Fall Protection at Fermilab

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Objectives

- Understand the definitions of fall prevention, fall restraint, and fall arrest.
- Understand the requirements of fall protection.
- Recognize the hazards associated with fall protection.
Objectives

- Know where to seek help and advice for fall protection (FESHM Chapter 7080).
- Know how to inspect and wear personal fall arrest system equipment (PFAS).
- Know the requirements for anchorage points and how to tie off to them.

What is Fall Protection?

Fall Protection is a series of steps taken to eliminate or control the injurious effects of an unintentional fall while accessing or working at heights.

Fall Statistics

- Falls are the leading cause of fatalities in the construction industry.
- An average of 363 fatal falls occurred each year from 1995 to 1999, with the trend on the increase.
- The cost of care for injuries related to falls is a financial burden for the entire construction industry.
Where Do Fatal Falls Occur?

- Floors: 30%
- Loading Docks: 12%
- Slips: 10%
- Other: 5%
- Entrapments: 5%
- Falling Objects: 3%
- Rocks: 2%
- Ladders: 1%
- Scaffold: 1%
- Ladder: 1%
- Slips/Trips: 1%
- Non-moving Vehicle: 1%

Where Do Non-Fatal Falls Occur?

- Other: 22%
- Rocks: 15%
- Scaffold: 12%
- Non-moving Vehicle: 9%
- Stair/Step: 7%
- Ladders: 6%
- Structural Steel: 5%
- Hit Object: 5%
- Entrapment: 3%
- Ladder: 3%
- Slip/Trip: 2%

Anatomy of a Fall

- It takes most people about 1/3 of a second to become aware.
- It takes another 1/3 of a second for the body to react.
- Planning will keep workers safe and minimize fall exposures.
Planning for Fall Protection

Best practice dictates that fall protection becomes an integral part of the work planning process, from constructability, to systems installation, to use and maintenance.

The workplace cannot be truly safe unless fall protection is incorporated into every phase of the process.

Planning will keep workers safe and minimize fall exposures.

The Steps of Fall Protection

- Fall Arrest
- Restraint
- Personal Protection
- Fall Prevention

Controlling Fall Exposures

General Industry Regulations

Every open-sided floor, platform, wall opening, or hole 4 feet or more above adjacent floor or ground level shall be guarded by a standard railing, or the equivalent, on all open sides except where there is an entrance to a ramp, stairway, or fixed ladder.
Using Fall Protection Systems

- Select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Use safe work procedures.
- Train workers in the proper selection, use, and maintenance of fall protection systems.
- Evaluate the effectiveness of all steps.

Fall Protection Methods

**Fall Prevention**
A system that will prevent a person from falling to a lower level.
Example: Railings

**Work Positioning or Fall Restraint**
A system that will allow the worker to approach a fall hazard and work but will not allow the worker to fall to a lower level.

**Fall Arrest**
A system that will protect a person from crashing on to a lower level after a fall.
Example: Fall Arrest Harness/rope

Competent Person

A Competent Person is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them.
Qualified Person

A Qualified Person has a recognized degree or professional certificate and extensive knowledge and experience in the subject field who is capable of design, analysis, evaluation and specifications in the subject work, project, or product.

When Is Fall Protection Required?

What are the fall distances that trigger guardrails and fall protection?

When Is Fall Protection Required?

Fall prevention is required for falls onto dangerous equipment. Zero fall distance is allowed.
When Is Fall Protection Required?

Fall protection is required for work on forms or steel reinforcing over 6 feet in height.

Fall protection is required for scaffolding over 6 feet in height. OSHA allows up to 10 feet but the Lab rule is 6 feet.

Fall protection required for walking/working surfaces over 4 feet in height in general industry.
When Is Fall Protection Required?

Fall protection is required for walking/working surfaces over 6 feet in height in construction.

Fall protection is required for vertical ladders without cages over 24 feet.

No fall protection is required for portable extension ladders.
Hazard Recognition

What are the allowable controls and best practices?

Hazard Recognition - Walking & Working Surfaces

Hazards with working/walking surfaces
- Open-sided floors
- Holes
- Leading edges

Hazard Recognition - Open Sided Floors

- Guardrails
- Restraint Devices
Hazard Recognition - Wood Guardrail Construction

- Proper Height
- Midrails
- Toeboards
- Adequate Strength

Wood Guardrail Construction

Bad

Better

Cable Guardrail Construction

- Proper height
- Cannot deflect below 39"
- Marked every 6'
- Terminations and attachments
- Maintenance
Aerial Work Platforms

A personal fall arrest system (PFAS) is required whenever you are working in an Articulating and/or telescoping boom lifts and bucket trucks. Use the manufacturer's designated anchorage points.

Personal Fall Arrest Systems

Personal fall arrest systems should only be used when other fall prevention means can not be used or are not feasible.

Personal Fall Arrest Systems

Used to protect an employee from hitting a lower level once they have fallen.

Components include:
- An anchorage point
- Body harness
- Deceleration devices
- Connectors – lanyards, rope grabs, anchorage connectors
Personal Fall Arrest Systems

When using personal fall arrest systems:

- If you fall, the impact force to the body has to be less than 1900 pounds, achieved by using shock absorbing lanyards and a harness.
- Minimize fall distance, the maximum free fall distance can only be 6 feet.

- There cannot be any obstructions between you and the lower level.
- The maximum weight of an individual with tools is 310 pounds.

Free Fall Distance
The vertical displacement of the fall arrest attachment point on the employee's harness between onset of the fall and just before the system begins to apply force to arrest the fall.

Deceleration Distance
The distance between the location of a body harness attachment point at the moment of activation of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.
Minimizing Free Fall Distance

Extended Lanyard Length
Plus maximum 2’ extension
(usually within inches)

6’ Lanyard Length
3’5” Deceleration Device

Tie to anchor above the D-ring
Or use a retractable

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).

Calculating Total Fall Distance

Total Estimated Fall Distance
18’1½’ ft. (5.6m)

6 ft. (1.8m)
Length of Anchor Connector

6 ft. (1.8m)
Length of Lanyard

3’½ ft. (1.1m)
Swivel to Free Fall Distance

3’½ ft. (1.1m)
To Worker’s Back D-Ring

3’ ft. (0.9m)
Safety Factor

5’ ft. (1.5m)
Height of Worker

Watch Swing Falls

- This worker is tied off using a retractable lifeline.
- There is a major swing fall potential if he fell to either side.
Anchorage Connectors

These type of connectors enable you to tie off to various types of anchorage points.

Beam Clamps

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

Be sure pin is inserted full length and clamp is tight.

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 Line Engineering

Anchor stress depends on the sag angle of the line.

Line Stanchions

The connection of the line stanchion to the flange must support the bending moment applied to the base.

Aerial Work Platform Anchorages

Use the manufacturer's designated anchorage points. Never use guardrails as anchorage points.
Body Harness

Need to be inspected before use by the worker, and at least annually (documented) by a Competent Person.

Harnesses should never be modified.

Do not write on or paint harnesses unless material is approved for use.

Should be taken out of service immediately if defective or exposed to an impact.

Harness Fitting

Chest strap tightened at mid chest

O" ring between shoulder blades

Proper snugness shoulder to hips

Leg straps snug but not binding

Butt strap supports the load

Harnesses must be sized for the worker. Workers must weigh more than 130 lbs. and less than 300 lbs.
Harness Pressure Points

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

Spread load across but strap and belt strap if on the harness.

Excess pressure here can cut blood flow to the legs.

Deceleration Devices

Any mechanism with a maximum length of 3.5 feet, such as a rope grab, rip stitch lanyard, tearing or deforming lanyards, self-retracting lifelines, etc., which serves to dissipate a substantial amount of energy during a fall arrest, or otherwise limit the energy imposed on an employee during fall arrest.

Lanyards

A flexible line of rope, wire rope, or strap which generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline or anchorage.

Must not be tied back to themselves unless specifically designed for such use.
Lanyards

- Should have the appropriate clip for the intended anchorage points.
- Do not wrap or knot around sharp objects.

Here are a few types of energy absorbing lanyards.

Retractable Lifelines

- Deceleration devices containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.
- Do not use with energy absorbing lanyards.
Lifelines

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

Positioning Systems

Positioning devices provide hands-free work. Additional fall protection may be required to move or access.

Restraint Devices

Provide access but prevent the fall. Limit anchorage requirement to 1000 lbs. May be more suitable for loading areas, scaffold erection and dismantling. Should be installed and used under the supervision of a Competent Person.
Fall Restraint

Fall restraint assumes the employee cannot reach the edge, they are basically on a short leash.

Restraint Line

If the employee can fall over the edge, then a personal fall arrest system must be used.

Use of Restraint Cables

Here are two examples of restraint cables used during deck anchoring.

Planning For A Rescue

Whenever working with the potential of hanging by a harness, a rescue plan must be in effect.

A written Hazard Analysis must be done and employees must be trained on the plan.
Planning For A Rescue

The rescue plan must be written in the hazard analysis.
The goal is to rescue the employee as soon as possible and limit the hanging time to no more than fifteen minutes.
Plan for a worker that is unconscious.
Ensure all the rescue equipment in the vicinity.
Call x3131 whenever someone has been in a fall arrest situation.

For additional information regarding Fall Protection contact:
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Tom Gibbs  ESHQ section  tgbbs@fnal.gov  x8001
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This concludes Fall Protection Training.
You will need to take and pass a test in order to receive TRAIN credit for this course.
Please click here to request the test.