Fall Protection

Susan Harwood Grant Training Program

2019

Fall Arrest

Learning Objectives

- Identify the components of a proper personal fall arrest system (PFAS)
- Understand how to calculate total fall distance
- Recognize the OSHA requirements for anchorage points
- Understand the importance of an effective fall rescue plan

Fall Arrest System Design Factors

- The purpose of a fall arrest system is to reduce the risk of injury from an accidental fall to an acceptable level.
- The risk of injury from a fall can never be eliminated, only reduced.

Free Fall Distance

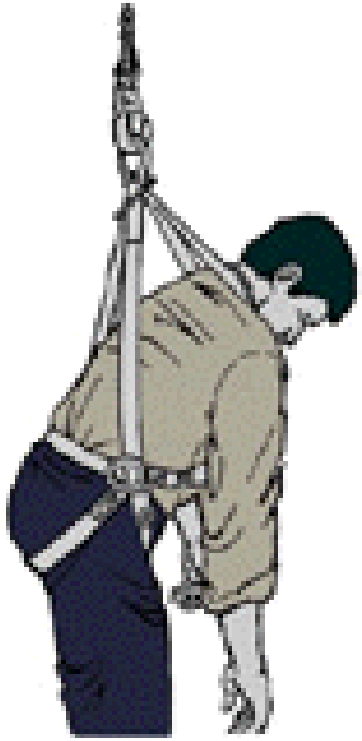
- How far a worker falls before shock absorbing or deceleration equipment begins to take effect
  - Affects both impact forces and total fall distance
- Anchorage point location in relation to D-ring height
  - Below the D-ring allows excessive falls
  - Above the D-ring minimizes free fall to less than 6’

The Catch/Arrest

- Even if you are using a fall arrest system, your body will not be braked at a uniform rate - certain parts will experience localized acceleration in relation to others.
- The duration and distance of your deceleration, and the degree to which parts of your body are stressed, depends on many factors including
  - Weight
  - distance you fall
  - characteristics of the fall arrest system
  - the orientation of your body at the onset of deceleration

Suspension

- The ***Suspension Phase*** of a fall lasts until you are rescued (assuming that you cannot regain your footing without assistance).
- You may be unconscious or incapacitated in some way.
- Your tolerance for suspension without risk of serious or fatal injury is relatively short especially if you are not in peak physical condition.



Fall Arrest Systems

- Must be able to support a 5,000 lbs load.
- Must be properly inspected before use.
- Must limit the fall distance to 6 feet before deceleration or harnesses must not exert more than 1,800 lbs.
- ANSI requires no more then 900 lbs. of force on the body

Primary Concerns

- Impact Force to the Body Less Than 1800# (with a harness)
- Maximum 6’ Free Fall Distance
- May Not Hit Structures Below
- Maximum Weight of Individual w/Tools of as rated by manufacturer

Personal Fall Arrest System

- A full Fall Arrest System consists of:
  - An anchorage
  - 2 lanyards
  - a body harness
- When fall arrest is used it must designed to be used 100% of the time.
- You must utilize fall protection while installing fall protection when ever possible.

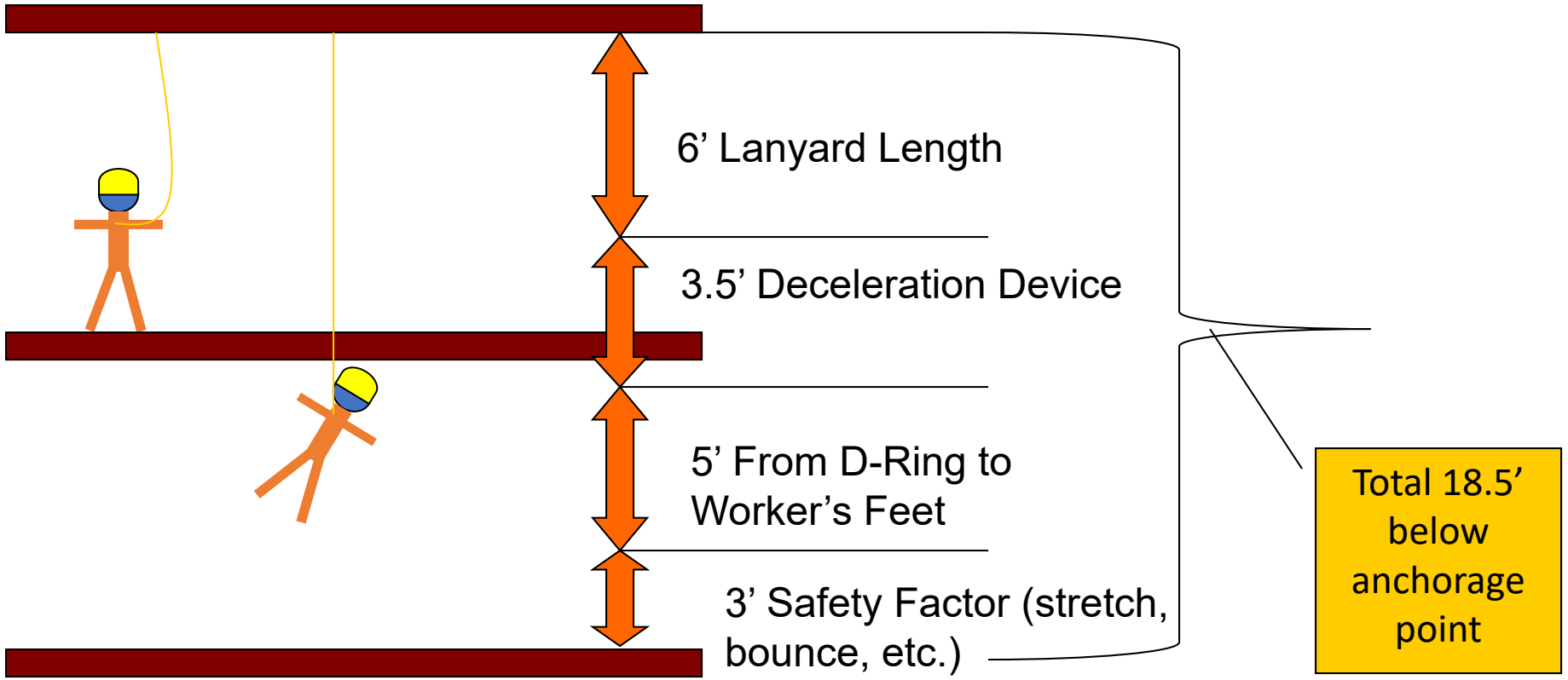
The 3 Most Important Questions

1. How far will I fall before I am completely stopped?
2. What will I hit on the way down?
3. How will they get me down?

Impacting Structures Below (Total Fall Distance)

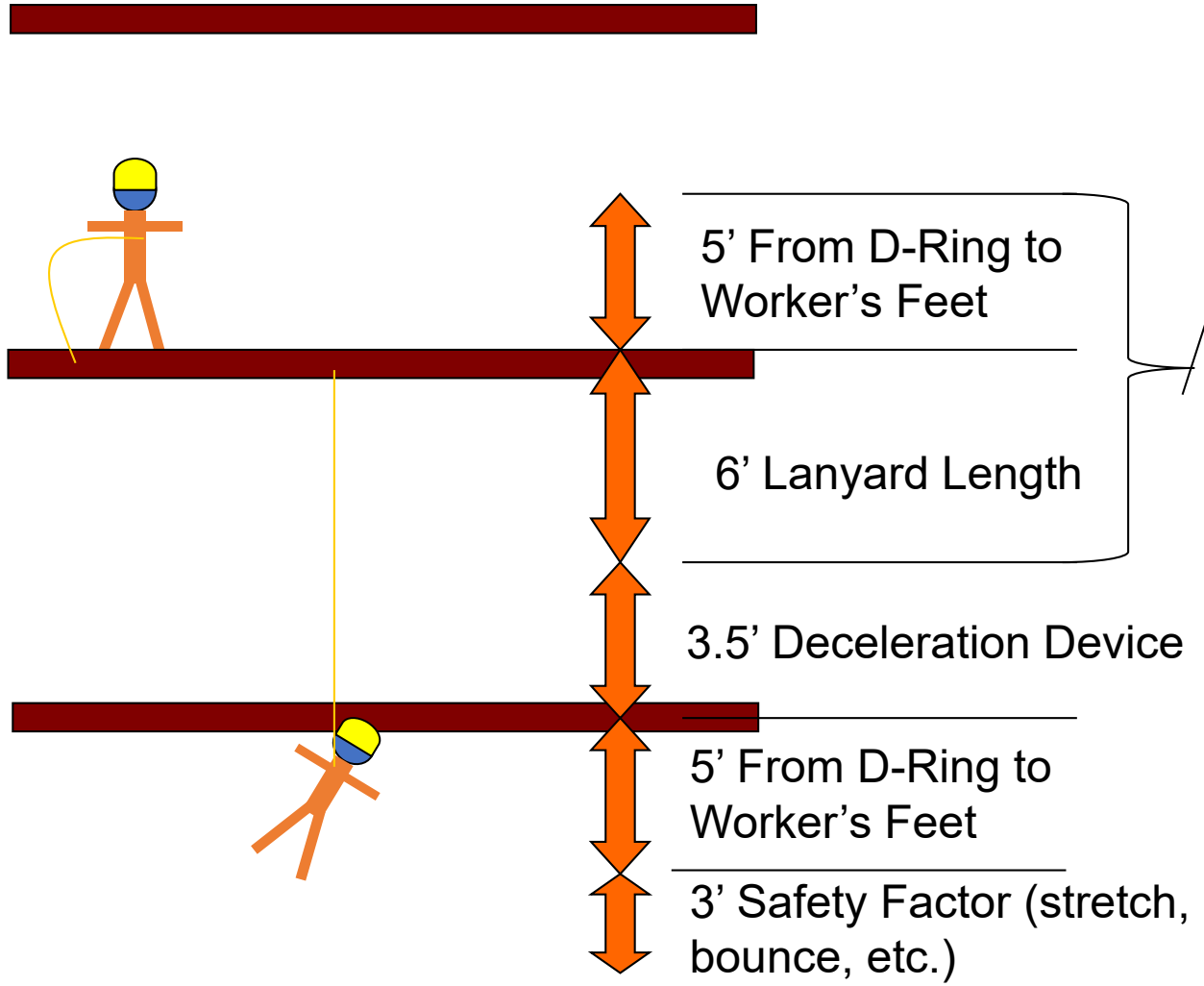
- **Consider:**
  - anchorage point location in relation to D-ring height
  - lanyard length,
  - harness elongation,
  - shock absorber opening length,
  - body below D-ring
  - body viscosity (soft tissue injuries!)

Impacting Structures Below (Total Fall Distance)



All distances are approximate, and shown for illustration only. This is why it is critical to maintain the safety factor distance!

Free Fall Distance or “Vertical Displacement”



Total 11’ travel distance of d-ring before fall arrest takes effect. This potential impact force exceeds many lanyard capacities (and OSHA standards).

When added to “total fall distance”, anchoring at the feet can become problematic

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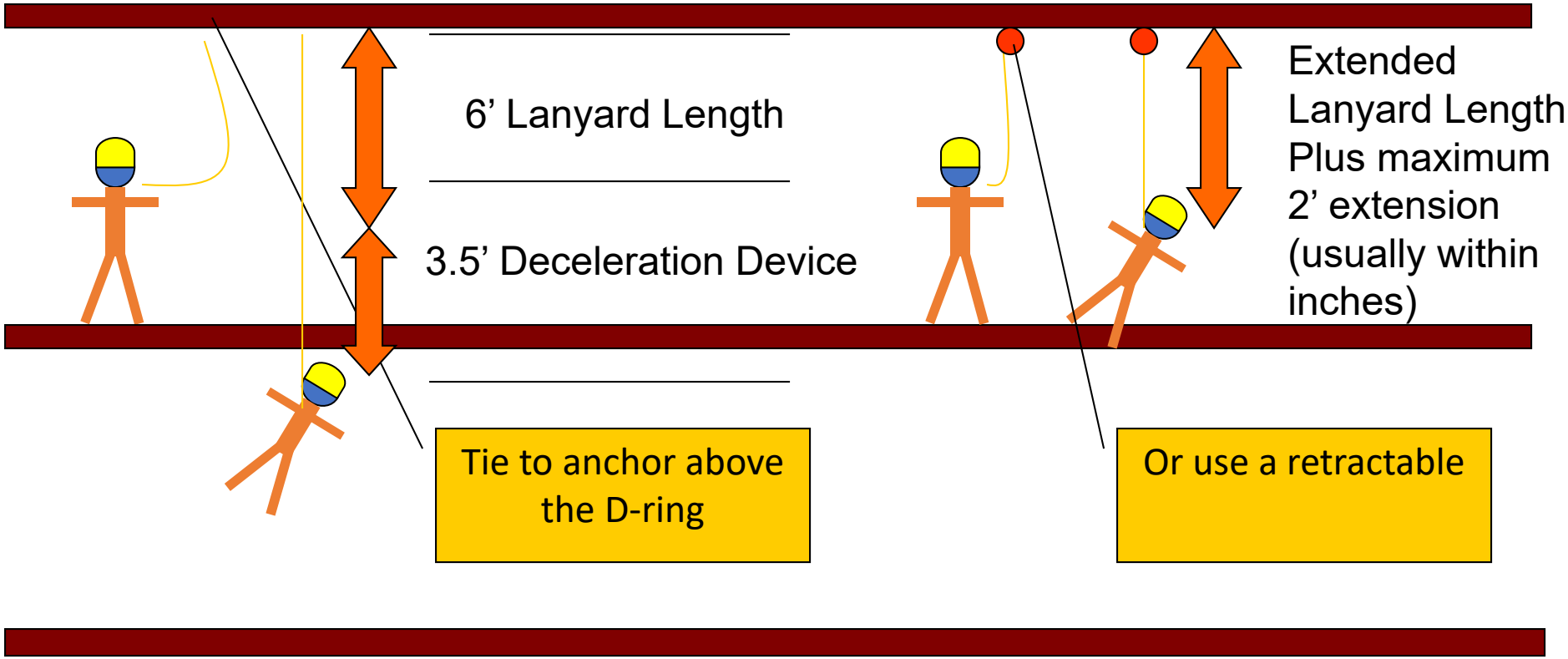
Minimizing Free Fall Distance or “Vertical Displacement”



Using an anchorage above the D-ring and a standard lanyard may still allow an employee to fall a distance that may be difficult to rescue from. Using a retractable minimizes forces on the body, and may make rescue easier (and therefore more timely)

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Fall Distance Exercise

- These workers are tied to the beams they are standing on with choker slings.
- How far will they fall?
- Calculate free fall distance
- Calculate total fall distance

Personal Fall Arrest Systems

- **Anchorage**
- **Body**
- **Connector**

Anchorages

- Must support 5000# per employee attached,
  - Or as part of a complete personal fall arrest system which maintains a safety factor of at least two
  - Or 3000# when using fall restraint or a Self-Retracting Lifeline (SRL, Retractable, or “yo-yo”) which limits free fall distance from 2 – 4.5 feet
- Should always be at or above D-ring height

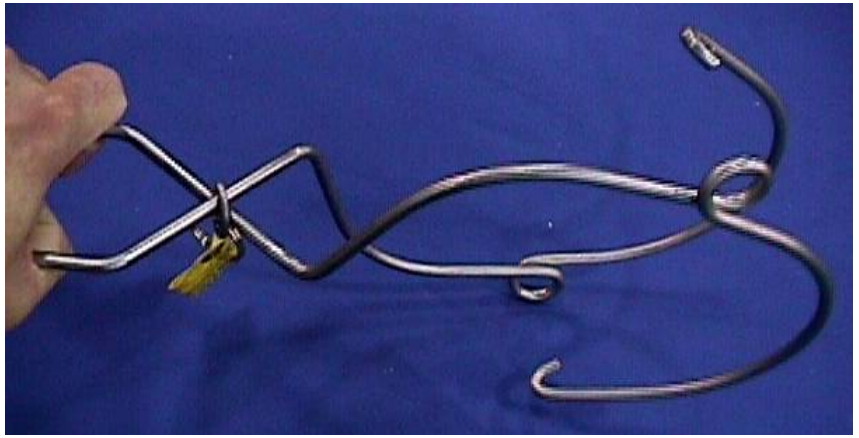
Roof & Deck Anchors

Permanent Anchors

Wood Roof Anchor

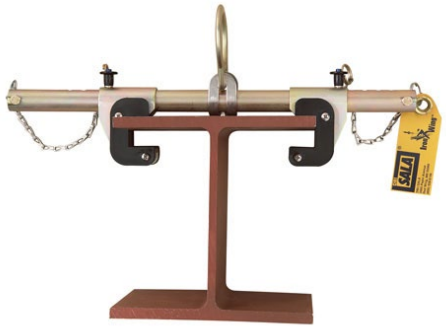
Metal Roof Anchor

Various Anchors



Beam Clamps

Beam clamps can make an effective anchorage when used properly, and with the correct lanyard



Be sure the beam clamp is tight and will not slide off ends.

Anchorage Points

- What if I don't have an identified anchorage point?
  - Use a building structural beam
  - What if I don't know what force my anchorage point will hold?
  - Minimize the arresting force
- Engineers need time to do their work – pre-planning is key!

Wrapping Beams

- **Beams can be wrapped by:**

Beam Wraps

Wrap-Around lanyards

Safe-T-Straps

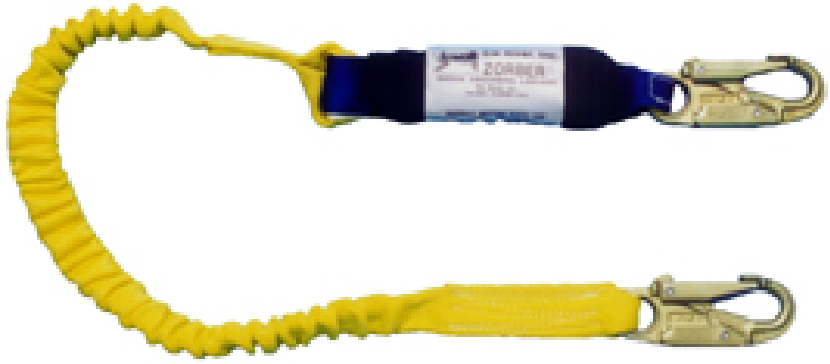
- Safety straps are effective simple anchors in concrete construction.
- They slip over rebar and are them embedded in the concrete.

Concrete Re-usable Expansion Anchors

- Designed for **vertical or overhead surface applications** Designed for **single user** fall protection applications.
- A hole is drilled into cured concrete and the anchor is insert
- Wedges tighten up against the hole sides

Shock Absorbers

- The most common type of shock absorber is a rip-stitch pouch that is attached integrally to a lanyard for fall arrest or a stitched lanyard.

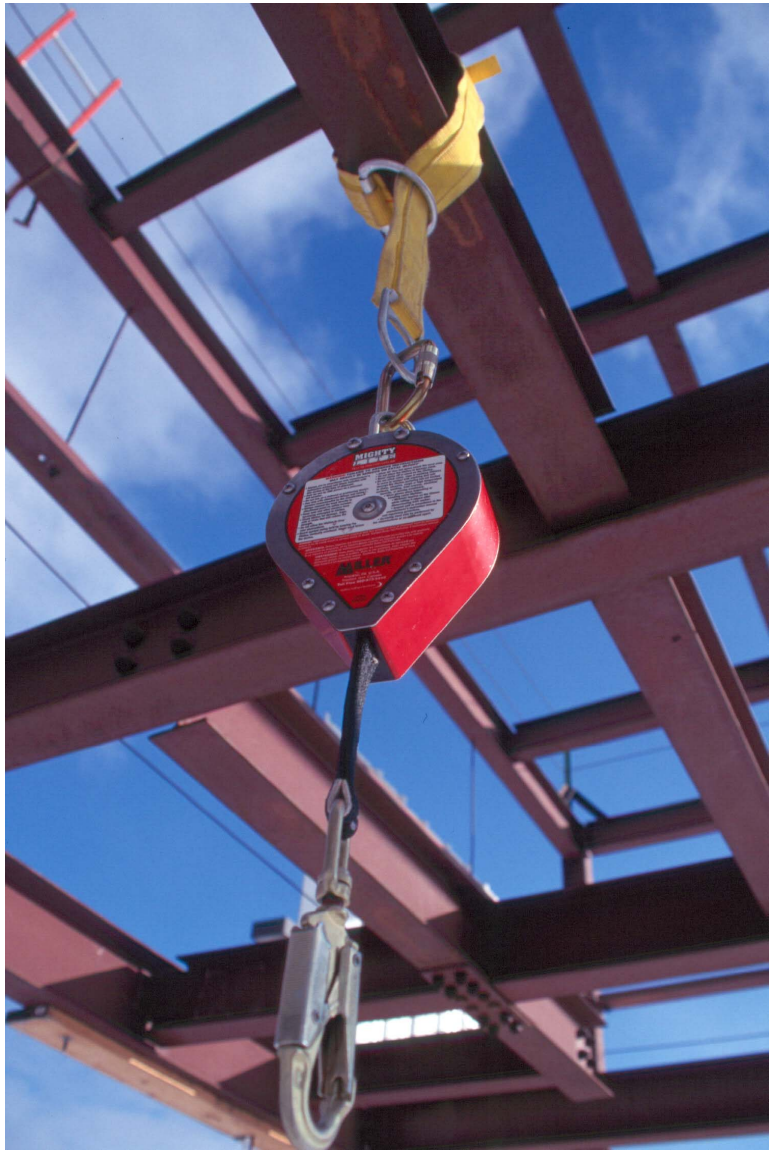


Double Leg Lanyard

- Recommend as an option to maintain 100% fall protection while moving where one lanyard is hooked at all times.

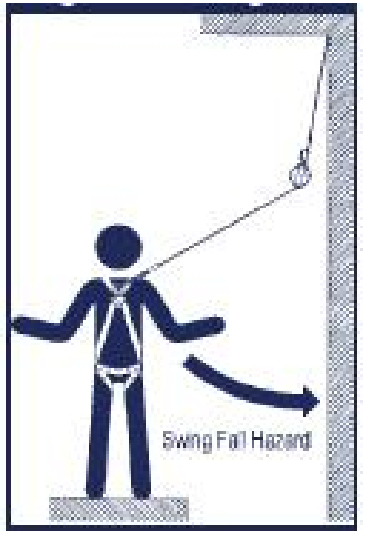
Retractable Lifelines

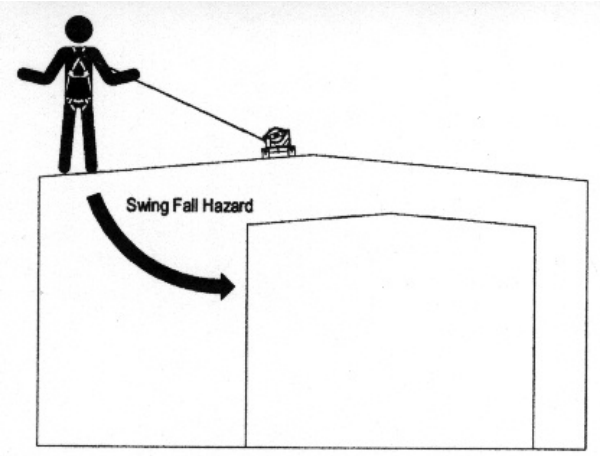
- Very effective for vertical applications.
- Will normally lock up in 2 – 4.5 feet, minimizing total fall distance and impact forces on the worker's body.



Retractable Issues

- Workers who move away from retractables are subject to swing falls.
- Retractables must be attached directly to the harness or a short D-ring extender





Safety Ropes

- A rope grab *fall arrester* travels on a *lifeline* and will automatically engage the lifeline and lock to arrest an accidental fall of a person.

Safety Ropes

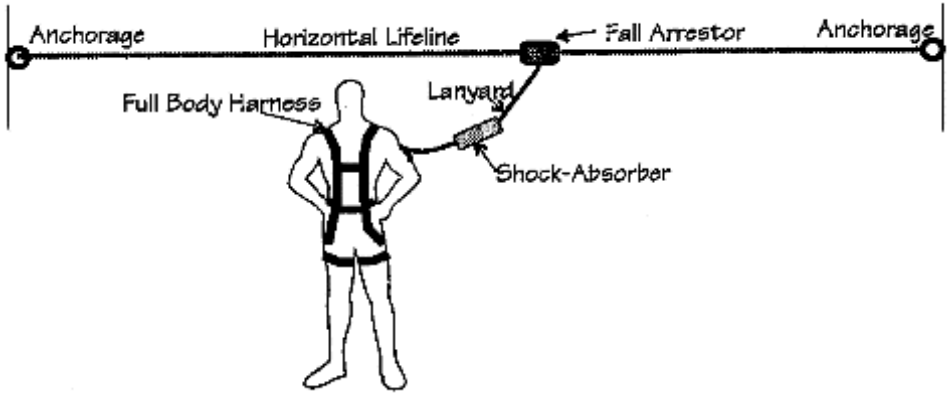
- Used in vertical and in restraint systems.
- The lanyard used with the rope grab fall arrester and vertical lifeline must be no longer than three (3) feet and should contain an energy-absorbing device.

Horizontal Life Lines

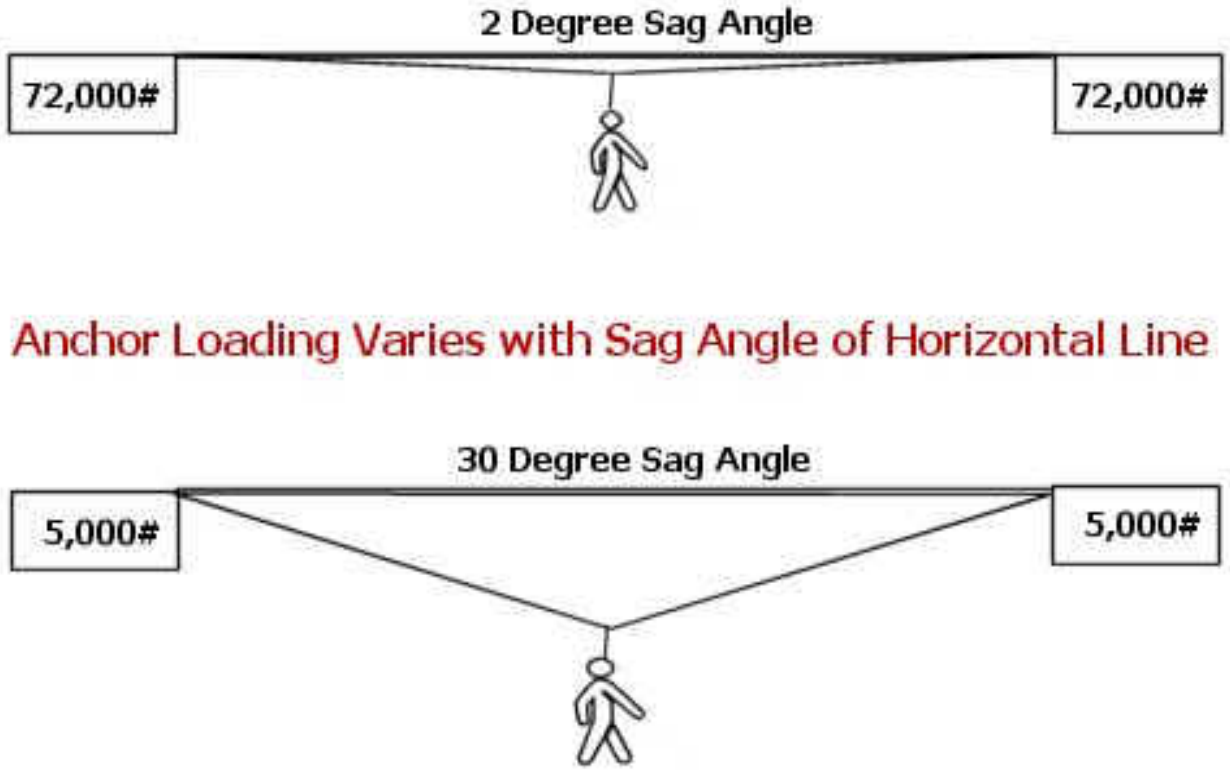
- Provide maneuverability.
- Must be designed, installed and used under the guidance of a qualified person
  - This could be interpreted as requiring the use of manufactured systems, which is *recommended*

Horizontal Lifelines

- Serve as anchoring lines that are rigged between fixed anchor points on the same level.
- HLL designed to help minimize the potential for the dangerous “pendulum” like swing falls.
- Should be positioned at a height above the waist.



Horizontal Lifelines

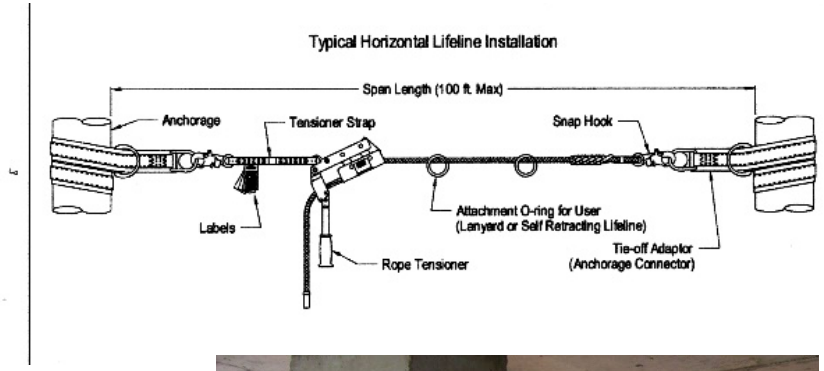


- The force transmitted through the line to the anchors is dependent on the sag created by the line during a catch

Permanent Horizontal Lifeline

- Inspect regularly

Temporary Horizontal Lifelines



Horizontal Retractable Life Lines

- What are the hazards?

Bridge Horizontal Lifelines

Body (Harnesses)

- Need to be inspected frequently (daily before use by the worker, at least monthly by a Competent Person)
- Should never be modified
- Should be taken out of service immediately if defective or exposed to an impact

Harness Fitting

Chest strap tightened at mid chest

Proper snugness shoulder to hips

Leg straps snug but not binding

"D" ring between shoulder blades

Sub-pelvic ("Butt") strap supports the load

- Harness must be sized for the worker

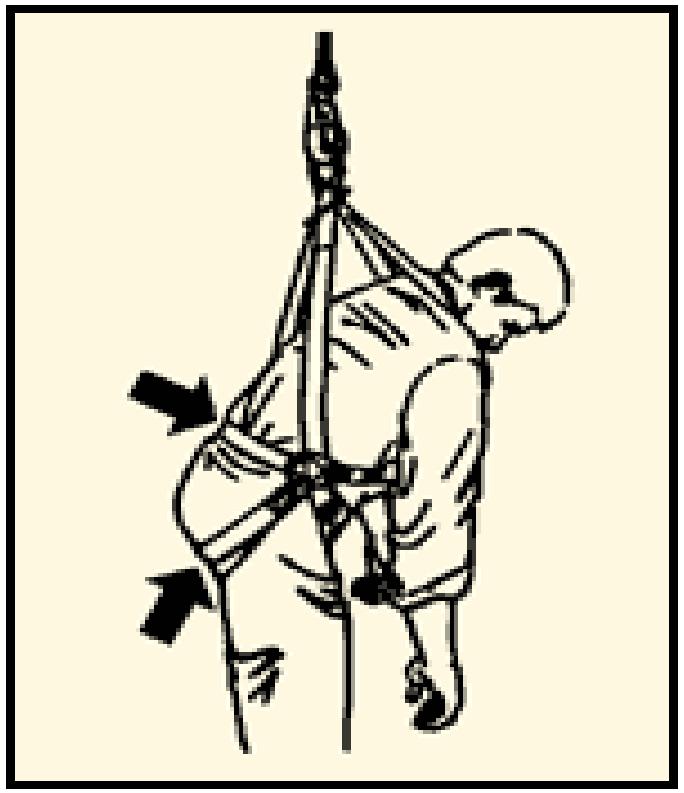
Proper Adjustment Is Key

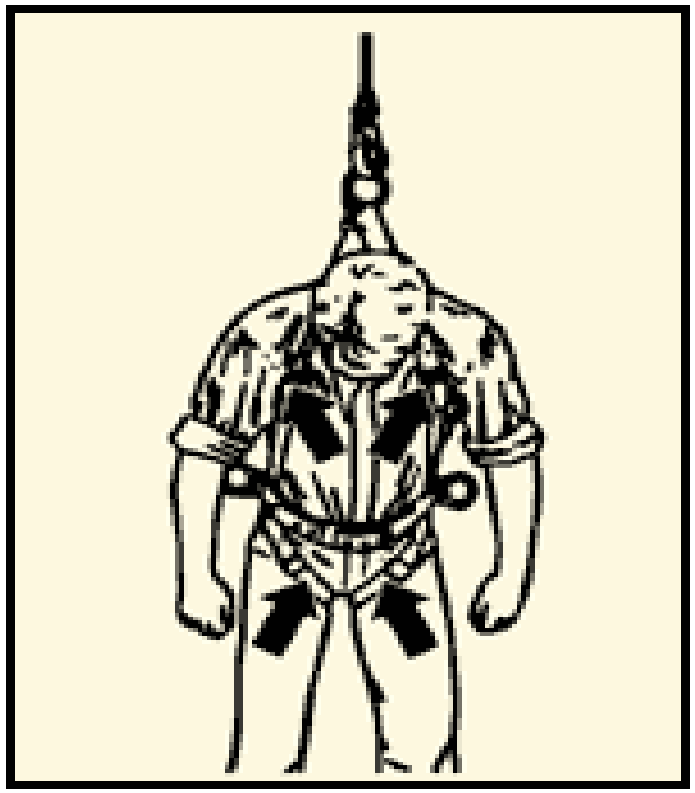
“Rules of Thumb”

- Be able to reach your D-ring with your thumb
- Maximum Four (flat) Fingers of Slack at the legs, straps as high as comfortably possible
- Ensure chest strap is across the chest/breastbone
- Have a buddy double check for twists, etc…

Harness Pressure Points

Spread load across butt strap and belt strap if on the harness





Excess pressure here can cut blood flow to the legs

Some studies have indicated permanent damage to the lower extremities when the worker hangs for more than twenty (20) minutes

100% Fall Arrest

Restraint Devices

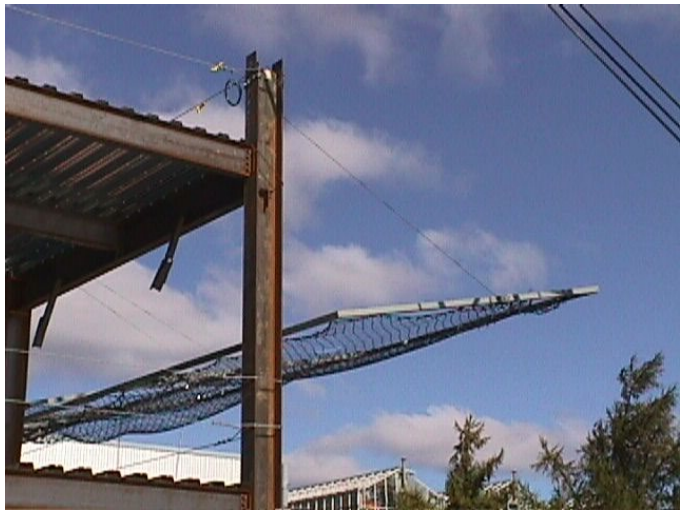
- Provide Access to the work area or working level but Prevent the Fall
- No regulatory reference.
- OSHA recognizes restraint.
- May be more suitable for loading areas, roof & deck work, etc.
- Should be installed and used under the supervision of a Competent Person

Fall Restraint

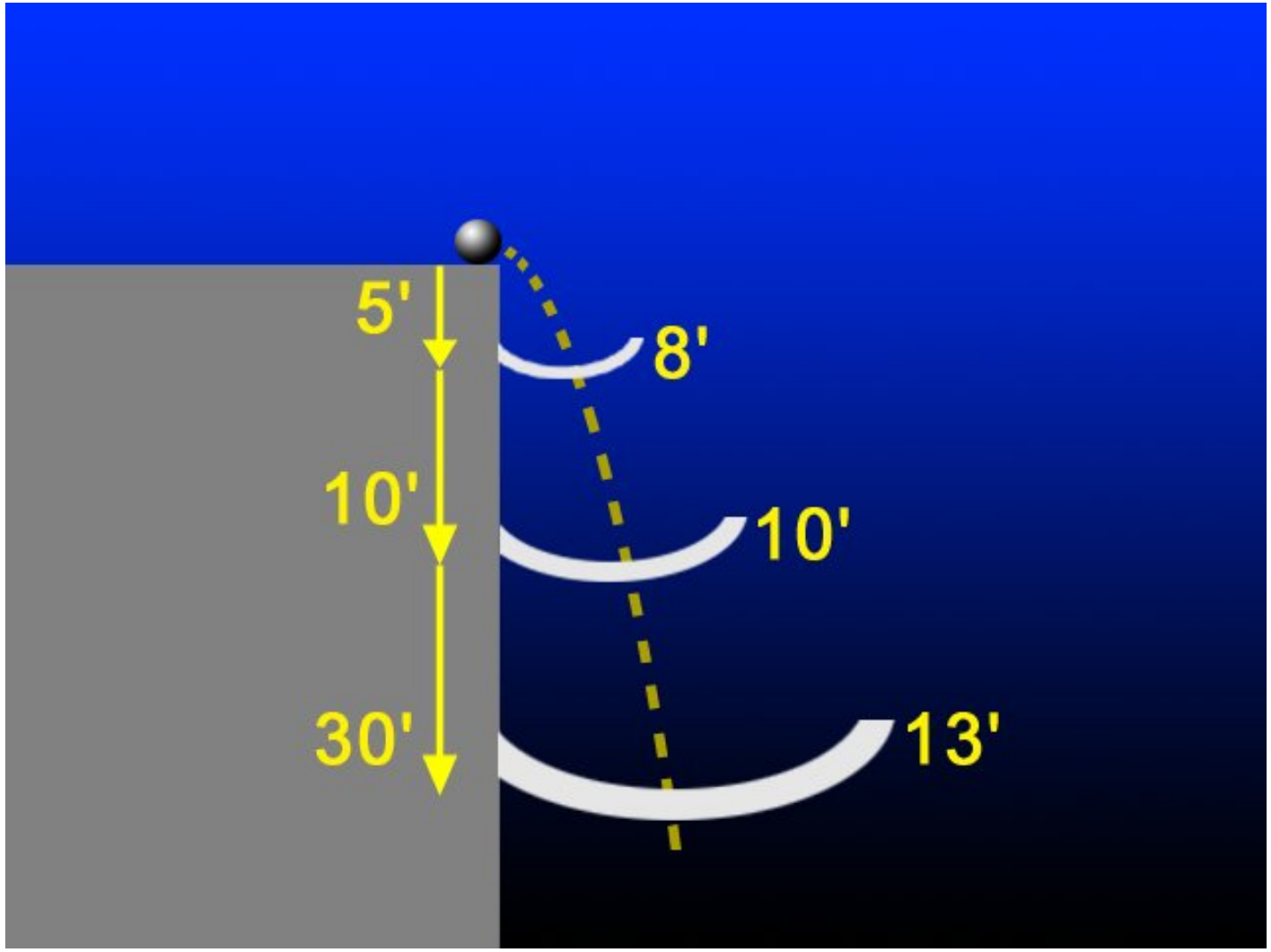
- Fall restraint assumes the employee cannot reach the edge.
- He is basically on a short leash.
- If the employee could reach to the edge and fall over the edge, he must be in fall arrest.

Use of Safety Nets

- Assumes the fall will occur
- Assumes adequacy of the system (or requires testing)



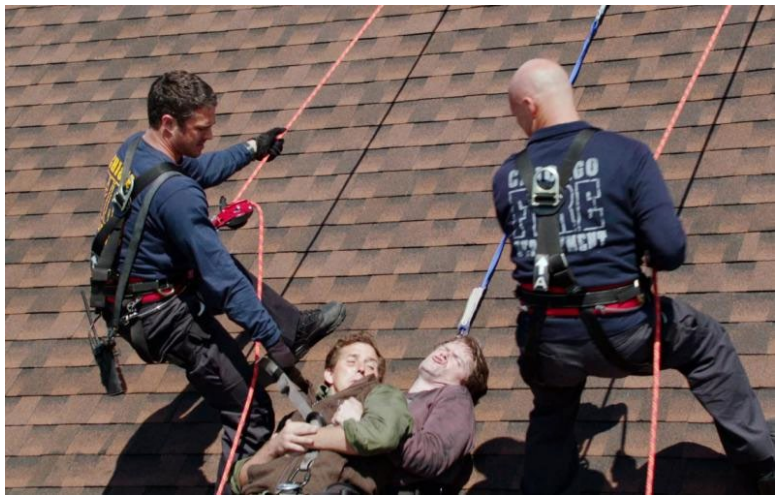
Safety Nets



Fall Rescue

Rescue

- There must be a plan to retrieve or rescue a fallen worker.
- You may not be able to only rely on 911.



After Fall Factors

- If the body is suspended motionless for too long a time (such as after a fall), the heart muscle can become dormant and blood will not circulate through the lower extremities.
- This dangerous condition, called venous pooling, has important implications for selection of a body support and design of rescue systems.

Suspension Trauma

- General feelings of unease
  - Dizzy, sweaty and other signs of shock
  - Increased pulse and breathing rates
- Then a sudden drop in pulse & BP
- Instant loss of consciousness
- If not rescued, **death is possible**
  - From suffocation due to a closed airway, or from lack of blood flow and oxygen to the brain.

How Long Do You Have?

- Uninjured volunteers felt dizzy in as little as 3 minutes
  - Typically 5 to 20 minutes
- Loss of consciousness in as little as 5 minutes
  - Typically 5 to 30 minutes

It is difficult to put a timeline on the process, however from research it is clear that death is a potential and is more rapid with existing injuries but can happen to anyone. Anyone immobilized in an upright posture is in immediate danger

Rescue Hierarchy

- Self Rescue
- Assisted Rescue
- Professional Rescue

Rescue Plan Components

- Type of fall that may occur
- What work surface the victim may fall from
- Potential of injury during the fall and catch
- How equipment utilized will affect the catch
- How far below the fall surface the victim may end up

Rescue Plan Components (Con't)

- Height of potential fall victim location
- Access to the fall victim
- Estimated time to rescue based
- Type of rescue access available
- Capability of local rescue services
- In-house rescue and training

Rescue Tools

Relief Step Safety Device

- Pull tab to deploy
- Insert foot into loop step and adjust
- Ability to stand allowing improved circulation
- Two Relief Steps provide added support, balance and comfort

When It All Works!