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Module 6: Stairways and Ladders

Module Description

Stairways and ladders are the major sources of workplace injuries and fatalities for construction workers. According to Bureau of Labor statistics, 24% of the 645 construction fatalities in 2009 resulted from falls from ladders and on stairs. Additionally, tens of thousands of workers were injured in these types of accidents with almost half of these injuries being serious in nature.

This module gives you a basic understanding of OSHA standards and the role they play in the prevention and elimination of work-related injuries and fatalities due to stairways and ladders at workplaces.

Module Learning Objectives

At the conclusion of this module, you should be able to:

- Discuss OSHA standards related to stairways and ladders.
- Discover methods of protection concerning stairways and ladder hazards.
- Explore safety guidelines and requirements of stairways and ladders used at construction sites.
- Explain training and other essential factors associated with stairways and ladders.

Lesson 1: OSHA Standards and Stairways

Lesson Focus

This lesson focuses on the following topics:

- OSHA Standards
- Stairways
- Stair rails and Handrails

OSHA Standards

OSHA Standards Application

The OSHA standards are applicable to all stairways and ladders used in alteration, construction, repair (including painting and decorating), and demolition work sites covered by OSHA's construction safety and health standards.

OSHA Standards Exemptions

The OSHA standards are not applicable to ladders that are purposely manufactured and used for scaffolds access and egress. These ladders are covered under the Scaffolding standard.

The Need for Stairways and Ladders

It is mandatory for employers to provide a stairway or ladder at points of access where the elevation between 2 steps is 19 inches or more.

Stairways

Stairways should be installed at an angle between 30 and 50 degrees from horizontal. Stairway must have uniform riser height and tread depth; variations in riser height or tread depth shall not be over ¼ inch in any stairway system.

In those places where doors or gates open directly to a stairway, a platform must be provided that is at least 20 inches in width beyond the swing of the door.

Stairways Landings

Stairway landings at least 30 inches deep and 22 inches wide, at every 12 feet or less of vertical rise, are essential for stairways which are not a permanent part of the structure. Stairways must be installed at least 30 degrees, and no more than 50 degrees, from the

horizontal. Metal pan landings and metal pan treads must be secured in place before filling.

> **Note:** Remember that a guardrail system is also required on a platform with a swinging door to protect from potential falls of 30 inches or more.

Stair rails and Handrails

Handrails and stair rails are used to protect workers from falling when using stairways. The clearance of temporary handrails must be at least three inches between handrail and walls, stair rail systems, and other objects.

Handrails must be provided to all stairways that have four or more risers, or are higher than 30 inches. If there is a fall hazard of more than 30 inches on an exposed side of the stairs, then a stair rail system must be provided to prevent workers from falling off the side.

> **More Information:** Stairways must be protected along each unprotected edge.

Handrails and top rails must be capable of withstanding a load/force of 200 pounds. The ends of stair rail systems and handrails must be constructed to prevent dangerous projections such as rails protruding beyond the end posts of the system.

Stair rail systems and handrails must be surfaced to prevent injuries such as punctures or lacerations and to keep clothing from snagging. Furthermore, unprotected sides and edges of stairway landings must be provided with a guardrail system.

Handrail and Stairwell System Height

The height of stair rails must not be less than 36 inches (91.5cm) from the upper surface of the stair rail system to the surface of the tread, in line with the face of the riser at the forward edge of the tread.

The height of handrails shall be not more than 37 inches (94 cm) nor less than 30 inches (76 cm) from the upper surface of the handrail to the surface of the tread, in line with the face of the riser at the forward edge of the tread.

When the top edge of a stair rail system also serves as a handrail, the height of the top edge shall be not more than 37 inches (94 cm) nor less than 36 inches (91.5 cm) from the upper surface of the stair rail system to the surface of the tread, in line with the face of the riser at the forward edge of the tread.

Dangerous Conditions

It is vital to fix or address potentially dangerous conditions (such as slippery steps or rungs) immediately; otherwise, they could be the cause of an accident. Furthermore, all stairway parts must be free from dangerous projections such as protruding nails.

Case Study

Victim Fell Due to Grease on Stairways

A worker in an under-construction building was wearing a pair of tennis shoes and was using a stairway to reach the second floor of the building. The victim fell 10 feet from the stairway directly onto the ground. He was immediately transferred to the hospital where doctors examined his body.

According to doctors, his spinal cord was severely damaged when he hit the ground.
Reasons:

- There was some grease or other slippery substance on the stairway at the time of the incident.
- The victim was wearing tennis shoes at the time of the incident—tennis shoes may become extremely hazardous with any greasy or slippery substance.
- No safety measures had been taken (such as a guardrail, stair rail).
- The victim had not received any safety and health education.

Lesson Summary

Handrails must be provided on all stairways that have four or more risers, or are higher than 30 inches. If there is a fall hazard of 30 inches or more on an exposed side of the stairs, then a stair rail system must be provided to prevent workers from falling off the side. The clearance of temporary handrails must be at least three inches between handrail and walls, stair rail systems, and other objects. Also, handrails and top rails must be capable of withstanding a load/force of 200 pounds.

Stair rail systems and handrails must be surfaced to prevent injuries such as punctures or lacerations and to keep clothing from snagging. Furthermore, unprotected sides and edges of stairway landings must be provided with a guardrail system.

Lesson 2: Ladders and Training

Lesson Focus

This lesson focuses on the following topics:

- About Ladders
- Training

About Ladders

Ladders must be kept in a safe and good working condition. The following points are important to consider while using or working with ladders:

- The area around the top and bottom of the ladder must be kept clean.
- Always keep ladders away from slipping hazards.
- Ensure that rungs are spaced 10 to 14 inches from each other. Also, ensure that cleats and steps are uniformly spaced.

Always use ladders only for their designed purposes. Do not lash ladders together to make a long ladder, unless they are designed for that purpose. Never over load ladders beyond their capacities. The manufacturer's rated capacity must be taken into consideration when using ladders.

Note: Do not use single-rail ladders.

Securing Ladders

Always use ladders on stable and level surfaces, unless they are precisely designed for other surfaces. Ladders placed in areas such as passageways, doorways, or where they can be displaced by workplace activities or traffic must be secured to prevent accidental movement, or a barricade must be used to keep traffic or activities away from the ladder. Do not use ladders on slippery surfaces, unless they are adequately protected with slip resistant feet/material.

Case Study

Two Painters Electrocuted

Two workers were painting the light poles outside of a restaurant. The victims were using an airless spray gun to paint the pole and a 36-foot aluminum extension ladder to reach the top of the pole.

A 12,460-volt power line was located approximately 21 feet above the ground. The actual length to which the ladder had been extended at the time of the accident is unknown (no eyewitnesses), but it is known to have at least extended beyond the crossbar.

One victim was standing on the ladder painting the crossbar at the top of the light pole. The second victim was standing on the ground steadying the ladder. The owner of the restaurant, who had been checking the progress of the two workers, heard a scream as he was walking back to the restaurant.

The owner turned and saw the painter and the ladder falling to the ground. The other worker who had been steadying the ladder was lying on the ground.

The owner called the fire department rescue squad and they reached the place immediately, but after a few minutes of their life saving efforts the painters were pronounced dead.

Reasons

There were no eyewitnesses of the accident; therefore the following reasons are based on the investigation conducted immediately after the accident:

- It is assumed that the ladder slid horizontally along the crossbar and the victim on the ladder contacted the power line.
- The current passed through the victim and the ladder to the ground. The current also passed through to the second victim (holding the ladder) to the ground.
- There were two factors present that may have contributed to this accident.
    - First, the ladder was placed on uneven ground and wooden blocks were placed under one leg of the ladder in an effort to provide an even surface. It is possible the blocks may have slid out from under the ladder.
    - Secondly, the top rung of the ladder was damaged. The victim may have leaned on this damaged rung and lost his balance, causing the ladder to slide along the crossbar.
- The victims had not received any safety and health training.

Portable Ladders

Portable ladders are those ladders that can be readily moved or carried. Before using portable ladders always inspect for cracks, dents, and missing rungs; rungs must be designed to minimize slipping risk.

The rungs and steps of portable metal ladders manufactured after March 15, 1991 must be corrugated, knurled, dimpled, coated with skid-resistant material, or treated to

minimize slipping. Furthermore, portable ladders must be able to withstand four times their maximum load.

Note: Side rails of portable ladders must be at least 11.5 inches apart.

Top step

Never use the top or top step of a stepladder as a step; otherwise, it could lead to a severe accident.



Cross bracing

Do not use cross bracing given on the rear of a stepladder for climbing, unless the ladder is designed for that purpose. A metal spreader or locking device must be provided on each stepladder to hold the front and back sections in an open position when the ladder is being used.



Damaged and Defective Ladders

It is necessary that a competent person inspect ladders for visible defects, like broken or missing rungs; if a defective ladder is found, immediately mark it defective, discard the ladder in a manner that it will not be recovered and reused, or tag it "Do Not Use."



Defective ladders need to be immediately removed from the service until repaired. Furthermore, ladders must be inspected on a periodic basis and after any incident that could affect their safe use.

Ladders near Energized Electrical Equipment

Ladders must be constructed with nonconductive side rails if they are used in places where the employee or the ladder could contact exposed energized electrical equipment.

Case Study

Fall Due to Electrocution

An employee was holding a small aluminum ladder beneath energized power lines. As he climbed to the top of the ladder to access a roof, the small ladder came into contact with 3600-volt power lines.

A bystander who witnessed the accident said that the victim shook for a few moments, and then fell backwards from the ladder onto the hard ground below. The worker was taken to the hospital where he died the next day as a result of injuries sustained from the fall.

Reasons

- The worker moved the aluminum ladder only a few feet and proceeded to climb the ladder.
- As the aluminum ladder came in contact with the high-voltage power lines, the worker was immediately electrocuted and fell backwards from the ladder.
- The worker was not wearing electrical safety gloves.
- His death was directly related to his injuries from the fall and indirectly related to the electrical shock.

How to Climb a Ladder

Employees should always face the ladder when going up or down. They should grab the ladder with at least one hand while mounting or dismounting, and each employee must never carry any load or object that could cause the employee to lose balance and fall.

Double-Cleated Ladders

A double-cleated ladder or two or more single ladders should be provided when ladders are the only way to enter and exit a working area with 25 or more employees and when ladders are used for two-way simultaneous traffic.

Structural Defects

Ladders with structural defects such as broken or missing rungs, cleats, or steps; broken or split rails; corroded components; or other faulty or defective components must be immediately marked or tagged with "Do Not Use" or similar language, and should be removed from service until they have been properly repaired.

It is important that ladders be repaired according to their original design criteria, before they are returned to use.

> **Note:** Defective ladders can also be blocked with a plywood attachment that spans several rungs.

> **More Information:** Remember, structural defects standards are applicable on both portable and fixed ladders.

Slipping Hazards

Ladders must be kept free of paint, oil, grease or other slipping hazards.

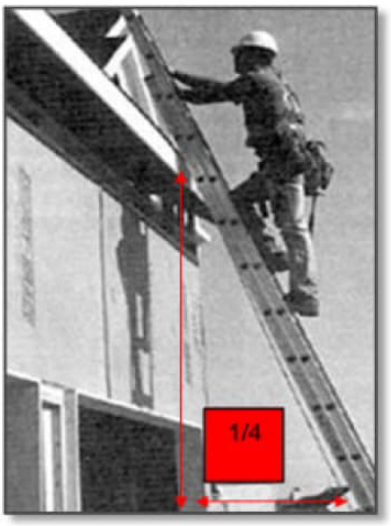
Never use varnish or any other opaque covering on wood ladders that might hinder a proper inspection of the equipment.

> **More Information:** According to OSHA standards, warning labels on one face of a side rail are allowed. For example, this ladder is not provided with a metal spreader or locking device as required.



Ladder Angle

Non-self-supporting ladders must be placed or positioned at an angle where the horizontal distance from the top support to the foot of the ladder is 1/4 the working length of the ladder. Working length of a ladder is the distance along the ladder between foot and top support.



Ladder Rail Extension

When portable ladders are used to access an upper landing surface, the side rails must extend at least three feet above the upper landing surface. When such an extension is not possible, the ladder must be secured, and a grasping device such as a grab rail must be provided to assist workers in mounting and dismounting the ladder.

Tall Fixed Ladders Requirements

It is mandatory to equip fixed ladders of 24 feet or more in height by using at least one of the following methods of protection:

- Ladder safety device
- Self-retracting lifelines with rest platforms every 150 feet or less
- Cage or well, and multiple ladder sections, each section not exceeding 50 feet

Fixed ladders must be able to support at least two loads of 250 pounds each, concentrated between any two consecutive attachments. They must also support added anticipated loads caused by ice buildup, winds, rigging and impact loads resulting from using ladder safety devices.

Training

It is essential that employers must provide training to their employees for using stairways and ladders. The training program must enable each employee to recognize hazards associated with stairways and ladders. Furthermore, employees should be capable of

using proper procedures and methods to protect themselves from various hazards of stairways and ladders.

Training Results

- Employees must be trained by a competent person to be:
- Aware of the maximum load-carrying capacities of ladders used in the construction industry.
- Capable of identifying and addressing fall hazards in the workplace.
- Aware of the correct procedures or methods for maintaining, erecting, assembling and disassembling fall protection systems.
- Able to safely position and use ladders and stairways.

Lesson Summary

A double-cleated ladder or two or more single ladders should be provided when ladders are the only way to enter and exit a working area with 25 or more employees and when ladders are used for two-way simultaneous traffic. Portable ladders must be able to withstand four times their maximum load. Never overload ladders beyond their capacities; be mindful of the manufacturer's rated capacity and adhere to it accordingly.

Always use ladders only for their designed purposes. Do not lash ladders together to make a long ladder, unless they are designed for that purpose. Employees should always face the ladder when going up or down. They should grab the ladder with at least one hand while mounting or dismounting and never carry any load or object that could cause them to lose balance and fall. It is necessary that a competent person inspect ladders for visible defects, like broken or missing rungs; if a defective ladder is found, one must immediately mark it defective or tag it "**Do Not Use.**"

Lesson 3: Safety Measures

Lesson Focus

This lesson focuses on the following topics

- General Requirements
- Design, Construction, Maintenance, and Inspection

General Requirements

Training

Employers shall ensure that all employees who use ladders with a working height of six feet (1.82 m) or more receive the necessary training, such as how to inspect ladders and use such ladders properly.

Proper Usage

Ladders shall be used only for the purposes for which they were designed. Non-self-supporting ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-fourth of the working length of the ladder (the distance along the ladder between the foot and top support).

Rails

When ladders are used for access to an upper landing surface, the ladder side rails shall extend at least three feet (0.9 m) above the upper landing surface to which the ladder is used to gain access. When such an extension is not possible because of the ladder's length, the ladder shall be secured at the top and a grasping device, such as a grab rail, shall be provided to assist employees in mounting and dismounting the ladder.

Stability

Ladders shall be used only on stable and level surfaces unless secured to prevent their accidental displacement. Non-self-supporting ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Single-rail ladders shall not be used.

Safety

Ladders shall not be moved, shifted, or extended while occupied by employees. Ladders placed in any location where they can be displaced by other activities or traffic, such as

in passageways, doorways, or driveways shall be secured to prevent accidental displacement, or a barricade shall be used to keep the activities or traffic away from the ladder.

Ladder Repairs

All ladder repairs shall be made by a qualified person trained and familiar with the design and the proper procedures for repairing defective components. Ladders shall be inspected for visible defects prior to the first use each work shift, and after any occurrence that could affect their safe use.

Ladder Tops

The top of a non-self-supporting ladder shall be placed with the two rails supported, unless it is equipped with a single support attachment.

Emergency escape ladders shall comply with all applicable requirements of this section except those requiring fall protection systems. The top of a stepladder shall not be used as a step.

Design, Construction, Maintenance, and Inspection

Portable Ladders: Load Capacity

Portable ladders shall be capable of supporting, without failure, the following loads:

- Each non-self-supporting ladder shall support at least four times the maximum intended load applied or transmitted to the ladder in a downward and vertical direction when the ladder is placed at a 75 1/2degree angle from the horizontal.
- Each self-supporting ladder shall support at least four times the maximum intended load in a fully opened position on a level surface.



Portable Ladders: Duty Ratings

The working loads corresponding to the duty ratings of portable ladders that pass the applicable ANSI test requirements shall be as follows:

Duty Rating	Ladder Type	Working Load (lbs)	Working Load (kg)
Special Duty	IAA	375	170.4
Extra heavy duty	IA	300	136.2
Heavy duty	I	250	113.5
Medium duty	II	225	102.2
Light duty	III	200	90.8

Portable Ladders: Maximum Load

The maximum intended load used for the design of portable ladders shall be at least 200 pounds (90.6 kg). The combined weight of the employee using the portable ladder and any tools and supplies carried by the employee shall not exceed the maximum intended load of the ladder.

Fixed Ladders: Load Capacity

Fixed ladders shall be capable of supporting at least two loads of at least 250 pounds (114 kg) each, concentrated between any two consecutive attachments, plus anticipated loads caused by ice buildup, winds, rigging, and impact loads resulting from the use of ladder safety devices.

The number and position of additional concentrated loads of 250 pounds (114 kg) each, determined from anticipated usage of the ladder, shall also be included in determining the capabilities of fixed ladders. Each step or rung shall be capable of supporting at least a single concentrated load of 250 pounds (114 kg) applied in the middle of the step or rung.

Ladder Rungs

Ladder rungs and steps shall be parallel, level, and uniformly spaced when the ladder is in position for use. Ladder rungs and steps shall be spaced not less than 10 inches (25 cm) apart, or more than 14 inches (36 cm) apart as measured between the centerlines of the rungs, cleats, or steps.

Ladder Rung Width

Ladder rungs and steps shall have a minimum clear width of 16 inches (41 cm) for individual-rung and fixed ladders, and 11-1/2 inches (29 cm) for all portable ladders, as measured between the ladder side rails.

Narrow Rungs

Narrow rungs, which are not designed to be stepped on, on the tapered ends of window washer's ladders, fruit pickers' ladders, and similar ladders, are exempt from the minimum rung width requirement.

Wooden and Metal Ladders

Wood ladders shall not be coated with any opaque covering, except for identification or warning labels which may be placed on one face only of a side rail.

Metal ladders shall be protected against corrosion.

Toe Clearance

The minimum toe clearance between the centerline of ladder rungs and steps and any obstructions behind the ladder shall be seven inches (18 cm).

Perpendicular Clearance

The minimum perpendicular clearance between the centerline of fixed ladder rungs and steps and any obstruction on the climbing side of the ladder shall be 30 inches (76 cm).

Obstructions

When unavoidable obstructions are encountered, the minimum perpendicular clearance between the centerline of fixed ladder rungs and steps and the obstruction on the climbing side of the ladder may be reduced to 24 inches (61 cm) provided that a deflection device is installed to guide employees around the obstruction.

Fixed Ladders: Safety Devices

Fixed ladders shall be equipped with personal fall protection systems or with cages, or wells, wherever the length of any climb on any fixed ladder exceeds 24 feet (7.3 m), or wherever the top of the ladder is at a distance greater than 24 feet (7.3 m) above lower levels.

Fixed Ladders: Cages and Wells

Cages and wells provided for fixed ladders shall be designed to permit easy access to or egress from the ladder that they enclose. The cages and wells shall be continuous throughout the length of the fixed ladder except for access, egress, and other transfer points. Cages and wells shall be designed and constructed to contain employees in the event of a fall, and to direct them to a lower landing.

Length of Continuous Climb

The length of continuous climb for any fixed ladder equipped only with a cage or a well shall not exceed 50 feet (15.2 m).

Fixed Ladders: Rest Platforms

Fixed ladders with continuous lengths of climb greater than 150 feet (45.7 m) shall be provided with rest platforms and self-retracting lifelines at least every 150 feet (45.7 m) or a cage or well and multiple ladder sections with each ladder section not to exceed 50 feet (15.2 m) in length.

Landing Platforms

Except where portable ladders are used to access fixed ladders, ladders shall be offset with a landing platform between each ladder when two or more separate ladders are used to reach a work area.

Ladder Surfaces

Ladder surfaces shall be free of puncture or laceration hazards. Fixed individual rung ladders shall be constructed to prevent the employee's feet from sliding off the end. A

ladder that might contact un-insulated energized electrical equipment shall have nonconductive side rails.

Pitch

Ladders having a pitch in excess of 90 degrees from the horizontal shall not be permitted. The step-across distance from the centerline of the steps or rungs of a fixed ladder to the nearest edge of the structure, building, or equipment accessed shall not exceed 12 inches (30 cm).

Connecting Ladders

Ladders and ladder sections, unless so designed, shall not be tied or fastened together to provide longer length. Ladders and ladder sections shall not have their length increased by other means unless specifically designed for the means employed.

Lesson Summary

Ladders having a pitch in excess of 90 degrees from horizontal are not permitted. Ladders must be used only for the purposes and in the manner for which they were designed. For instance, non-self-supporting ladders are to be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-fourth of the working length of the ladder (the distance along the ladder between the foot and top support).

The combined weight of the employee using a portable ladder and any tools and supplies carried by the employee is not to exceed the maximum intended load of the ladder. Ladders with structural or other defects must be immediately tagged with a danger tag reading "Out of Service," "Do Not Use," etc., and be withdrawn from service until repaired. Single-rail ladders must not be used.

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