

# Fall Protection and Fall Prevention

San José State University  
Environmental Health and Safety  
Facilities Development & Operations

# Learning Objectives

- To understand the hazards of falls
- To understand when fall protection equipment is required
- To know how to use, inspect, store, and wear fall protection equipment
- To understand the hazards of using fall protection equipment
- How to use and inspect various ladders



# Why Fall Protection ?

- Falls account for 10% of fatal work injuries.
- The act of falling is not painful, it's the sudden stop that causes the pain and injury.
- Force of Impact  
= Body Weight x Fall Distance
- LD50 = Lethal Distance 50%  
= 11 Feet
  - Golden Gate: 11 fatalities
  - Empire State Building: 7 fatalities.









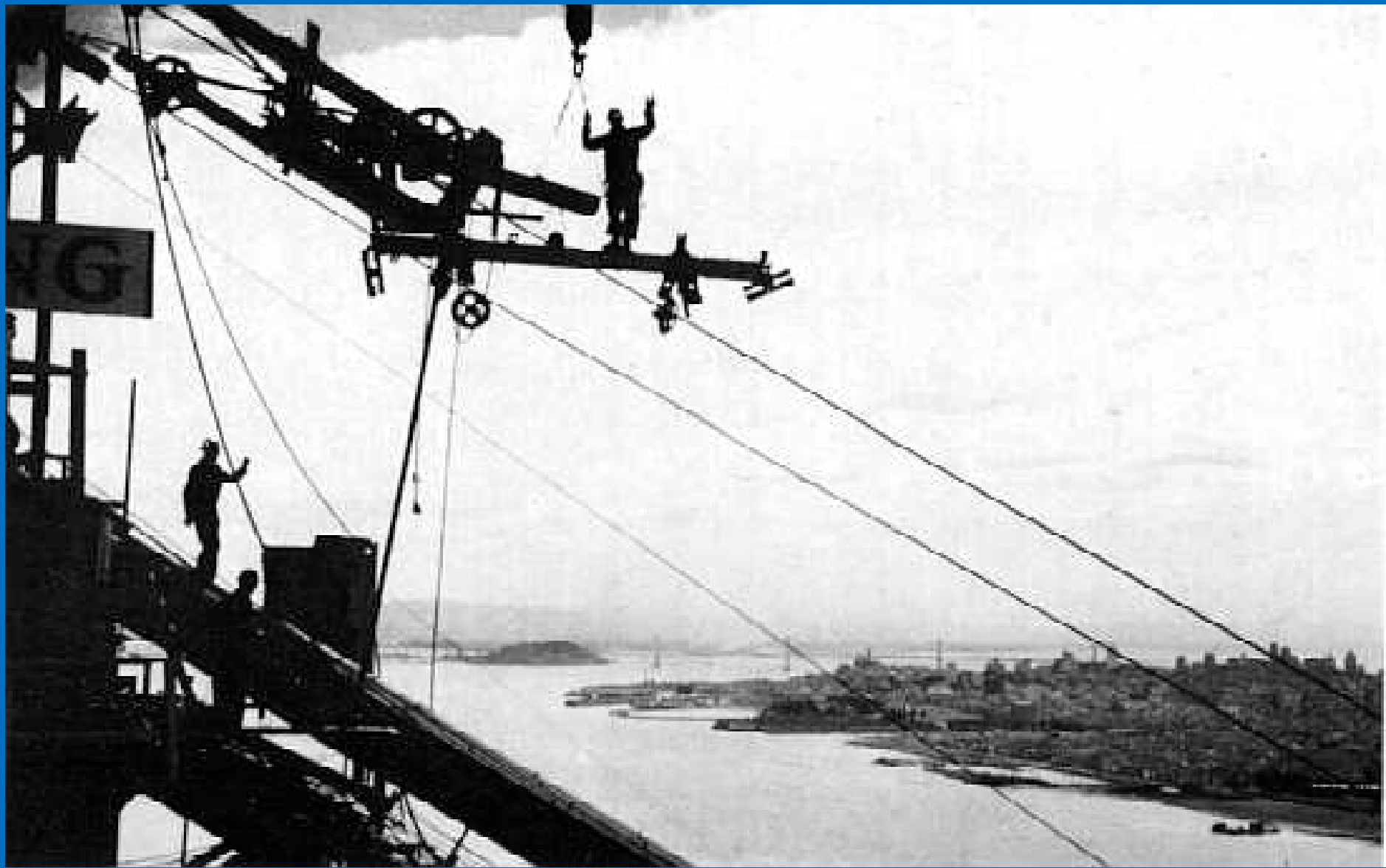














# Fall Protection and Fall Prevention

Fall Arrest  
and Fall Protection

versus

Fall Restraint  
and Fall Prevention



FALL ARREST

VS.



FALL RESTRAINT

# Fall Arrest – Fall Protection

Fall arrest is a system that is used primarily as your main form of fall protection.

- It only comes into its intended operation in the event of a fall.



# Fall Restraint – Fall Prevention

- A fall restraint system is one that will allow the worker to work at a leading edge while preventing the worker from reaching a fall hazard.
- This type of restraint system is often compared to a leash.
- It restricts the worker's movements enough to prevent them from traveling beyond the fall hazard.



# Cal/OSHA Standards for Fall Protection

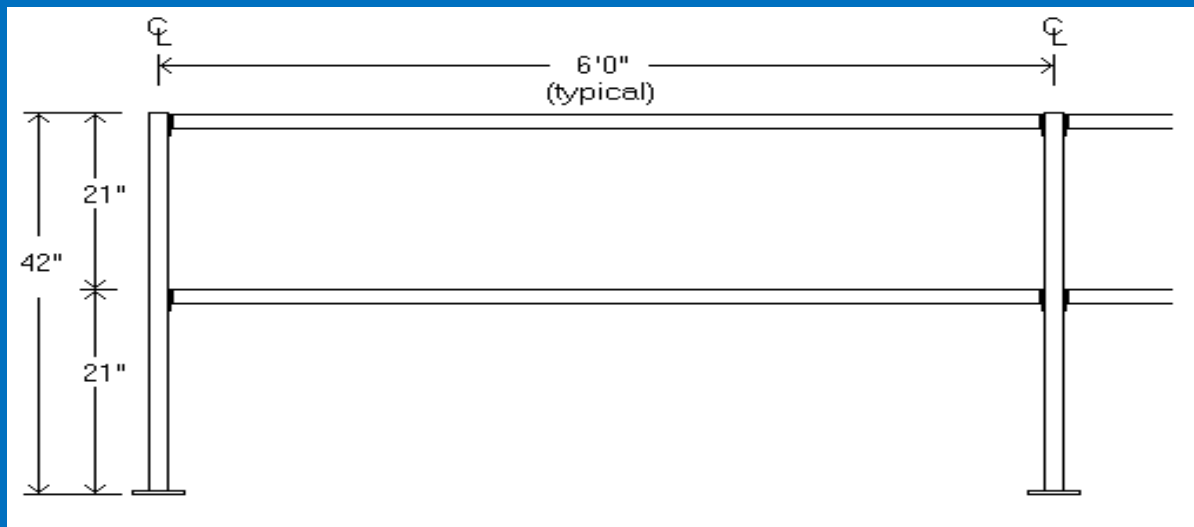
## **FALL PROTECTION TRIGGER HEIGHTS**

⇒	Above 30' -	<i>Iron workers: Connecting steel only</i>
⇒	Above 20' -	<i>Roofers</i>
⇒	Above 15' -	<i>Iron Workers, panelized roof construction (Section 1716.1), and employees on 4 inch nominal or wider structural members.</i>
⇒	Above 7½' -	<i>Anyone working on unprotected platforms, scaffolds, or edge of structures.</i>
⇒	Above 6' -	<i>Rod busters: Working with rebar (exception is point to point travel)</i>
⇒	Grade or Ground	<i>Not required</i>



# Fall Protection

- Guardrails
  - Required for elevated work locations more than 30 inches above the floor.
  - Top rail 42 – 45 inches from work surface.
  - Mid-rail approximately halfway between top rail and work surface.
  - Vertical posts every 6 - 8 feet.



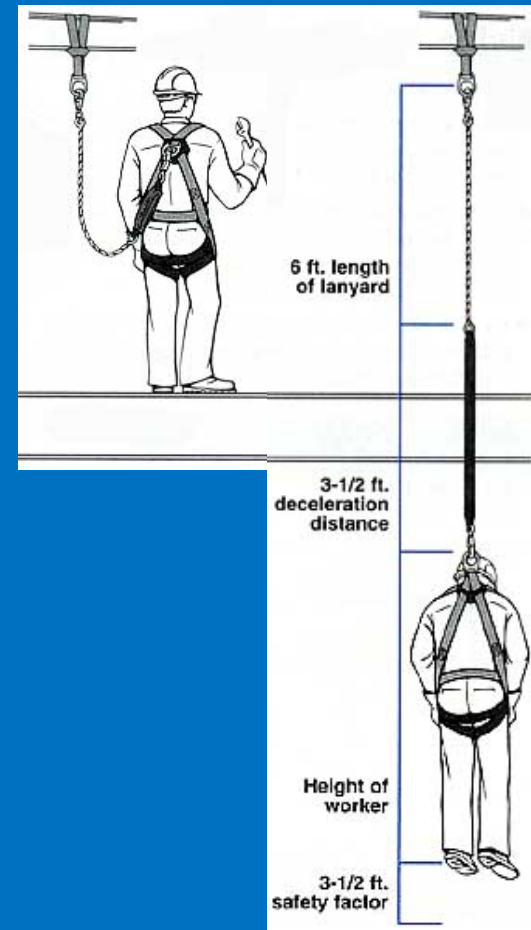
# Fall Protection

- Fall Protection Required
  - ... if unguarded working surface is in excess of 7.5 feet above the surface below (Construction Safety Orders)
  - Boom-type aerial lifts.
  - Fixed ladders over 20 feet.
  - Within 6 feet of roof edge, skylight or floor opening.

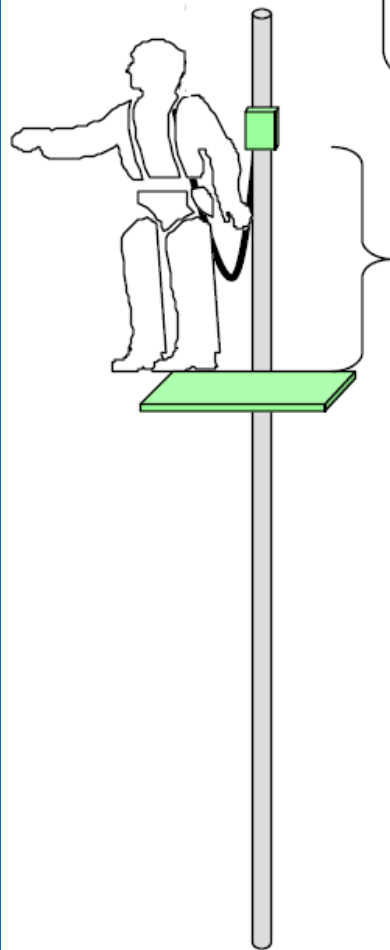


# Personal Fall Arrest System (PFAS)

- Passive systems
  - They don't prevent falls, they prevent you from striking next lower level.
  - Must not allow a free fall of greater than 6 feet.
  - Must be properly worn and rigged.
  - Injuries may still occur.
  - Must not be used for any other purpose.

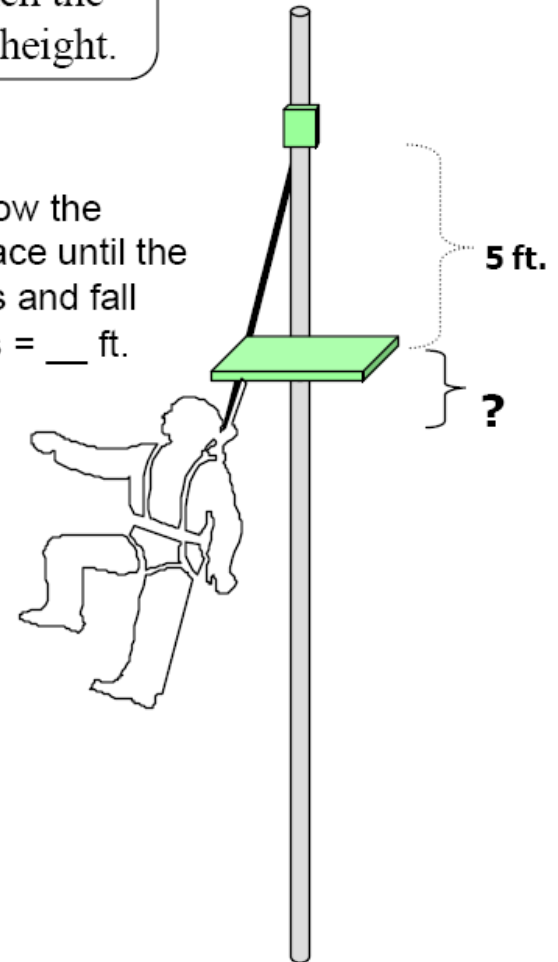


Let's calculate the fall distance using a six foot, shock absorbing lanyard, when the anchorage is at shoulder (D-Ring) height.



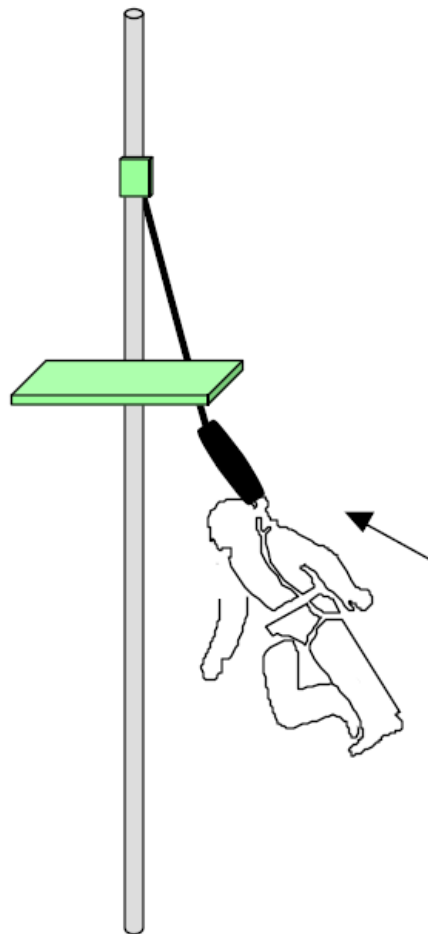
Distance from the anchorage/ D-Ring to the working surface = **5 ft.**

Distance below the working surface until the free fall stops and fall arrest begins =      ft.



**Free fall distance =      ft.**

If the anchorage is at shoulder/D-Ring level the free fall distance includes the area from the D-Ring location between the shoulders to the surface (approx. 5 ft.) plus the remaining one foot of lanyard falling below the surface. **This gives us a total free fall distance of six feet.**



*5 ft. from the anchorage/  
D-Ring to the working surface*

+

*\_\_\_ ft. below the working surface*

=

*\_\_\_ ft. free fall*

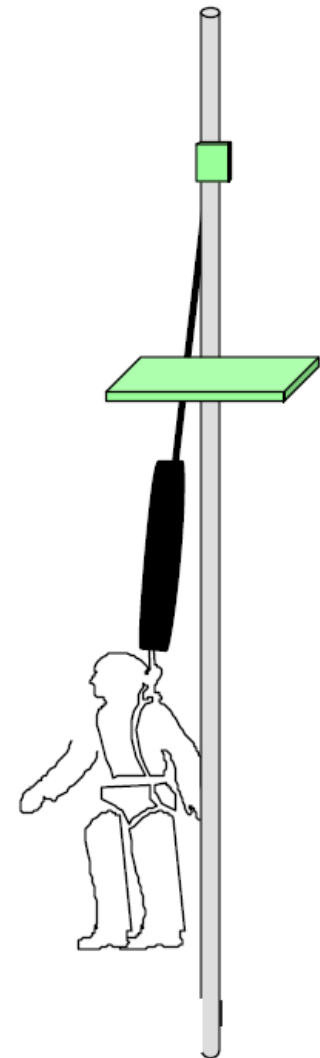
+

*3.5 ft. from shock absorber elongation*

+

*\_\_\_ ft. - you came down too!*

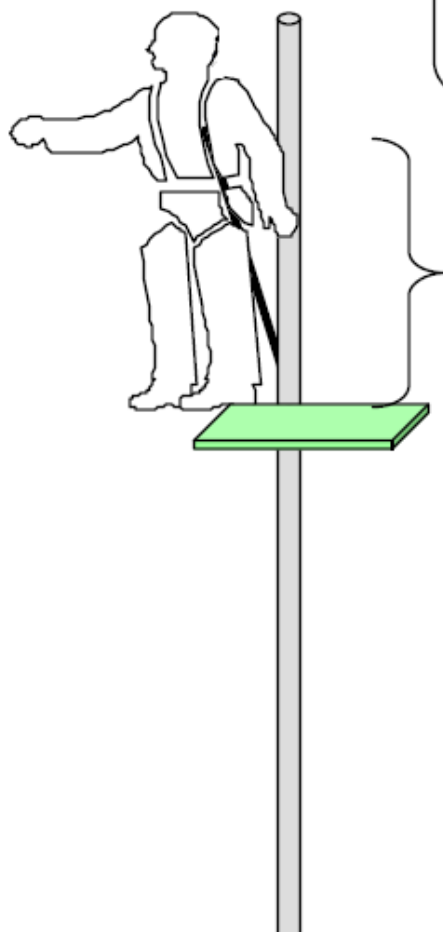
**= 14.5 ft. Total Fall Distance**



22

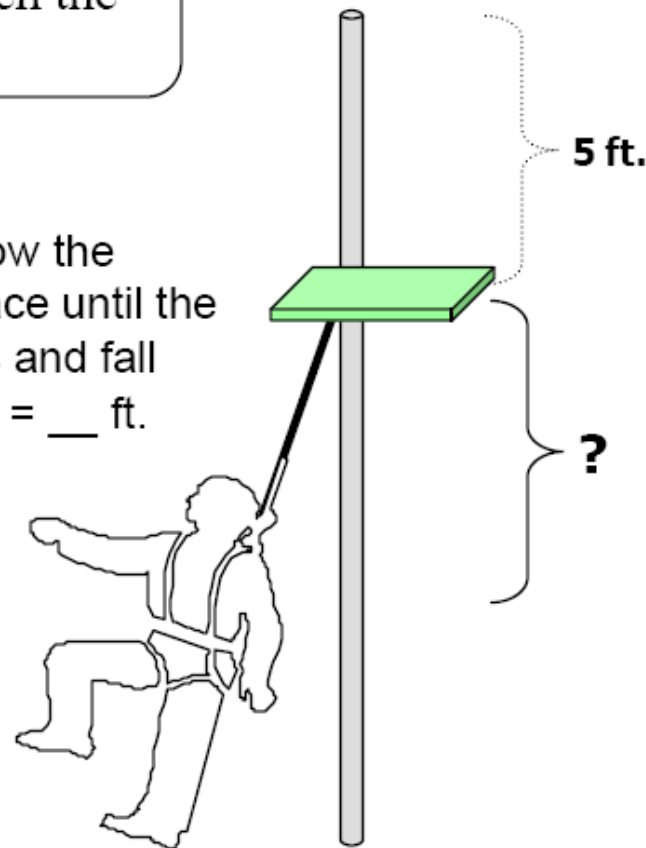
In this case, the worker would maintain the maximum allowable free fall of six feet. If the anchorage were two feet above shoulder level, the free fall would only be four feet. Any additional distance the worker falls beyond the free fall is added to the free fall distance and referred to as the *total fall distance*.

Let's calculate the fall distance using a six foot, shock absorbing lanyard, when the anchorage is at your feet.

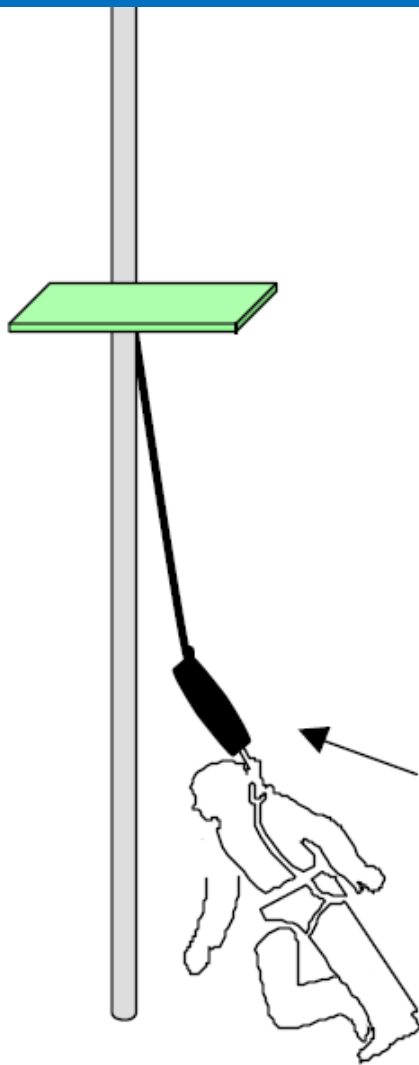


Distance from the D-Ring to the working surface = **5 ft.**

Distance below the working surface until the free fall stops and fall arrest begins =      ft.



When the anchorage is at your feet the free fall still includes the area from the D-Ring location between the shoulders to the surface (approx. 5 ft.) plus the remaining length of lanyard below the surface.



*5 ft. from the D-Ring to the working surface*

+ *\_\_\_ ft. below the working surface*

= *\_\_ ft. free fall*

+ 3.5 ft. from shock absorber elongation

+ *\_\_\_ ft. - you came down too!*



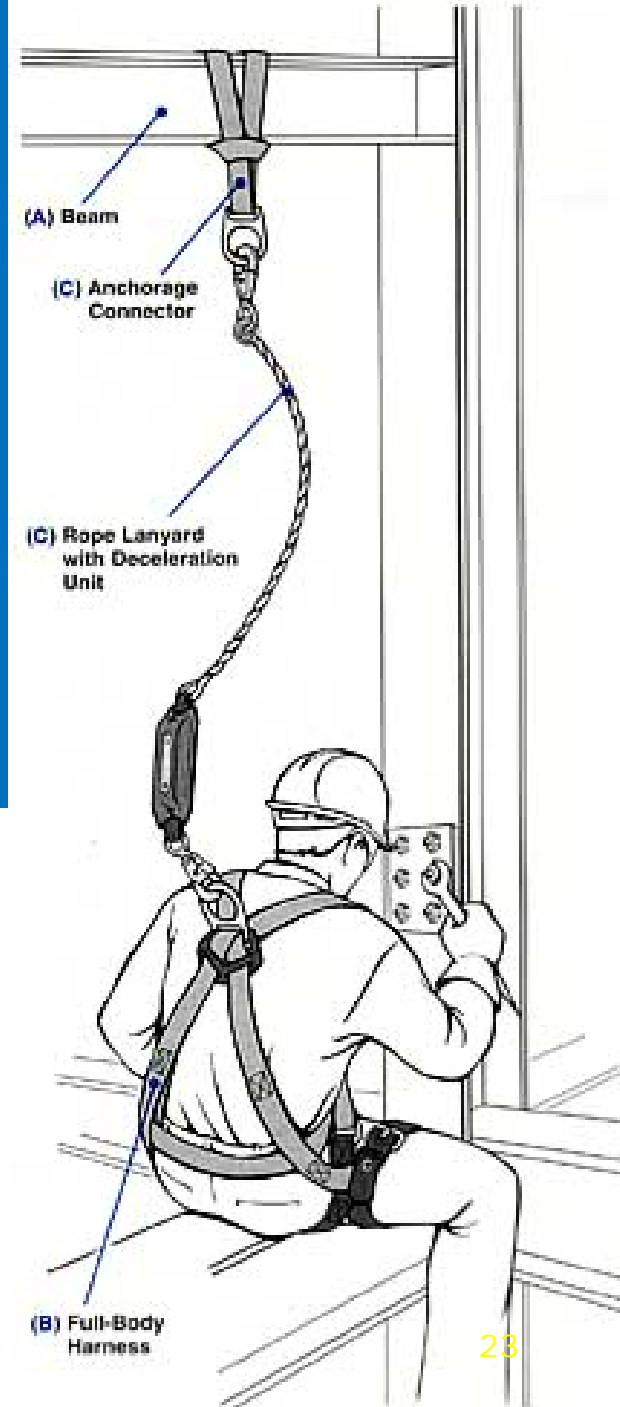
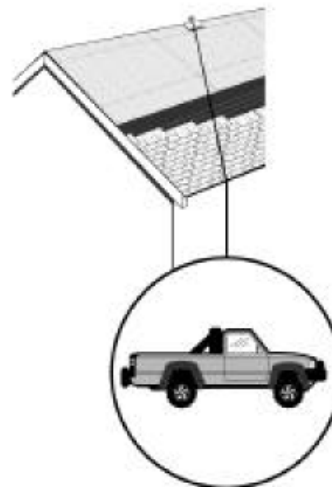
**= 19.5 ft. Total Fall Distance**



# PFAS Components

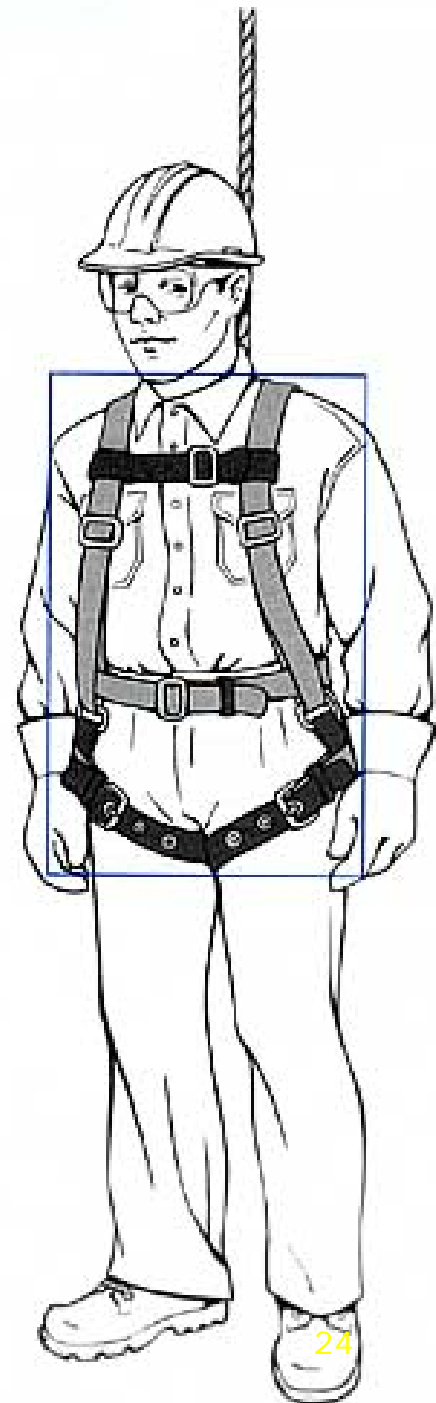
- Anchorage
  - Rated to 5,000 pounds for each connection.
    - Not to water lines, electrical conduit or T bars.
  - Directly above worker.
  - At or above harness hookup point.

*Would you suspend your  
truck from this anchor point?  
If not, don't use it!*



# PFAS

- Full body harness
  - ANSI approved for PFAS.
  - Distribute arresting forces on thighs, pelvis, waist, chest and shoulders.
  - Hookup at dorsal D-Ring.
  - Rated for 1,800 pounds of arresting forces.
    - ***310 pound body weight limit***
  - Tolerable suspension time of 15 minutes.
  - Snug fit.
  - Wear chest strap low.



# Body Belts

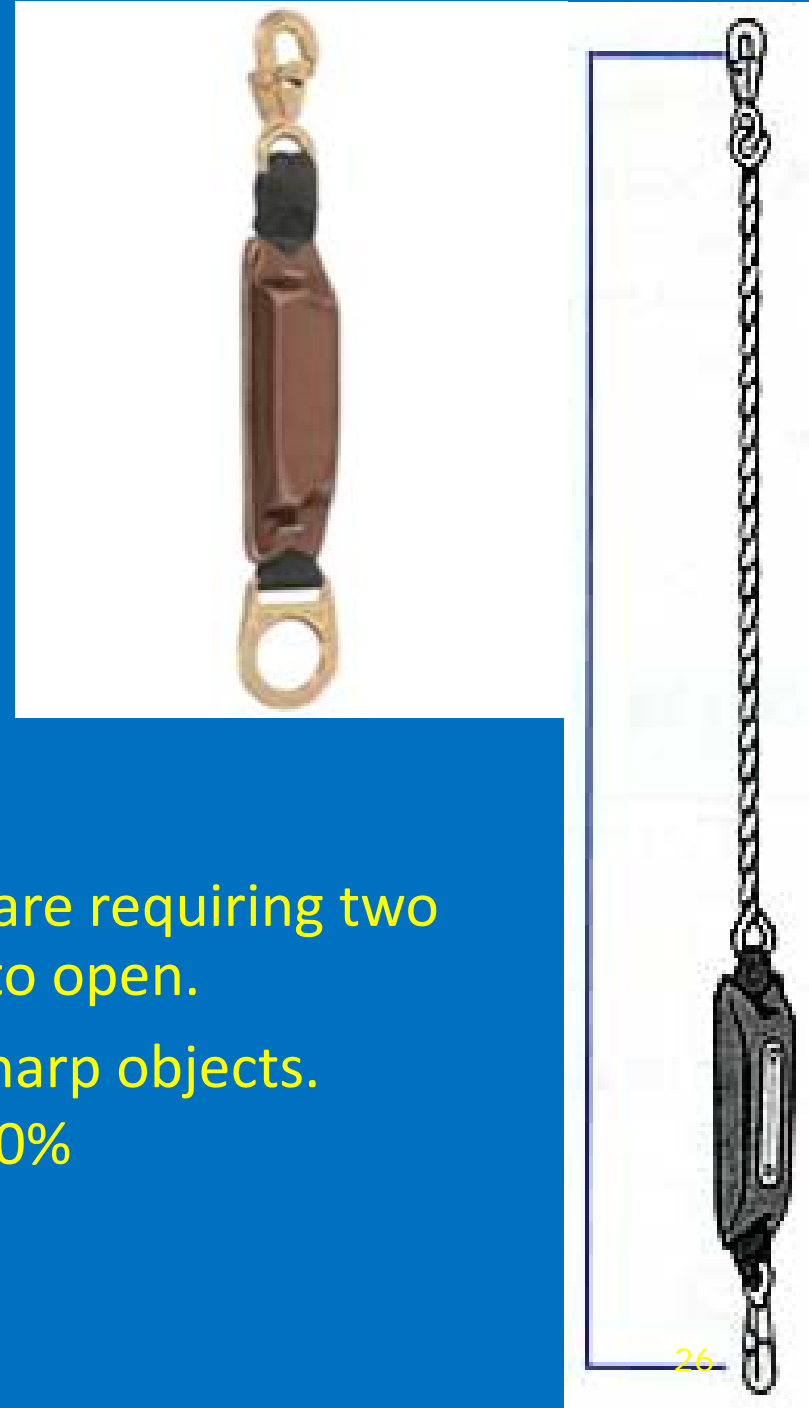
- Body Belts
  - No longer allowed for fall arrest (January 1, 1998).
  - Damage to spine and internal organs.
  - Mechanical asphyxiation.
  - Tolerable suspension time of 90 seconds.
  - May be used for positioning and restraint.



# Lanyards

ANSI approved for fall arrest

- 6 feet or less in length.
- Deceleration/breaking device.
  - Rip stitch or stretch
    - Single use only
  - Self retracting lanyards (web or wire rope).
  - Self closing, self latching hardware requiring two consecutive deliberate actions to open.
  - No knots or wrapping around sharp objects.  
May reduce strength by up to 70%



# Anchorage Devices

ANSI approved

- Straps
- Carabineers
  - Self closing, self latching, with two deliberate actions to open.
  - May not be linked together.
- Girder grips
- Beam trolleys

DBI/SALA



Figure 2



Figure 3

# The Fall

*'It's not the fall that's hurts but the sudden stop at the end'.*

- When the fall does come to a complete stop, the action is referred to as the fall arrest.
- This force imposed during the arrest is known as the **arrest force**.



*For example: A 220 lb. worker:*

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

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

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

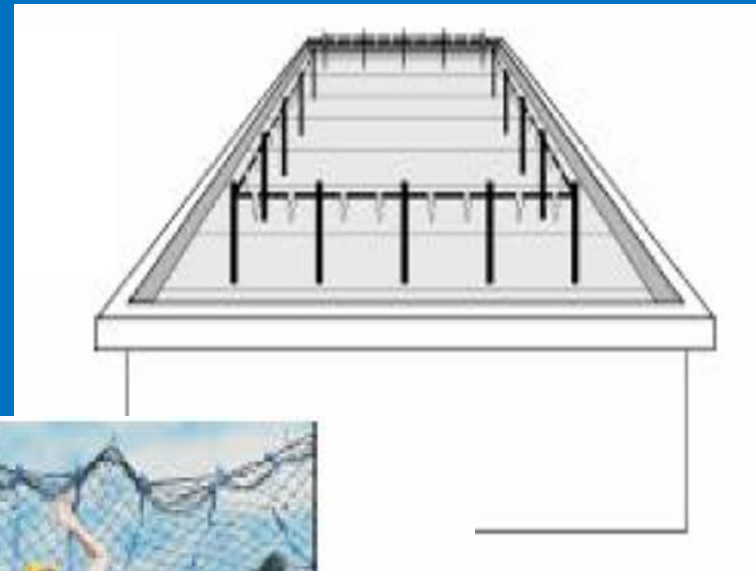
# Inspection of Equipment

- Inspect all equipment before every use.
- Cuts, tears, abrasions, torn stitches.
- Elongation of D Rings and cracks, breaks in snaps.
- Red warning threads.
- Activate all components.
- No alterations.
- Each lanyard can only be used for one fall arrest.
- If used in fall arrest report the incident and return all components to EH&S for further inspection.



# Fall Protection / Prevention Methods

- **Travel Restrict Systems**
  - Full body harness.
  - Anchorage and lifeline designed for two time maximum expected horizontal forces.
- **Warning Line**
  - 6 feet from edge, 34-39 inches tall, tipping force 16 pounds horizontally and 500 pounds tensile strength.
- **Safety Nets**
  - Designed by Professional Engineer, employees trained.
  - Only used if other methods can not be used.



DBI/SALA

# Personnel Lifts

## Boom-type aerial lifts

- PFAS required upon entry into platform.
- Connect to designated anchorage, not to guardrail.
- Do not connect to adjacent structures.
- No protection if vehicle tips over.
- **Avoid potential catapult conditions.**



3648 (GISO)	<i>Approved fall restraint systems required in aerial devices (man basket)</i>	<i>When working from an elevated aerial device, worker must be secured to the boom, basket or tub by proper safety device (i.e. fall arrest or restraint device).</i>
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# Personnel Lifts

## Scissor Lift

PFAS not required unless:

- Both feet are not firmly on the platform.
  - No standing on objects to gain height.
- Leaning over top rail or between rails.
- Guardrails not in place around entire platform.
- Guardrails less than 39 inches in height.
- Entrance gate not closed and secured.



# Equipment Storage

Responsibility of user.

- Store separate from other equipment.
- Hang by dorsal D-Rings and snap hooks.
- Avoid environmental factors;
  - Heat
  - Sunlight
  - Moisture
  - Chemicals and their vapors



# Plan for Rescue

Assume that a fall will occur.

- Where will you fall to?
- Will you swing into anything?
- Where will you end up?
- How will you get down?
  - Climb down?
  - Scissor Lift?
  - Aerial lift?
  - Ladder?
- Buddy system.





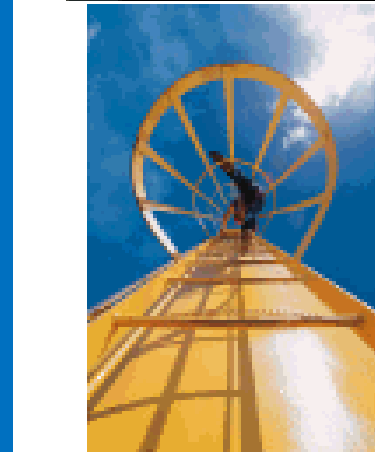
# Fixed Ladders over 20 feet

Equipped with cage beginning at 8 feet.

- Always maintain 3 points of contact.
- Ascend and descend slowly.
- If you fall, put your arm in the first ring of the cage you encounter.

Rope or bar in front of rungs.

- Rope or bar grab.  
Ascend freely, descend with releases.
- Chest D Rings.



# Portable Ladders

## Basic Ladder Safety;

- Inspect prior to each use, tag and remove from service if defective.
- Maintain ladder in a safe working condition.
- Stable footing/base.
- Do not position on elevated platform.

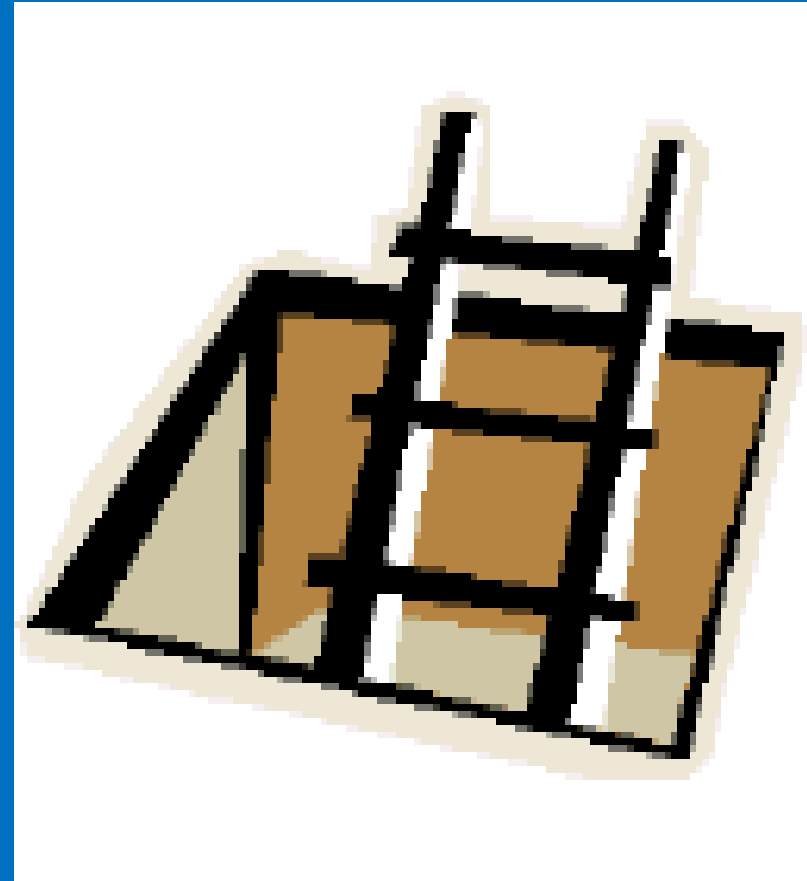




# Portable Ladders

## Basic Ladder Safety

- Extend 3 feet above roof or platform.
- 1 foot out for every 4 feet up.
- Have helper steady ladder and tie top off on first ascent.
- Never stand or sit on the top two rungs.



1675  
1676

*Ladders-safe access  
Job-made ladders*

*Ladders must extend 36 inches above landing and be secured from displacement-face ladder using both hands. Use only properly constructed ladder.*

# The End



# Fall Protection Quiz

1. True / False Falls account for 10% of all workplace fatalities.
2. True / False The Lethal Distance 50% for falls is 11 feet.
3. True / False Elevated work locations 30 inches or more above the floor are required to have guardrails.
4. True / False The top rail of any guardrail is required to be 42 - 45 inches from the work surface.
5. True / False A personal fall arrest system is required to be worn at all times in a aerial boom lift.

# Fall Protection Quiz

6. Fall protection must be provided for all fixed ladders over?
  - A) 7.5 feet
  - B) 11 feet
  - C) 20 feet
  - D) There is no requirement for fixed ladders
7. Fall protection anchorages must be rated to?
  - A) 310 pounds
  - B) 2200 pounds
  - C) Twice the weight of the worker
  - D) 5000 pounds
8. Fall protection equipment is approved for use by which organization?
  - A) OSHA
  - B) ANSI
  - C) ACGIH
  - D) EPA

# Fall Protection Quiz

9. Body belts may be worn for fall protection?
- A) When the worker is too large for full body harness (over 310 pounds)
  - B) The fall exposure is less than 11 feet
  - C) Never
  - D) When they are approved by OSHA
10. Lanyards are connected to a full body harness at the?
- A) Waist strap
  - B) Pectoral D ring
  - C) Chest strap
  - D) Dorsal D ring
11. Knots tied into lanyards reduce the strength of the lanyard by what percentage?
- A) 5 - 10
  - B) 20 - 30%
  - C) 50 - 70%
  - D) Knots have no effect on lanyard strength

# Fall Protection Quiz

12. Lanyards equipped with deceleration devices may be used to arrest how many falls?
- A) None
  - B) One
  - C) Two
  - D) There is no limit
13. How many workers are allowed on a single anchorage?
- A) None
  - B) One
  - C) Two
  - D) There is no limit
14. Personal fall arrest systems must not allow an employee to free-fall more than?
- A) 30 inches
  - B) 6 feet
  - C) 11 feet
  - D) No free fall is allowed

# Fall Protection Quiz

15. What component is no longer allowed in a personal fall arrest system?
- A) Self closing self latching hardware
  - B) Y lanyards
  - C) Full body harnesses
  - D) Body belts
16. If a 16-foot extension ladder is placed against a wall how far should the base of the ladder be from the wall?
- A) 3 feet
  - B) 4 feet
  - C) 5 feet
  - D) 6 feet
17. All fall protection connectors must be?
- A) Self closing
  - B) Self latching
  - C) Require two deliberate actions to open
  - D) All of the above

# Fall Protection Quiz

18. Fall protection equipment is required to be inspected?

- A) At the beginning of each use
- B) At the end of each shift
- C) Once per month
- D) There are no requirements for inspection frequency

19. How far must ladders extend above a roof or platform?

- A) 1 foot
- B) 3 feet
- C) 6 feet
- D) There are no requirements

20. Employees must not stand on which rung (s) of a portable ladder?

- A) Top
- B) Top two
- C) Bottom two
- D) Top three



# The End

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