

# Module 6: Stairways and Ladders Pages 213 - 231

- The most effective means of protecting workers is to minimize their exposure through engineering controls, good work practices, proper training, and the use of personal protective clothing and equipment, including respirators where required.
- Workers in many industries face potential exposure to cadmium. The potential for exposure is highest among workers in electroplating, metal machining, plastics, ceramics, paint, and welding operations. The main exposure routes are through inhalation of dust and fumes and the incidental ingestion of dust from contaminated hands, food, or cigarettes.
- Overexposure to cadmium may cause fatigue, headaches, nausea, vomiting, abdominal cramps, diarrhea, and fever.

## 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.

### Module Learning Objectives

At the conclusion of this module, students will 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

At the end of this lesson, students will be able to:

- Describe the OSHA standards pertaining to stairways



- Describe the OSHA standards pertaining to stair-rails and handrails
- Explain the dangerous conditions arising from stairways

## OSHA Standards for Stairways

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. 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. 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.

The following requirements apply to all stairways as indicated:

- Stairways that will not be a permanent part of the structure on which construction work is being performed should have landings measuring no less than 30 inches (76 cm) in the direction of travel and extending at least 22 inches (56 cm) in width, which should be located at every 12 feet (3.7 m) or less of vertical rise.
- Stairs should be installed between 30 degrees and 50 degrees from horizontal.
- Riser height and tread depth should be uniform within each flight of stairs, including any foundation structure used as one or more treads of the stairs. Variations in riser height or tread depth should not be over 1/4-inch (0.6 cm) in any stairway system.
- Where doors or gates open directly on a stairway, a platform should be provided, and the swing of the door must not reduce the effective width of the platform to less than 20 inches (51 cm).
- Metal pan landings and metal pan treads, when used, should be secured in place before filling with concrete or other material.
- All parts of stairways should be free of hazardous projections, such as protruding nails.
- Slippery conditions on stairways should be eliminated before the stairways are used to reach other levels.
- Except during stairway construction, foot traffic is prohibited on stairways with pan stairs where the treads and/or landings are to be filled in with concrete or other material at a later date, unless the stairs are temporarily fitted with wood or other solid material at least to the top edge of each pan. Such temporary treads and landings shall be replaced when worn below the level of the top edge of the pan.
- Except during stairway construction, foot traffic is prohibited on skeleton metal stairs where permanent treads and/or landings are to be installed at a later date, unless the stairs are fitted with secured temporary treads and landings long enough to cover the entire tread and/or landing area.



- Treads for temporary service should be made of wood or other solid material and be installed the full width and depth of the stair.

## OSHA Standards for Stair-rails and Handrails

The following requirements apply to all stair-rails and handrails as indicated:

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- Stairways having four or more risers, or rising more than 30 inches (76 cm), should be equipped with at least one handrail and one stair-rail system along each unprotected side or edge.
- Winding and spiral stairways should be equipped with a handrail offset sufficiently to prevent walking on those portions of the stairways where the tread width is less than 6 inches (15 cm).
- The height of stair-rails shall be as follows:
  - Stair-rails installed after March 15, 1991, must be no 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.
  - Stair-rails installed before March 15, 1991, should be no less than 30 inches (76 cm) nor more than 34 inches (86 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.
- Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members should be provided between the top rail of the stair-rail system and the stairway steps.
- Midrails, when used, should be located at a height midway between the top edge of the stair-rail system and the stairway steps.
- Screens or mesh, when used, should extend from the top rail to the stairway step, and along the entire opening between top rail supports.
- When intermediate vertical members, such as balusters, are used between posts, they should be no more than 19 inches (48 cm) apart.
- Other structural members, when used, should be installed such that there are no openings in the stair-rail system that are more than 19 inches (48 cm) wide.
- Handrails and the top rails of stair-rail systems should be capable of withstanding, without failure, a force of at least 200 pounds (890 n) applied within 2 inches (5 cm) of the top edge, in any downward or outward direction, at any point along the top edge.
- The height of handrails should be no 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 should be no 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.

- Stair-rail systems and handrails should be surfaced to prevent injury to employees from punctures or lacerations, and to prevent snagging of clothing.
- Handrails should provide an adequate handhold for employees grasping them to avoid falling.
- The ends of stair-rail systems and handrails should be constructed so as not to constitute a projection hazard.
- Handrails that will not be a permanent part of the structure being built should have a minimum clearance of 3 inches (8 cm) between the handrail and walls, stair-rail systems, and other objects.
- Unprotected sides and edges of stairway landings should be provided with guardrail systems.

## Dangerous Conditions

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

Stairways not built to OSHA's specifications can also create dangerous conditions. For example, if the angle of the stairway's pitch is too steep it can lead to unnecessary strain on workers as well as causing them to trip and fall. Shoddy or improperly built handrails and stair-rails can also lead to falls or dropped objects. Injuries on stairways can be severe and both employers and workers must be vigilant when using stairways at worksites.

## Case Study

### Victim Fell Due to Grease on Stairways

A worker in a building under construction 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 determined that his spinal cord was severely damaged when he hit the ground.

### What went wrong?

- 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

- 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.
- Stairs should be installed between 30 degrees and 50 degrees from horizontal.
- Riser height and tread depth should be uniform within each flight of stairs, including any foundation structure used as one or more treads of the stairs
- Stairways having four or more risers, or rising more than 30 inches (76 cm), should be equipped with at least one handrail and one stair-rail system along each unprotected side or edge.
- Other structural members, when used, should be installed such that there are no openings in the stair-rail system that are more than 19 inches (48 cm) wide.
- It is vital to immediately fix or address potentially dangerous conditions (such as slippery steps or rungs). Otherwise, they could be the cause of an accident. Furthermore, all stairway parts must be free from dangerous projections such as protruding nails.

## Lesson 2: Ladders and Training

### Lesson Focus

At the end of this lesson, students will be able to:

- Describe the proper use of ladders
- Explain how ladder training should be conducted and what it should include

### Using Ladders

The following rules apply to all ladders:

- Maintain ladders free of oil, grease and other slipping hazards.
- Do not load ladders beyond their maximum intended load nor beyond their manufacturer's rated capacity.
- Use ladders only for their designed purpose.
- Use ladders only on stable and level surfaces unless secured to prevent accidental movement.
- Do not use ladders on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental movement. Do not use slip resistant feet as a substitute for exercising care when placing, lashing, or holding a ladder on slippery surfaces.
- Secure ladders placed in areas such as passageways, doorways, driveways, or anywhere else they can be displaced by workplace



activities or traffic, to prevent accidental movement. Alternatively, use a barricade to keep traffic or activity away from the ladder.

- Keep areas clear around the top and bottom of ladders.
- Do not move, shift or extend ladders while in use.
- Use ladders equipped with nonconductive side rails if the worker or the ladder could contact exposed energized electrical equipment.
- Face the ladder when moving up or down.
- Use at least one hand to grasp the ladder when climbing.
- Do not carry objects or loads that could cause loss of balance and falling.
- Do not use single-rail ladders.

### Choosing the Right Ladder

Ladders are built from one of three basic materials: wood, fiberglass, and metal (aluminum). The environment of your work site is the first factor in choosing the material from which your ladder is constructed. For example, if you are working near sources of electricity, a metal ladder should be rejected since aluminum is an electrical conductor. Your body can complete an electrical circuit between the electrical power source, the ladder, and then to the ground in the event of a live wire contact incident. An electrical shock while working from a ladder can trigger a fall or cause your heart to stop leading to serious injury or death. On the other hand, if there are no electrical power sources in your work area, the aluminum ladder is the lightest weight when compared to fiberglass or wood.

There are several kinds of ladders manufactured for a variety of uses. Again, evaluation of your work environment and knowledge of what ladders are available will allow you to choose the right ladder for the job. Each of the following considerations addresses safety issues in your work environment:

- Will the ladder be resting on an uneven surface?
- Is the work area crowded with people and/or materials?
- What obstructions are in the path of the climb?

Next, the proper ladder length must be selected. It is unsafe to use a ladder that is too long or too short. When using a Step Ladder, for example, standing on the top cap or the step below the top cap is not permitted due to the increased likelihood of losing your balance. Likewise, when using an Extension Ladder, the top three rungs are not to be used for climbing. A Straight Ladder is too long, for example, if ceiling height prohibits the ladder from being set-up at the proper angle. Likewise, an Extension Ladder is too long if the ladder extends more than three (3) feet beyond the upper support point. In this case, the portion of the ladder that extends above the upper support point can act like a lever and cause the base of the ladder to move or slide out. Safety standards require a label on the ladder to indicate the highest standing level.

Finally, consider the Duty Rating of the ladder. This is an indication of the maximum weight capacity the ladder can safely carry. To figure out the total amount of weight your ladder will be supporting, add:





- Your weight, plus
- The weight of your clothing and protective equipment, plus
- The weight of tools and supplies you are carrying, plus
- The weight of tools and supplies stored on the ladder

There are five categories of ladder Duty Ratings:

Type IAA (Extra Heavy Duty)	375 pounds
Type IA (Extra Heavy Duty)	300 pounds
Type I (Heavy Duty)	250 pounds
Type II (Medium Duty)	225 pounds
Type III (Light Duty)	200 pounds

The Duty Rating of your ladder can be found on the specifications label. Safety standards require a Duty Rating sticker to be placed on the side of every ladder. Do not assume that a longer ladder has a higher weight capacity. There is no relationship between ladder length and weight capacity.

### 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.

The minimum clear distance between side rails for all portable ladders must be 11.5 inches (29 cm). In addition, the rungs and steps of portable metal ladders must be corrugated, knurled, dimpled, coated with skid-resistant material, or treated to minimize slipping.

Non-self-supporting and self-supporting portable ladders must support at least four times the maximum intended load; extra heavy-duty type 1A metal or plastic ladders must sustain 3.3 times the maximum intended load. To determine whether a self-supporting ladder can sustain a certain load, apply the load to the ladder in a downward vertical direction with the ladder placed at a horizontal angle of 75.5 degrees.

When portable ladders are used for access to an upper landing surface, the side rails must extend at least 3 feet (.9 m) 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. A ladder extension must not deflect under a load that would cause the ladder to slip off its supports.

### Stepladders

Some safety rules pertaining specifically to stepladders include the following:

- Do not use the top or top step of a stepladder as a step.





- Do not use cross bracing on the rear section of stepladders for climbing unless the ladders are designed and provided with steps for climbing on both front and rear sections.
- Metal spreader or locking devices must be provided on stepladders to hold the front and back sections in an open position when ladders are being used.



### Fixed Ladders

If the total length of the climb on a fixed ladder equals or exceeds 24 feet (7.3 m), the ladder must be equipped with one of the following:

- Ladder safety devices
- Self-retracting lifelines and rest platforms at intervals not to exceed 150 feet (45.7 m)
- A cage or well and multiple ladder sections with each ladder section not to exceed 50 feet (15.2 m) in length. These ladder sections must be offset from adjacent sections and landing platforms must be provided at maximum intervals of 50 feet (15.2 m).

In addition, fixed ladders must meet the following requirements:

- Fixed ladders must be able to support at least two loads of 250 pounds (114 kg) each, concentrated between any two consecutive attachments. Fixed ladders also must support added anticipated loads caused by ice buildup, winds, rigging, and impact loads resulting from using ladder safety devices.
- Individual rung/step ladders must extend at least 42 inches (1.1 m) above an access level or landing platform either by the continuation of the rung spacings as horizontal grab bars or by providing vertical grab bars that must have the same lateral spacing as the vertical legs of the ladder rails.



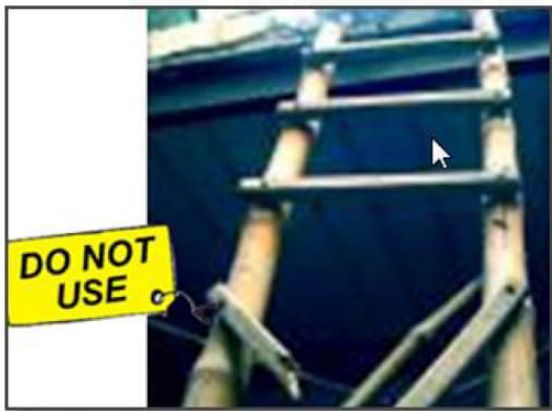
- Each step or rung of a fixed ladder must be able to support a load of at least 250 pounds (114 kg) applied in the middle of the step or rung.
- Minimum clear distance between the sides of individual rung/step ladders and between the side rails of other fixed ladders must be 16 inches (41 cm).
- Rungs of individual rung/step ladders must be shaped to prevent slipping off the end of the rungs.
- Rungs and steps of fixed metal ladders manufactured after March 15, 1991, must be corrugated, knurled, dimpled, coated with skid-resistant material, or treated to minimize slipping.
- Minimum perpendicular clearance between fixed ladder rungs, cleats, and steps and any obstruction behind the ladder must be 7 inches (18 cm), except that the clearance for an elevator pit ladder must be 4.5 inches (11 cm).
- Minimum perpendicular clearance between the centerline of fixed ladder rungs, cleats and steps, and any obstruction on the climbing side of the ladder must be 30 inches (76 cm). If obstructions are unavoidable, clearance may be reduced to 24 inches (61 cm), provided a deflection device is installed to guide workers around the obstruction.
- Step-across distance between the center of the steps or rungs of fixed ladders and the nearest edge of a landing area must be no less than 7 inches (18 cm) and no more than 12 inches (30 cm). A landing platform must be provided if the step-across distance exceeds 12 inches (30 cm).
- Fixed ladders without cages or wells must have at least a 15-inch (38 cm) clearance width to the nearest permanent object on each side of the centerline of the ladder.
- Fixed ladders must be provided with cages, wells, ladder safety devices or self-retracting lifelines where the length of climb is less than 24 feet (7.3 m) but the top of the ladder is at a distance greater than 24 feet (7.3 m) above lower levels.
- Side rails of through or side-step fixed ladders must extend 42 inches (1.1 m) above the top level or landing platform served by the ladder. Parapet ladders must have an access level at the roof if the parapet is cut to permit passage through it. If the parapet is continuous, the access level is the top of the parapet.
- Steps or rungs for through-fixed-ladder extensions must be omitted from the extension; and the extension of side rails must be flared to provide between 24 inches (61 cm) and 30 inches (76 cm) clearance between side rails.
- When safety devices are provided, the maximum clearance distance between side rail extensions must not exceed 36 inches (91 cm).
- Fixed ladders must be used at a pitch no greater than 90 degrees from the horizontal, measured from the back side of the ladder.

### **Damaged and Defective Ladders**

Ladders needing repairs are subject to the following rules:



- Portable 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 immediately be marked defective or tagged with "Do Not Use" or similar language and withdrawn from service until repaired.
- Fixed ladders with structural defects—such as broken or missing rungs, cleats or steps, broken or split rails or corroded components—must be withdrawn from service until repaired.
- Defective fixed ladders are considered withdrawn from use when they are immediately tagged with "Do Not Use" or similar language, or marked in a manner that identifies them as defective or blocked—such as with a plywood attachment that spans several rungs.
- Ladder repairs must restore the ladder to a condition meeting its original design criteria before the ladder is returned to use.



### Other Information

- 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.
- 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.
- 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.
- 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  $\frac{1}{4}$  the working length of the ladder. Working length of a ladder is the distance along the ladder between foot and top support.





- 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.
- 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

Employers must train all employees to recognize hazards related to ladders and stairways and instruct them to minimize these hazards. For example, employers must ensure that each employee is trained by a competent person in the following areas, as applicable:

- Nature of fall hazards in the work area
- Correct procedures for erecting, maintaining and disassembling the fall protection systems to be used
- Proper construction, use, placement and care in handling of all stairways and ladders
- Maximum intended load-carrying capacities of ladders used

Note: Employers must retrain each employee as necessary to maintain their understanding and knowledge on the safe use and construction of ladders and stairs.





## Definitions

- Cleat: A ladder crosspiece of rectangular cross section placed on edge upon which a person may step while ascending or descending a ladder.
- Double-cleat ladder: A ladder with a center rail to allow simultaneous two-way traffic for employees ascending or descending.
- Failure: Load refusal, breakage or separation of components.
- Fixed ladder: A ladder that cannot be readily moved or carried because it is an integral part of a building or structure.
- Handrail: A rail used to provide employees with a handhold for support.
- Job-made ladder: A ladder that is fabricated by employees, typically at the construction site; noncommercially manufactured.
- Load refusal: The point where the structural members lose their ability to carry the load.
- Point of access: All areas used by employees for work-related passage from one area or level to another.
- Portable ladder: A ladder that can be readily moved or carried.
- Riser height: The vertical distance from the top of a tread or platform/landing to the top of the next higher tread or platform/landing.
- Side-step fixed ladder: A fixed ladder that requires a person to get off at the top to step to the side of the ladder side rails to reach the landing.
- Single-cleat ladder: A ladder consisting of a pair of side rails connected together by cleats, rungs, or steps.
- Stair rail system: A vertical barrier erected along the unprotected sides and edges of a stairway to prevent employees from falling to lower levels.
- Temporary service stairway: A stairway where permanent treads and/or landings are to be filled in at a later date.
- Through fixed ladder: A fixed ladder that requires a person getting off at the top to step between the side rails of the ladder to reach the landing.
- Tread depth: The horizontal distance from front to back of a tread, excluding nosing, if any.

## Case Studies

### 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. He 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.

### **What went wrong?**

There were no eyewitnesses of the accident, so 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 also not received any safety and health training.

### **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.

### **What went wrong?**

- 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.

## Lesson Summary

- Evaluation of your work environment and knowledge of what ladders are available will allow you to choose the right ladder for the job. Each of the following considerations addresses safety issues in your work environment:
  - Will the ladder be resting on an uneven surface?
  - Is the work area crowded with people and/or materials?
  - What obstructions are in the path of the climb?
- Portable ladders are those ladders that can be readily moved or carried. Before using portable ladders always inspect for cracks, dents, and missing rungs.
- Do not use the top or top step of a stepladder as a step.
- Fixed ladders must be able to support at least two loads of 250 pounds (114 kg) each, concentrated between any two consecutive attachments. Fixed ladders also must support added anticipated loads caused by ice buildup, winds, rigging, and impact loads resulting from using ladder safety devices. If the total length of the climb on a fixed ladder equals or exceeds 24 feet (7.3 m), the ladder must be equipped with one of the following:
  - Ladder safety devices
  - Self-retracting lifelines and rest platforms at intervals not to exceed 150 feet (45.7 m)
  - A cage or well and multiple ladder sections with each ladder section not to exceed 50 feet (15.2 m) in length. These ladder sections must be offset from adjacent sections and landing platforms must be provided at maximum intervals of 50 feet (15.2 m).
- Ladders should be regularly inspected for defects or damage, and removed from service until any defects or damaged parts are repaired.
- Employers must train all employees to recognize hazards related to ladders and stairways and instruct them to minimize these hazards.

## Lesson 3: Safety Measures

### Lesson Focus

At the end of this lesson, students will be able to:

- Describe ladder safety requirements
- Explain the factors that go into designing, constructing, maintaining, and inspecting ladders





## Ladder Safety Requirements

- **Training:** Employers should 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 should be used only for the purposes for which they were designed. Non-self-supporting ladders should 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 should 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 should be secured at the top and a grasping device, such as a grab rail, should be provided to assist employees in mounting and dismounting the ladder.
- **Stability:** Ladders should be used only on stable and level surfaces unless secured to prevent their accidental displacement. Non-self-supporting ladders should 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** should 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, should be secured to prevent accidental displacement, or a barricade should be used to keep the activities or traffic away from the ladder.
- **Ladder Repairs:** All ladder repairs should be made by a qualified person trained and familiar with the design and the proper procedures for repairing defective components. Ladders should 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 should be placed with both rails supported, unless it is equipped with a single support attachment.
- **Emergency escape ladders** should comply with all applicable OSHA requirements except those requiring fall protection systems.

## Design, Construction, Maintenance, and Inspection

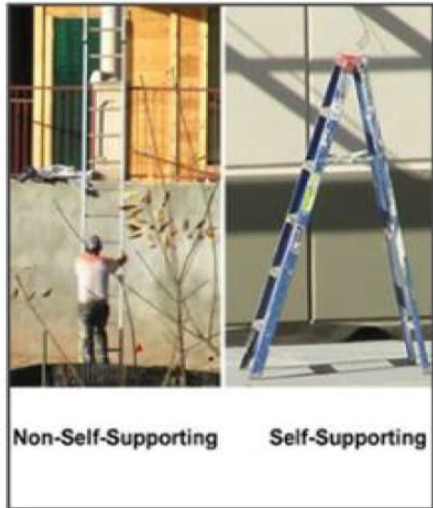
### Portable Ladders: Load Capacity

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





- Each non-self-supporting ladder must 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 ½ degree angle from the horizontal.
- Each self-supporting ladder must 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 must 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 should 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 should not exceed the maximum intended load of the ladder.



## **Fixed Ladders: Load Capacity**

Fixed ladders should 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 should be parallel, level, and uniformly spaced when the ladder is in position for use. They should be spaced no less than 10 inches (25 cm) apart and no more than 14 inches (36 cm) apart as measured between the centerlines of the rungs, cleats, or steps. Ladder rungs and steps should 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.

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

## **Other Information**

- Wood ladders should 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 must be protected against corrosion.
- The minimum toe clearance between the centerline of ladder rungs and steps and any obstructions behind the ladder should be seven inches (18 cm).
- The minimum perpendicular clearance between the centerline of fixed ladder rungs and steps and any obstruction on the climbing side of the ladder should be 30 inches (76 cm).
- 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 should 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.
- 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.

- 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 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.
- 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 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.
- 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).
- 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

- Employers should 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.
- Ladders should be used only for the purposes for which they were designed. When ladders are used for access to an upper landing surface, the ladder side rails should extend at least three feet (0.9 m) above the upper landing surface to which the ladder is used to gain access.
- Do not load ladders beyond their maximum intended load nor beyond their manufacturer's rated capacity. Use ladders only for their designed purpose. Use ladders only on stable and level surfaces unless secured to prevent accidental movement.
- Do not use ladders on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental movement. Do not use slip resistant feet as a substitute for exercising care when placing, lashing, or holding a ladder on slippery surfaces.





- Ladders should be used only on stable and level surfaces unless secured to prevent their accidental displacement. Non-self-supporting ladders should 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.
- Ladders placed in any location where they can be displaced by other activities or traffic, such as in passageways, doorways, or driveways, should be secured to prevent accidental displacement, or a barricade should be used to keep the activities or traffic away from the ladder.
- All ladder repairs should be made by a qualified person trained and familiar with the design and the proper procedures for repairing defective components.
- Portable ladders must be capable of supporting, without failure, 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 ½ degree angle from the horizontal.
- Fixed ladders should 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.
- Ladder rungs and steps should be parallel, level, and uniformly spaced when the ladder is in position for use.

## Module 7: Concrete and Masonry Construction

### Module Description

This module is designed for construction workers who want to learn about safely working with concrete and masonry projects and addresses the requirements necessary to protect all construction employees from the hazards associated with concrete and masonry construction operations performed in workplaces covered under applicable OSHA standards. In addition to the requirements in Subpart Q, other relevant provisions in Parts 1910 and 1926 apply to concrete and masonry construction operations. Topics include general requirements for formwork and masonry construction.

### Module Learning Objectives

At the conclusion of this module, students will be able to:

- Describe post-tensioning operations requirements
- Identify the requirements relating to working under loads
- Discuss the requirements concerned with Personal Protective Equipment
- Identify and defend the lockout/tagout procedures requirements
- Summarize the requirements relating to pre-cast concrete

