall arrest system, with an independent lifeline for each worker, tied to the structure

The answer is c. The worker’s lifeline must be tied to the structure, *not to the suspended scaffold*. If you are properly tied off to the building or structure, you’ll live even if the scaffold comes off the structure.

17. Each rope on a two-point *suspended* scaffold must hold the weight of the scaffold and _____ the intended load.
- a. 10 times
 - b. 4 times
 - c. 6 times

ANSWER: 6 times the intended load is the required safety factor for *each rope* holding a *suspended* scaffold.

18. When you position a ladder against a wall that is 20 feet high, how far from the wall should you place the ladder?
- a. 2 feet ($\frac{1}{10}$ the distance from the surface to the top support)
 - b. 4 feet ($\frac{1}{5}$ the distance)
 - c. 5 feet ($\frac{1}{4}$ the distance)

The answer is c: $\frac{1}{4}$ of the vertical distance to the top. This angle can be approximated by holding your hands out in front of you. The point at which your fingers touch the rails of the ladder will provide the required angle. Additionally, it's always wise to tie off a ladder to prevent unwanted movement.

19. The top of a ladder must extend at least _____ above the surface you are climbing onto.
- a. Three feet
 - b. Two feet
 - c. Four feet

ANSWER: It's 3 feet. You'll really appreciate this fact when it's time to climb *down* the ladder from the roof or other surface.

20. The best material for a step ladder used by an electrician who may be working near energized conductors is:
- a. Wood
 - b. Fiberglass
 - c. Aluminum

ANSWER: Fiberglass is the only reliable electrical *insulator* of the three materials listed. Wood conducts electricity when it's wet; and, never trust wood if the ladder is near a power line. Aluminum is a metal and an electrical *conductor*.

NOTE: This question is not an endorsement of the practice of working too closely to energized electrical conductors. In general, you must remain at least 10 feet away from power lines. Even greater distances are required at very high voltages.

Guardrails And Safety Nets

When workers on a construction site are exposed to vertical drops of 6 feet or more, OSHA requires that employers provide fall protection, generally in one of these three ways before work begins:

- placing guardrails around the hazard area;
- deploying safety nets;
- providing a personal fall arrest system for each employee.

On Construction Site X, the employer has chosen to use guardrails and safety nets. Let's make sure that all the requirements are followed to ensure the workers' safety.

EXERCISE

Guardrails And Safety Nets: Lifesaving Devices

Below are several questions regarding the proper set-up of guardrails and safety nets. Look at the list of answers and choose the one that correctly completes the sentence.

GUARDRAIL ANSWERS

21 inches	150 pounds	39 to 45 inches
toprail	200 pounds	No rough and jagged surfaces
walkway	3½ inches	39 inches

GUARDRAIL QUESTIONS

1. On Job #1, the supervisor is putting up guardrails, and is checking the *height of the toprail*, since he knows that it needs to be between **39 TO 45** inches above the walking/working level.
2. He is also ensuring that there is a *midrail, mesh and/or screens* on this rail, because there is no wall or parapet wall at least **21 INCHES HIGH**.
3. The supervisor needs to make sure that the guardrail system is capable of *withstanding* at least **200 LBS.** of *force*, within 2 inches of the top edge in any downward or outward direction and at any point along the edge. If, from the force, the rail deflects downward to a height less than **39 INCHES**, then he knows he has a problem with that guardrail system.
4. He then checks to ensure that the mid-rail/screen/mesh is able *to withstand* at least **150 LBS.** of force.
5. The workers are using various tools on the scaffold, so a *toeboard* is installed. The supervisor ensures that the toeboard is at least **3½ INCHES HIGH**, which is the minimum height requirement.
6. If he decides that he wants to use mesh or screen instead of the toeboard, the mesh must extend from the **TOPRAIL** to the **WALKWAY**.
7. The supervisor also wants to make sure that there are **NO ROUGH OR JAGGED SURFACES**, or anything pointy or sharp, since he doesn't want anyone to be cut, hurt, or have their clothes caught in the guardrail system.

SAFETY NETS ANSWERS

Drop test	Once a week	Six inches
30 feet	400-lb. bag of sand	Whenever relocated
5,000 pounds	13 feet	Six inches by six inches
Highest		

SAFETY NETS QUESTIONS

8. On Job #2, the supervisor is setting up safety nets. He knows he can use a safety net because the employees will be working no more than **30 FEET** above the net; if it were a longer potential fall, he could not use the net.
9. Since the distance from the working level to the net is more than 10 feet, he is setting up the safety net to extend outward from the working surface a total of **13 FEET**.
10. In order to check if the safety net system is set up properly, the supervisor will conduct a **DROP TEST**.
11. For the drop test, the supervisor must use a **400-LB. BAG OF SAND**, 28-32 inches in diameter, and he will drop it into the net from the **HIGHEST** surface at which the workers are exposed to fall hazards, but not less than 42 inches above the net.
12. The drop test must be done after initial installation and before being used, **WHENEVER RELOCATED**, after major repair, and at 6-month intervals if left in one place.
13. The maximum size of the net's mesh must not exceed **6 INCHES BY 6 INCHES**.
14. The supervisor knows that he must inspect the safety net system at least **ONCE A WEEK** to check for damage and/or wear, and after any event that could affect the integrity of the system.
15. The supervisor will ensure that each safety net has a border rope for webbing with a minimum breaking strength of **5,000 LBS**.
16. Since they plan to use several nets, the supervisor needs to be sure that the connections between the panels are not spaced more than **SIX INCHES** apart.

SUMMARY

Guardrail And Safety Net Systems

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

If the employer uses guardrails, s/he must be sure that:

- toprails are 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 are installed when there are no walls at least 21 inches high. Screens and mesh must extend from the toprail to the working level.
- there are no openings more than 19 inches;
- the toprail can withstand at least 200 lbs. of force; the midrail can withstand 150 lbs. of force;
- the system is 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 so offset that a person cannot walk directly into the hole.

If an employer uses safety nets, s/he must be sure that:

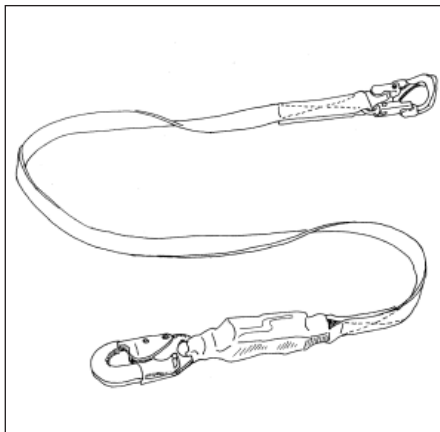
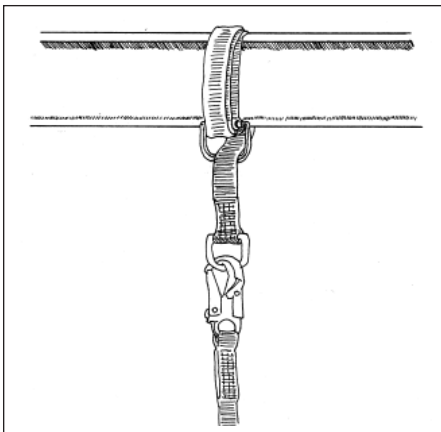
- the nets must be as close as practicable under the working surface, but never more than 30 feet below;
- they must inspect the safety net every week for damage;
- each net has a border rope with a minimum strength of 5,000 lbs.;
- the safety net extends outward a sufficient distance, depending on how far the net is from the working surface (OSHA has a formula to follow);
- the safety net can 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 are removed as soon as possible.

Personal Fall Arrest Systems

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.

Before you begin work using your Personal Fall Arrest System, you must be sure that **all** parts of your system are in working order. Complete the exercise below to better understand the steps you need to take to protect yourself from a dangerous fall.

EXERCISE

A Checklist For Your Personal Fall Arrest System

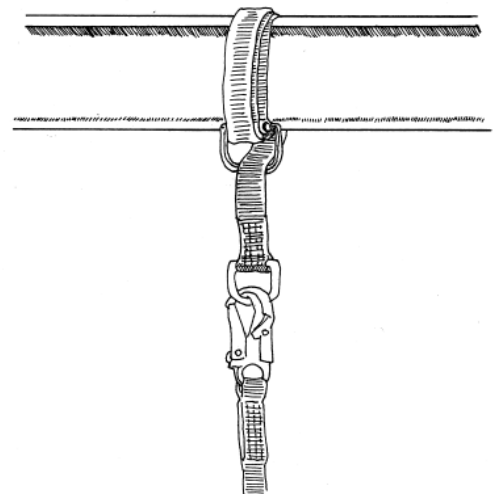
In your group, identify all the things you need to do when inspecting your personal fall arrest system to make sure you can work safely. Each piece of paper contains a statement regarding personal fall arrest systems; include all those statements that you believe should be included in your checklist. (Note: Some of the statements are incorrect, so discuss your choices with other members of the group.)

Each group should post their answers, and the entire group should discuss all the points addressed. Participants should also be trying on a harness to get better acquainted with the equipment.

TRAINERS' NOTE: Each group will receive a pack of cards; each card will contain one of the following statements, and then they will post their choice of instructions on the board for all to see and compare.

ANCHOR AND ANCHORAGE CONNECTOR

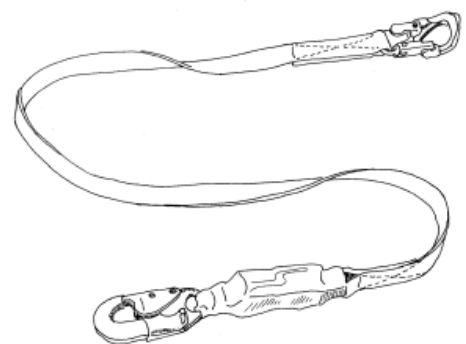
- (Y) Your anchorage point must be capable of supporting 5,000 pounds per attached worker.
- (N) You can tie onto a beam or other substantial structural member that can withstand 3,000 pounds if there is only one worker tying on.
- (Y) The material for your anchorage connector must be synthetic material that is resistant to cutting.
- (N) You can use twisted rope as your anchor connector, as long as it is capable of withstanding 5,000 pounds of dead weight.
- (N) If need be, you can use a guardrail or a water pipe as your anchor.
- (Y) Each worker must have an independent lifeline attached to an anchor.



Safe Work: Lanyard is connected to a beam strap.

CONNECTING DEVICE (LANYARD OR RETRACTABLE LIFELINE) WITH SNAPHOOKS

- (Y) Use a lanyard that has a minimum breaking strength of 5,000 lbs.
- (N) Lanyards can be made of natural fiber rope.
- (Y) Lanyard material must be synthetic and appropriate for the environment in which it is used.
- (Y) Lanyards should have locking snaphooks on each end.



Safe Work: Lanyard with locking snap-hooks and built-in shock absorber.

- (N) You can use a regular carabiner (a type of non-locking snaphook used in mountaineering) instead of a locking snaphook, as long as it can withstand 5,000 pounds of force.
- (Y) Shock absorbers must be able to reduce the total force on the worker's body, through the full-body harness, to no more than 1,800 pounds.
- (N) You could use your co-worker's lanyard when he is not around.

HARNESSES

- (N) You can use a body belt if a full-body harness is not available.
- (N) Wear a body harness that is loose and easy to take off.
- (Y) Wear a body harness that fits snug but allows for full range of movement.
- (Y) Personal fall arrest systems must be inspected prior to each use.
- (Y) Personal fall arrest systems must be rigged such that, an employee can neither free fall more than 6 feet nor contact any lower level.



Safe Work: Worker is wearing a full body harness.

SUMMARY

Personal Fall Arrest Systems

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 can not fall more than 6 feet, nor come into contact with any lower level.

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 that you are using components from the same manufacturer to ensure that the system works as it should. Mixing and matching components from different manufacturer's systems isn't a good idea.
2. Body belts can not 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 before each time 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 the wearer's back, near the shoulder level or above the 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 employee 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 employee attached to it.
9. **Connectors** must be made from **steel** or equivalent materials, they must have 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 also be a locking-type, (they are generally double-locking) and designed to prevent the snaphook from opening and slipping off the connector.
12. **Snaphooks can not 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.

EXERCISE #1

Ladder Safety: Introduction

Every year, about 50 workers are killed by falls from ladders. Work with others to answer these questions.

QUESTIONS

1. What's more dangerous, going up or coming down a ladder?

ANSWER:

Twice as many falls occur stepping down compared to going up ladders.

2. What do you think the main cause of falls from straight and extension ladders is?

ANSWER:

Sliding of the ladder base

3. For self-supported ladders or stepladders, what is the main cause of the falls?

ANSWER:

Tipping sideways

4. What other injuries can workers get from working with ladders?

ANSWER:

Back injuries from carrying the ladder.

EXERCISE #2

LADDER SAFETY: What's Wrong with this Picture?

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
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.



“We can handle it.”

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 on to 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.)



Unsafe Work: "What's wrong with this picture?"
(See the arrows.)

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...

(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, tie on to 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.

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.

QUESTIONS

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?

LADDER SAFETY CHECKLIST

When you are working on ladders, you need to ensure your safety...

1. Choose the right ladder to use!

There are two types of ladders: fixed and portable. If you need to use a portable ladder, decide whether you need a self-supporting ladder (an “A” frame), or a straight ladder or extension ladder.

2. Always inspect the ladder first!

- a. Check for any damage, like cracks, any bends, look for splits or corrosion. If you are working on a extension ladder check to see that there are no frays in the rope.
- b. Check all the rungs and the steps.
- c. Slip-resistant pads are needed to make sure the ladder can be properly placed on the surface.
- d. Make sure locks and bracers are working properly, and that all bolts are securely fastened.

Setting up and using a straight or extension ladder:

- Use two people to carry and set up a ladder, if possible.
- The horizontal distance between the ladder and the wall should be $\frac{1}{4}$ of the length of the ladder. For example, if a ladder is 20 feet high, it should be 5 feet from the wall (20 divided by 4 is 5). Counting the rungs will give you a good estimate of the length – rungs are about 1 foot apart.
- Don't place ladders in front of door unless the doors are blocked off, locked or guarded.
- Don't place ladders on boxes, barrels or other unstable bases.
- When using a ladder to get onto a roof, the top of the ladder must extend at least 3 feet above the roof surface.

When you are using the ladder:

1. Hold on with both hands when going up or down. Always use at least one hand to hold on.
2. If material must be handled, hoist it up and lower it using a rope.
3. Always face the ladder when climbing up or down.
4. Always rest a ladder on the side rails – never on the rungs.
5. Do not climb higher than the 3rd rung from the top on straight or extension ladders.
6. Do not climb higher than the 2nd tread from the top on step ladders.
7. Do not reach your body to a point where your waist is beyond the side rails.
8. Do not use a metal ladder near electricity (be at least 10 feet away).
9. Use three-point contact at all times, always with at least one hand on the ladder. Carry only small objects, and no heavy loads.
10. Take special precautions when setting up or climbing a ladder on a windy day.

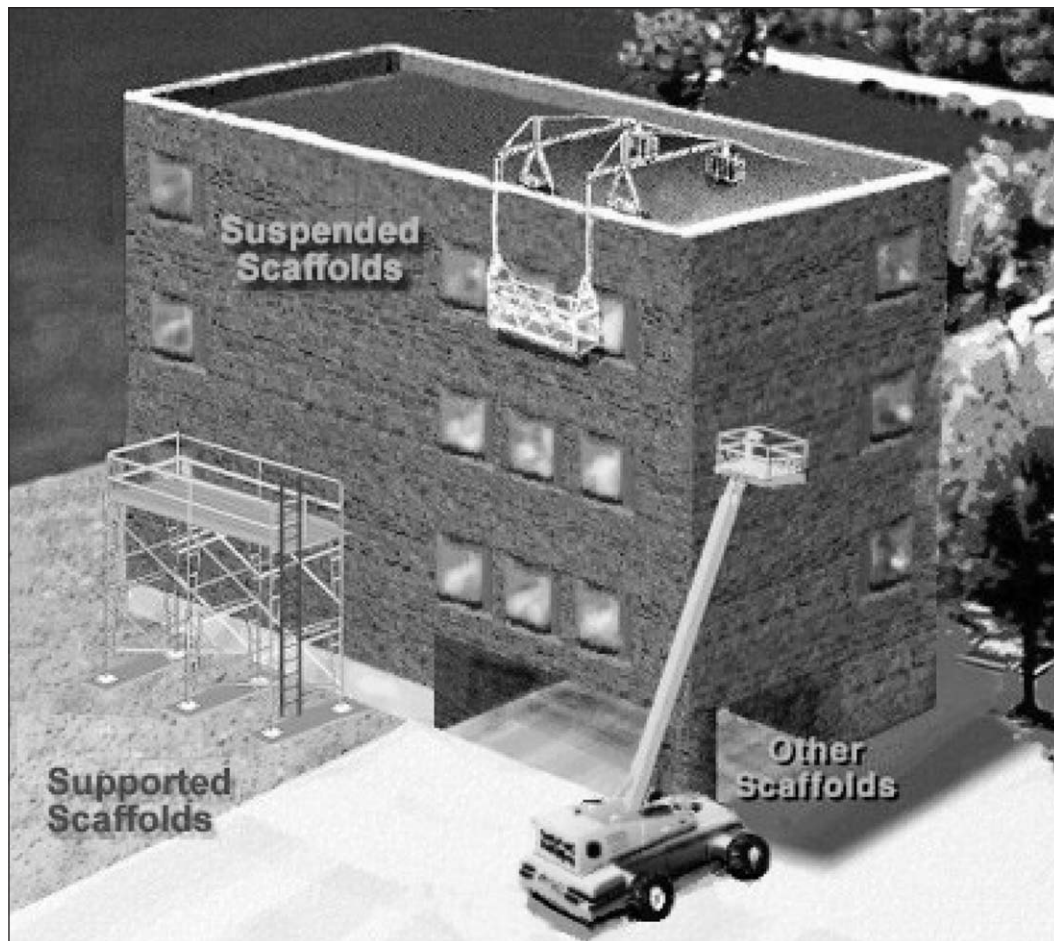
Scaffolds

Use the attached worksheet to:

1. identify the different types of scaffolds in use
2. conduct the exercise “What’s Wrong with this Picture?”

Participants receive a copy of the exercise with no answers. Ask them to work in groups to figure out what is wrong with the picture, and to discuss ways to prevent falls from occurring.

Scaffold Hazards: As Seen in Pictures



This drawing illustrates the three different types of scaffolds. In general:

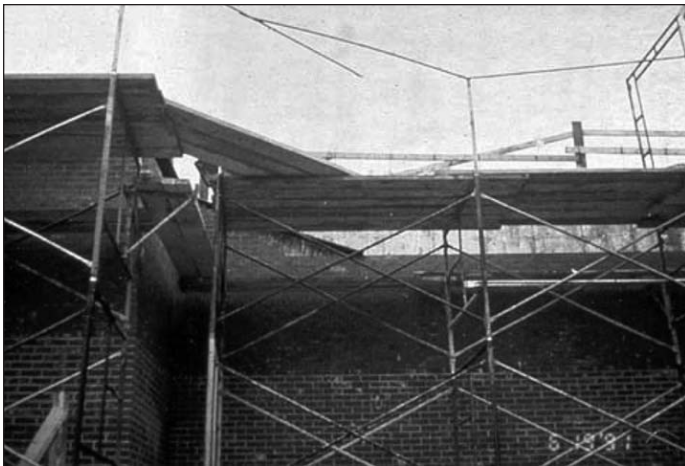
1. Supported scaffolds are supported by the earth or by a floor. The legs are supported by base plates, sometimes on mud sills (as shown here). Portable scaffolds are supported by casters (wheels).
2. Suspended scaffolds hang from buildings or other structures by ropes. The ropes can be made of steel or fibers. There is a wide variety of suspended scaffolds in use, including the two-point (swing stage) scaffold shown here.
3. "Other" scaffolds include the personnel lift with boom and platform, as shown. Elevated platforms or buckets can also be in other forms, such as a scissors lift. All of these are considered to be "aerial platforms."



Worker is climbing a portable scaffold over an uncovered floor hole. No fall protection is being used, although total fall would be more than 10 feet above lower level.



Different view of the same scene: the floor hole is not covered and workers have no fall protection.



No standard guardrails here, folks...



The roof of this truck is not a solid platform for the scaffold above it...



This worker is climbing the scaffold frame. He has no fall protection and unsafe access.



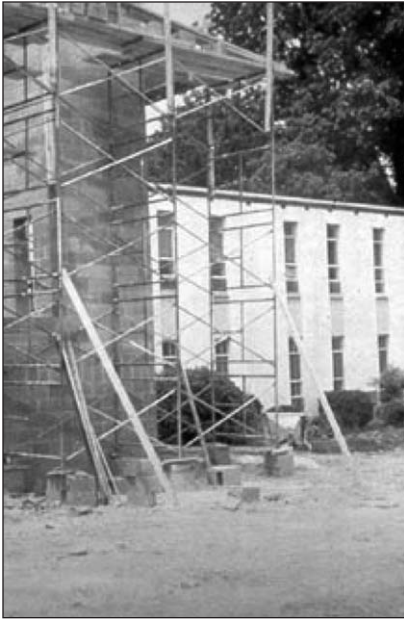
He's standing on a sawhorse, placed on top of a scaffold, and has no fall protection...



Out of the window, stepping on a ledge and over the second stage of an illegal scaffold...



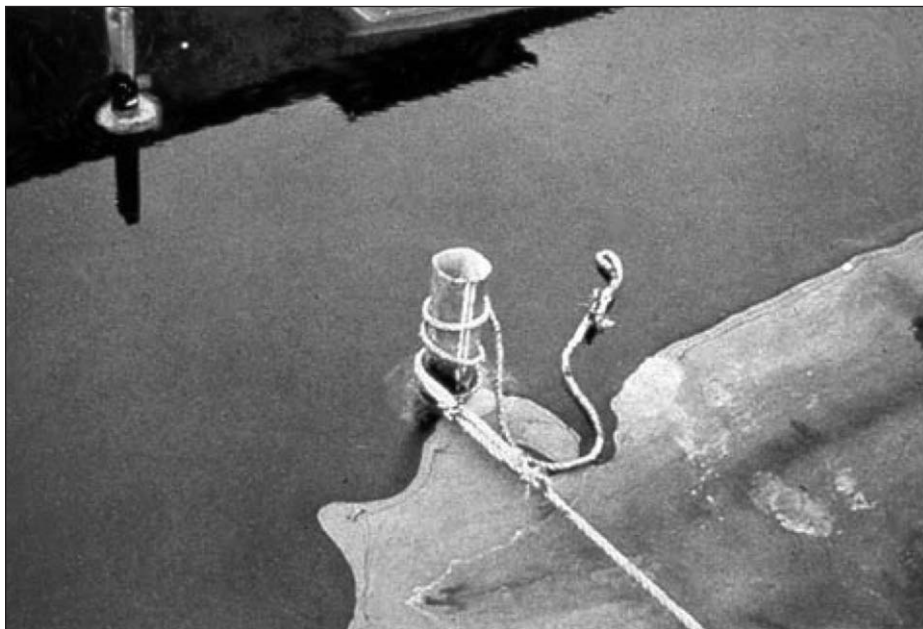
Let's hope that neither the pipe nor the rope is part of the anchor for a worker's lifeline. Neither one would meet the requirement of withstanding 5,000 lbs. of dead weight per worker tied to it...



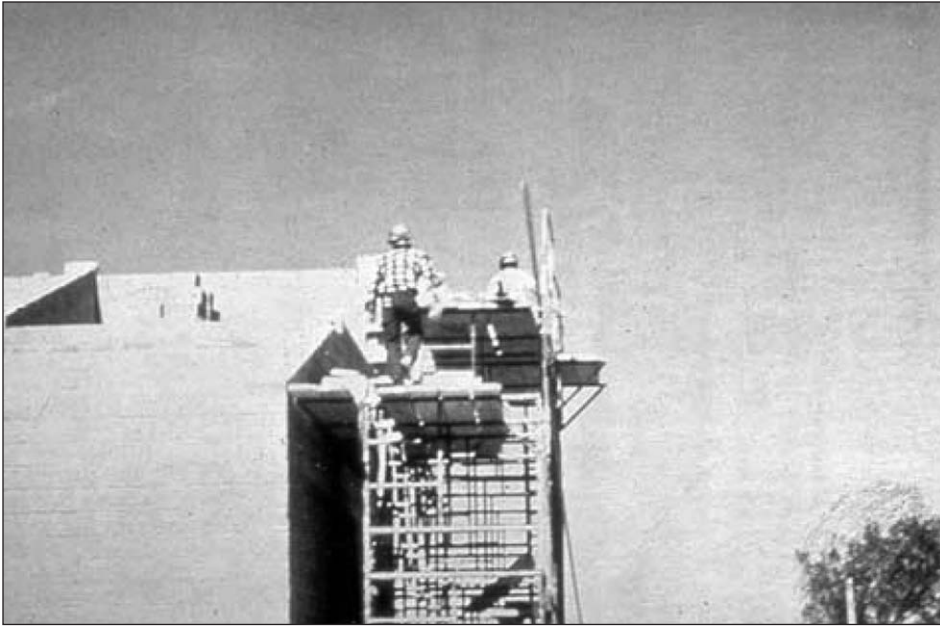
This scaffold is propped up with planks, rather than being tied to the structure.



This is a different view of the same scene. Notice that the scaffold sections are sitting on blocks and propped up with planks. The entire scaffold could collapse if planks move or blocks shift.



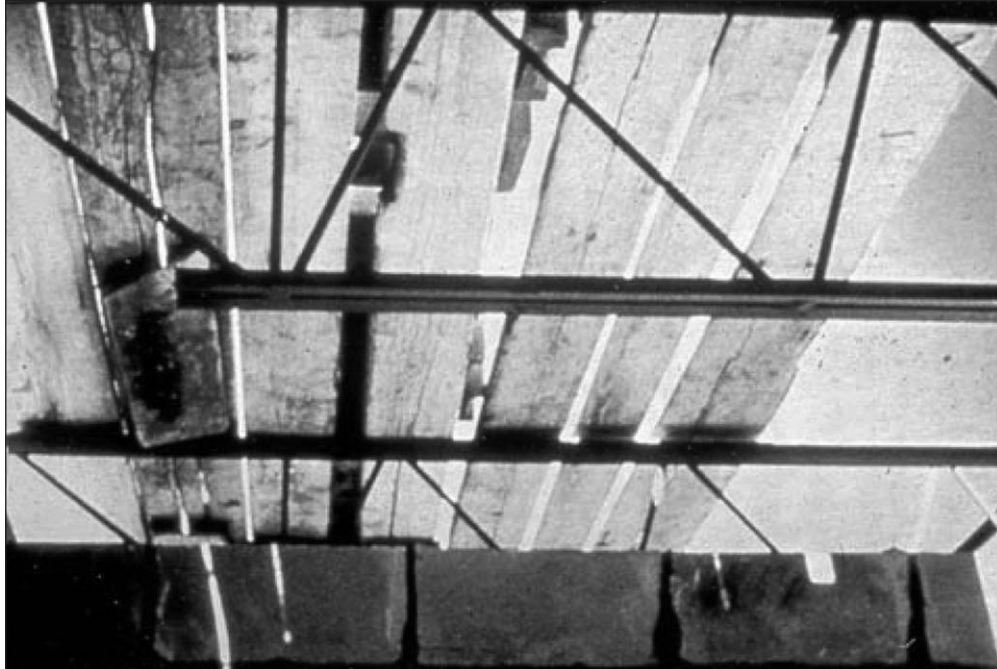
This vent pipe and rope are no better than the one shown on page 26.



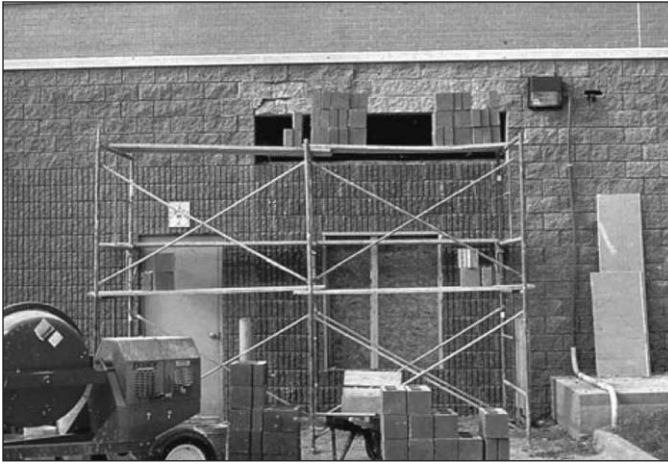
At roof level, this worker has no fall protection.



No fall protection here, either.



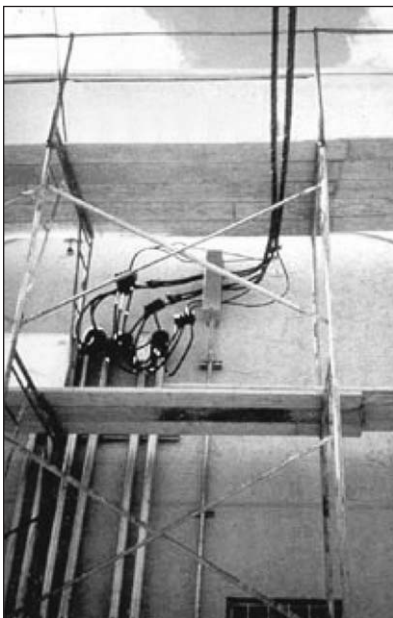
It's charred, broken and unsupported: the plank at left has it all...



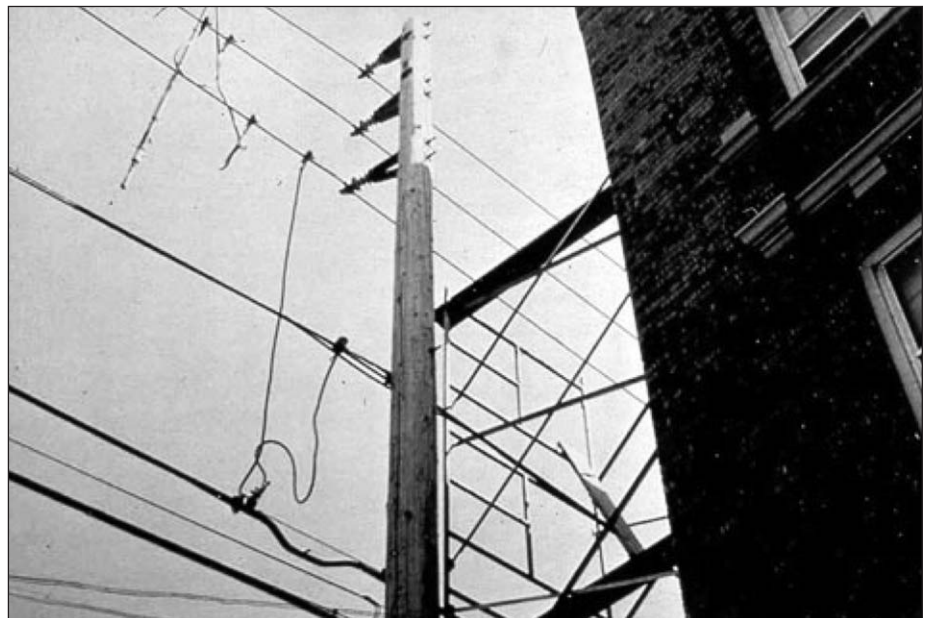
The excessive number of concrete blocks on one section of this scaffold has created a condition known as “point loading.” There is a risk of the blocks breaking the scaffold planks, which could result in a worker’s fall and the collapse of the entire scaffold.



Close-up view of point-loading condition: You can see the bow in the planks caused by overloading. The two solutions to this are to either spread out the blocks over more of the scaffold or reduce the number of blocks. Note also that the scaffold is not fully planked, nor does it have a guardrail. A guardrail or a personal fall arrest system is required if the scaffold is 10 feet or more above the ground.



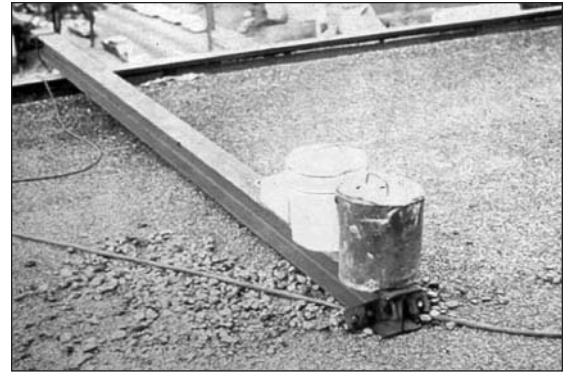
There is a hazard of shock or electrocution: scaffold and platform are less than 10 feet away from these powerlines.



This scaffold has been protected from electrical hazards: three powerlines at the top have been de-energized, jumpered together and then electrically grounded by the power company.



This two-point suspension scaffold doesn't have the required guardrail. The workers may be tied into the required lifelines but that looks like a safety belt, **not the required full body harness**, on the worker at the right.



These two concrete-filled buckets aren't a very good counterweight for this counterweight beam. If they're knocked off the beam, down goes the scaffold. Let's hope it's not the scaffold shown to the left...



There is rope tied to these two counterweight beams and the rope is slack. Why are they tied together? What's going on here? Surely they aren't being used as an anchor for workers' lifelines...



This close-up shows the rope from this counterweight beam going over the edge. It's probably for a worker's lifeline. *Each worker is supposed to be tied off to an independent lifeline with an independent anchor, capable of withstanding 5,000 lbs. of dead weight per worker.* The scenario shown here would likely result in the movement of the counterweight beams, possibly pulling down the entire scaffold, workers and all, in the event of a fall.

ACTIVITY: SUPPORTED SCAFFOLD CASE STUDY

Read the story and discuss the questions below.

The incident occurred at a single-family house located in a suburban area. The house was a single-story, wood-framed structure with a tall, peaked roof. The owner wanted to convert the attic into living space by raising the roof and adding dormers.

The victim was working for his son, who was the owner of a small construction company that had been in business for four years. The owner was an immigrant from Costa Rica who hired other Hispanic laborers as needed. The owner said he was not aware of OSHA or that safety standards existed. The victim was an experienced carpenter who traveled periodically to the United States to work with his son.

Before the incident, the contractor and his crew had already demolished and rebuilt most of the rear section of the house. The crew removed the back section of the peaked roof, and all the discarded wood and surrounding lumber from the rear roof was piled in the backyard. They then rebuilt the roof to increase the interior space. Once the new addition was built, the crew started installing vinyl siding on the outside of the house. During the project, the crew built a homemade scaffold with the discarded lumber from the backyard. This scaffold was poorly built, using wood that had been damaged during the demolition (See Photo 1).

On the day of the incident, the company owner and his crew arrived early to install the vinyl siding. At about 4:00 pm, the victim arrived at the jobsite after just having flown in that day from Costa Rica. The company owner (his son) was away from the work site to get a gutter, so the victim started installing siding on the side of the house. He was standing on a 2" by 6" wood plank set 10 ½ feet above a concrete walkway. One end of the plank was placed on the peak of a small porch roof, and the other end rested on the improvised scaffold at the back of the house (See Photo 2).

A short time later, the company owner arrived back at the house and greeted his father. The victim, who was bending and cutting siding, turned around to talk to him, lost his balance, and fell from the narrow plank. He fell to the concrete, striking his head and losing consciousness. He was brought to a hospital where he underwent surgery for severe head injuries, but he died later that day.



Photo 1. Damaged wood used to make the improvised scaffold.



Photo 2. Porch roof peak used to support the scaffold plank.

QUESTIONS

1. The contractor said that he did not know about the OSHA regulations? What could be done to ensure that employers know about these rules?

ANSWER:

Construction contractors should be aware of federal OSHA safety standards for the construction industry.

The employer was a small construction contractor who received all of his training in Costa Rica. When he started his business in the US, he was unaware of OSHA safety standards that he needed to follow. To prevent future incidents, it is important that new companies are aware of applicable safety, health, and environmental standards.

2. What was wrong with this scaffold work? How could this incident have been avoided?

ANSWER:

Employers should use properly designed and assembled scaffolds and/or ladders for working at heights over six feet.

The scaffold was an improvised and homemade scaffold made with scrap wood left over from the demolition work. This scaffold was unsafe and could have collapsed at any time. The unguarded wood plank from which the victim fell was an extension of this scaffold and was unsafe. Employers and employees need to always use properly designed and assembled commercial scaffolds and/or ladders when working at heights.

It should also be noted that fall protection is required in most cases when working six or more feet above the ground. However, for work involving scaffolds, OSHA doesn't require fall protection until 10 feet above the ground. A proper scaffold with safety railings is adequate, but more fall protection may be needed in other situations, such as during roofing, when a personal fall arrest system may be preferable.

3. What do employers need to do to protect workers on all construction jobs?

ANSWER:

Employers and employees should conduct a safety survey of the job site before starting work, and employees need to be properly trained.

Employers should conduct a safety survey of the work area with all employees. This should consist of a brief walk-through to look for any apparent hazards at the work site, such as fall, electrical, chemical, equipment, or other hazards they may encounter. Once found, the hazards can be corrected, and employees should be trained on all safety measures.

(From New Jersey Case Report: 03NJ091)

ACTIVITY: SUSPENDED SCAFFOLD CASE STUDY

Read the story and discuss the questions with your group.

A window washer died when he fell 60 feet from a swing stage scaffold onto the pavement below. The center shaft of the electric hoist operating one side of the scaffold failed. The primary and secondary brake of the hoist also failed, causing the scaffold to drop to a vertical position.

The window washer's employer was a small company that had been in business for 23 years. The window washer had 12 years of window washing experience, and training was done mainly on the job.

The site of the incident was a 12-story building with windows on all four sides. The north side of the building was landscaped with a parking lot. The building was equipped with permanent rooftop attachments to accommodate the scaffold rigging needs. The equipment being used was a swing stage, type-F, elevating scaffold. This scaffold measures approximately 20 feet long and 3 feet wide. It had a carrying capacity of about 2,000 pounds, and it was attached to the building by two 5/16" wire rope cables dropped from the roof. These cables were attached to electric hoists on each end of the scaffold, which raised and lowered the scaffold.

The electric hoist comes equipped with an emergency power cut-off, an over-speed secondary brake, and an auxiliary slack rope brake which attaches to a second wire rope. Also secured to the roof were two safety lifelines that were dropped over the side of the building for the workers to attach to their fall protection devices.

After the window washing was completed on a bank of windows, the scaffold was on the ground. The window washer and his co-worker decided to finish up for the day. They went to the roof of the building to transfer the scaffold over one bank and secure the safety lifelines on the roof. Upon returning to the scaffold at ground level and re-evaluating the job, the window washer decided to finish washing the windows on the building because they only had one bank of windows left.

The co-worker wanted to return to the roof of the building and drop the safety lifelines over the side, but the window washer convinced him to finish the job with him. The co-worker got in the scaffold, but he tied off to the guardrail of the scaffold.

The window washer and the co-worker then proceeded to raise the scaffold to the top of the building. About 60 feet from the ground, the left hoist suddenly failed, dropping the scaffold from a horizontal to vertical position. The window washer fell to the concrete parking lot below. The co-worker, who was tied off to the scaffold handrail, was able to climb onto the building balcony.

The paramedics arrived in less than five minutes, and found the window washer without a pulse and not breathing. He died from multiple blunt force traumatic injuries.

QUESTIONS

1. What should the window washer have done to protect himself and his co-worker? Why do you think he did what he did?

ANSWER:

Ensure employees always attach the lanyard to the fall protection harness and the independent safety lifeline before operating a swing stage scaffold.

All too often a sense of false security overtakes employees of high-risk occupations when repetitive tasks occur. With 12 years experience as a window washer, the repetitive act of attaching the lanyard over and over again without any incident could have created a sense of false security for the window washer. Had he taken the time to drop the lifelines and attach his lanyard, this incident still would have occurred, but he would be alive.

2. What are the other safety features of this scaffold which – *if they had been used* – might have prevented this accident?

ANSWER:

Ensure that all safety features of the hoist systems are used as prescribed by the manufacturer when feasible. The company could have required the workers to use all available safety equipment included with the scaffold, such as the auxiliary slack rope brake system.

This particular electric hoist came equipped with an auxiliary slack rope brake system. This system locks the hoist to a second wire rope whenever the main suspension wire rope is slack. It would require the installation of a second wire rope to be used. This system was not used on the day of the incident. Had it been incorporated, this incident might have been prevented.

3. Would having a supervisor there made a difference? Why or why not?

ANSWER:

Ensure employees are supervised when using window washing equipment and safety gear.

In this incident, there was no supervisor to stop the window washer when he began raising the scaffold without being properly tied off. Therefore, when the hoist failed, he fell to his death. Safe work practices can be assured through supervision, as well as training programs.

(Excerpted from California FACE Report #00CA003)

SUMMARY

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; s/he must also train employees, 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 you need a **qualified person**, someone who has very specific knowledge or training, to 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 you will place 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. Inspection of **supported** scaffolds must include:
 - Check metal components for bends, cracks, holes, rust, welding splatter, pits, broken welds and non-compatible parts.
 - Cover and secure floor openings and label 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. The OSHA standard requires that a worker have **fall protection when working on a scaffold 10 or more feet above the ground.**
 - OSHA requires the use of a **guardrail OR a personal fall arrest system** when working on a **supported scaffold.**
 - OSHA requires **BOTH a guardrail AND a personal fall arrest system** when working on a **single-point or two-point suspended scaffold.**

- OSHA requires 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 you have 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 can not be easily dislocated (no sand, no water, no rolls of roofing, etc).

(The term “tipping moment” refers to the number of *foot-pounds* where *weight times distance* of the *counterweight equals, or balances, weight times distance* for the *loaded scaffold*. Therefore, *multiplying the calculated weight of the counterweight by four* will ensure that the scaffold is able to resist at least “four times the tipping moment.” 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:
 1. how to use the scaffold, and understand how to recognize hazards associated with the type of scaffold they are working on;
 2. understanding the maximum intended load and capacity;
 3. recognizing and reporting defects;
 4. fall hazards, falling object hazards and any other hazards that maybe encountered, including electrical hazards (such as overhead power lines);
 5. having proper fall protection systems in place.

NOTE: Only some scaffolds were selected for this training. There may be additional hazards associated with other scaffolds that will not be covered in your training.

Training Evaluation – Focus 4 Construction Safety & Health

FALL PROTECTION

Date:

Location:

Trainer:

1. Overall, how would you rate this training?

Excellent Good Fair Poor

2. Were the teaching methods (activities, exercises) effective?

Yes No Not sure

3. Were the handouts and materials useful?

Yes No Not sure

4. Will the information you received in this workshop be useful on your job?

Yes No Not sure

5. What did you like most about this training?

6. What did you like least about this training?

7. Please feel free to make additional comments or to suggest ways to improve the training.
