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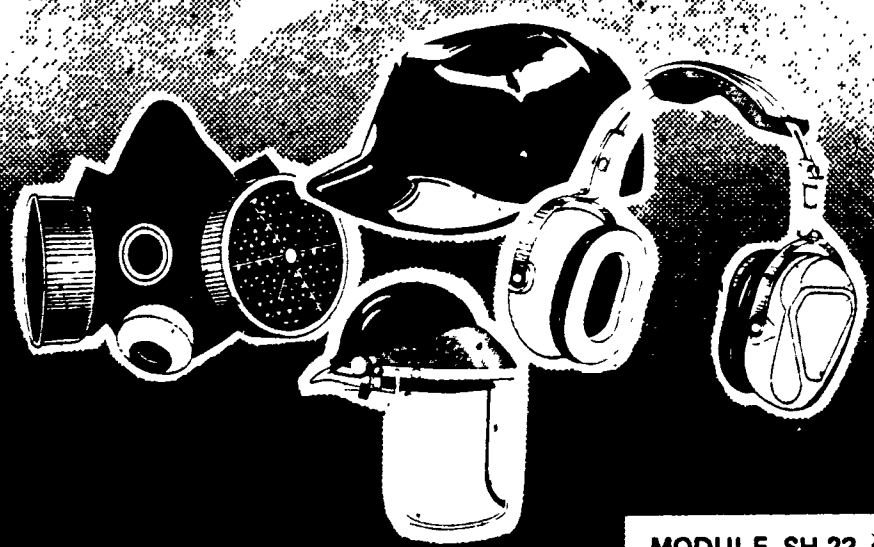
ABSTRACT

This student module on ladder and scaffold safety is one of 50 modules concerned with job safety and health. This module describes the proper construction, use, and maintenance of portable and fixed ladders. Following the introduction, 10 objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Define three types of scaffolding). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

SAFETY AND HEALTH

LADDER AND SCAFFOLDING SAFETY



MODULE SH-22

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INTRODUCTION

"What goes up must come down," is a common phrase based on fact. There is little anyone can do to control the law of gravity. However, how one goes up and down is something a person usually can control.

Ascending and descending ladders and scaffolding are serious matters. If certain safety rules are not followed, coming down from a ladder or scaffolding can be a very painful experience - possible even fatal. A fall from a height of just five feet can be fatal - depending on how the person lands (on the feet or on the head) and what he or she lands on (sand or concrete).

Falls from a ladder or scaffolding can be caused by unsafe acts or unsafe conditions - or by a combination of both. Unsafe conditions are correctable and therefore should never be allowed to exist in a workplace. Unsafe acts are the worker's responsibility, and so only the worker can guard against their occurrence. Both workers and employers must be aware of the potential hazards of ladder and scaffold use and guard against them.

The proper construction, use, and maintenance of portable and fixed ladders will be described in this module. Safety precautions and regulations that apply to ladders will also be discussed, as will the handling and storage of ladders.

Three types of scaffolds - built-up, rolling, and suspension - will be presented, and their safe construction and use will be outlined. Safety features included in the construction of scaffolds will be described, as well as personal safety devices.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. Name two ways to reduce accidents associated with ladders. (Page 3)
2. Describe four types of portable ladders that are commonly used. (Page 5)
3. Name three practices to avoid when using a stepladder. (Page 6)

4. List procedures for safe use of straight ladders and extension ladders. (Page 8)
5. State four features of the correct storage of ladders. (Page 11)
6. Describe three types of protection that can be used with fixed ladders to prevent a worker's uninterrupted fall. (Page 13)
7. Name four hazards connected with scaffolds. (Page 16)
8. Define three types of scaffold. (Page 18)
9. Define rolling scaffolds and three safety rules that apply to them. (Page 20)
10. Describe suspension scaffolds and three safety procedures that relate to them. (Page 22)

SUBJECT MATTER

OBJECTIVE 1: Name two ways to reduce accidents associated with ladders.

Most people do not think of a ladder as a tool. Actually, it is one of the most commonly used tools. Ladders are used in almost all workplaces - including industries, construction sites, offices, and homes. Because a ladder is such a common sight, it is often regarded as harmless. In reality, a ladder can be a very hazardous device. This is because the most common accident occurring from the use of ladders is a fall from one level to another. Such falls usually result in serious - and sometimes fatal -- injuries.

On-the-job injuries from falls are common and often serious. More than 500,000 persons are injured each year from falls that occur on the job. Of these falls, 3,000 result in death or permanent, total disability and many of these falls are from ladders or scaffolds. Accidents may be events that occur unexpectedly, but they do not occur by chance. This maxim is especially true of accidents that occur in the workplace. In order for accidents in the workplace to be prevented, both employers and employees must accept that all accidents have causes and that those causes must be detected and corrected.

Two measures that can help reduce the number of accidents occurring with ladders are: (1) to eliminate the use of unsafe ladders, and (2) to eliminate the unsafe use of ladders. These measures can be carried out by rigid inspection of ladders and of the workplace and by proper use and maintenance of ladders, and by regular physical examinations of the workers.

Regular physical examinations for workers will help to determine physical disabilities which could restrict a worker from working on a ladder. For example, a worker with a serious heart condition should not be required to climb a ladder. Also, it is not recommended that a worker with a severe hearing impairment work at heights, because this worker could lose his or her equilibrium and fall from the ladder or scaffold. Climbing a ladder should never be attempted if one feels dizzy or ill. If this feeling is

experienced while on a ladder, the worker should never try to climb down hurriedly. Draping the arms around the rungs, and resting the head against the ladder is the safe procedure to follow until the feeling of illness subsides.

Before a ladder is used, the workplace should be examined for potential hazards, such as electrical power lines in the area or holes in the floor. Also, the ladder should be inspected before, during, and after use.

Several general safety procedures apply to the use of all ladders, regardless of type. For instance, safe climbing of a ladder requires two hands and should not be attempted while carrying tools or other materials. Trying to climb a ladder while holding something creates two hazards: (1) a possible slip and fall, and (2) the objects that are being carried could be dropped, injuring someone below. To avoid these hazards, one end of a rope should be tied around the waist and the other end around the material to be raised. The ladder can then be climbed, the rope used to pull up the materials.

Only one worker should be on a ladder at a time. Ladders are not designed to support the weight of two people. A worker should never attempt to walk up or down the ladder while facing away from it.

Ladder safety includes keeping the steps and siderails of any ladder free of grease, oil, and mud to prevent slipping accidents. Slipping hazards can be further reduced by the worker's wearing shoes that have clean, nonskid soles. Dirty, greasy, or slippery shoes are particularly dangerous on ladders. Also shoes with worn or loose heels are hazardous, because they can catch on the rungs of the ladder and cause a fall. Leaving tools on the rungs of a ladder is another unsafe practice.

ACTIVITY 1:*

1. Name two ways to reduce the number of accidents occurring with ladders.

   a. _____

   b. _____

*Answers to Activites appear on Page 26.

2. Name two physical disabilities that should exclude workers from working on ladders.

a. _____

b. _____

OBJECTIVE 2: Describe four types of portable ladders that are commonly used.

Ladders are classified as either portable or fixed (permanently attached to a structure). They can be made of wood, metal, or fiberglass.

Four types of portable ladders are shown in Figure 1: the stepladder, the single ladder, the sectional ladder, and the extension ladder.

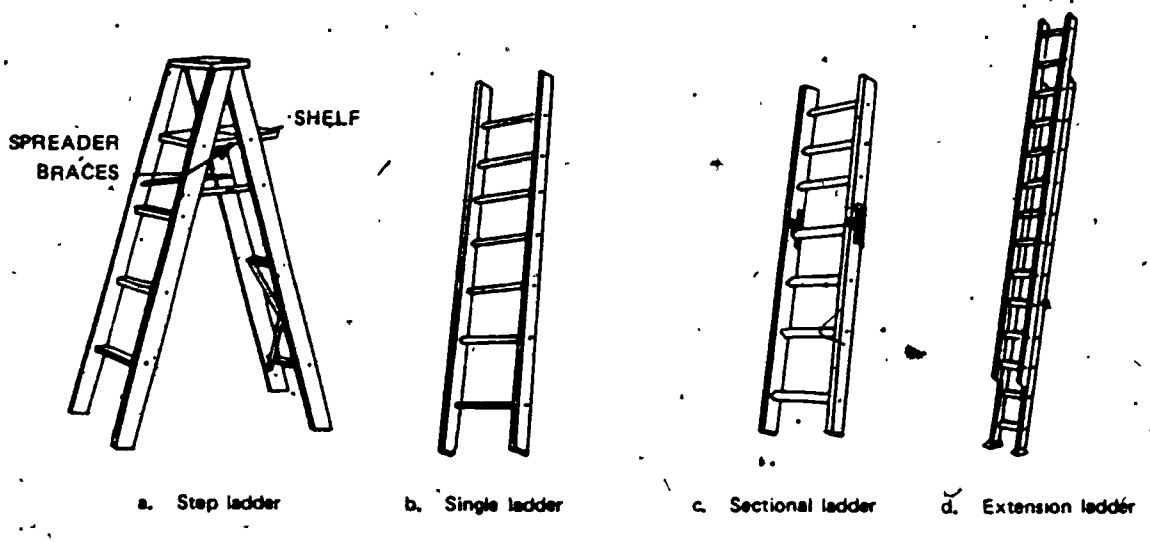

Figure 1. Four types of portable ladders.

A stepladder (Figure 1a) is a self-supporting portable ladder that is nonadjustable in length and has flat steps and a hinged back. Small stepladders (those from 3-6 feet long) are commonly used around the home. Stepladders that are 6 to 12 feet long are used for such things as painting, office use, or light industrial use. Longer ladders (from 12 to 20 feet long) are frequently used by utilities, contractors, and industries.

Single, sectional, and extension ladders are also classified as straight ladders. These three types, although portable, are not self-supporting, which means they must be placed against a wall or other support.

A single ladder, as shown in Figure 1b, has a fixed length and contains only one section. A sectional ladder (Figure 1c) is nonadjustable in length, but it contains two or more sections that may be combined to function as a single ladder. An extension ladder, illustrated in Figure 1d, is adjustable in length. It consists of two or more sections that travel in guides, or brackets, to permit length adjustment.

ACTIVITY 2:

List four types of portable ladders that are commonly used and list three characteristics of each.

1. _____
2. _____
3. _____
4. _____

OBJECTIVE 3: Name three practices to avoid when using a ladder.

A self-supporting ladder, such as a stepladder, should never be leaned against a wall. If it is used in this way, the ladder will be awkward to stand on, very unsteady, and likely to slip or tip, causing a fall.

Before a stepladder is climbed, its legs must be completely spread and placed to prevent slipping. Unstable ladders should be lashed or held in position. The shelf or spreader braces should be locked (Figure 1a) to prevent the ladder from collapsing. A worker should never climb on the braces on the back of a stepladder. These braces are not designed to support that kind of weight, but are used only to increase stability.

The higher a person climbs on a stepladder, the less stable the ladder becomes. Consequently, it is important that the top rail never be used as a step. For maximum safety, the top three steps should not be used for standing. If more reach is needed, a longer stepladder should be used.

Before a stepladder is used, it should be thoroughly examined for any of the following defects:

- Broken, loose or missing steps.
- Split or broken siderails.
- Broken or missing spreaders.
- Too light construction.
- Poor material (such as wood not being straight grained).
- Lack of stability.
- Loose hinges.

A ladder that has any of the above defects is unsafe and should not be used.

All steps of a stepladder must be parallel and level to the ground when the ladder is in position for use. The distance between each step must be no more than 12 inches and this spacing must be uniform throughout the length of the ladder. This even spacing is important so that the person climbing can anticipate where the next step will be.

OSHA (Occupational Safety and Health Administration) standards call for a minimum width of 11 1/2 inches from one siderail to the other at the top of the ladder. From top to bottom, the siderails must spread at least one inch for each foot of the ladder's length.

ACTIVITY 3:

1. Name two areas of a stepladder that should not be used for climbing.
   a. _____
   b. _____
2. List five defects that might be found on a stepladder.
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

OBJECTIVE 4: List procedures for safe use of straight ladders and extension ladders.

All straight ladders, whether one piece or multi-sectioned, should be positioned with their bases one-quarter of their working length from the wall, as illustrated in Figure 2.

For example, a ladder with a working length of 24 feet should be placed one-fourth that length - or 6 feet - from the wall or supporting structure.

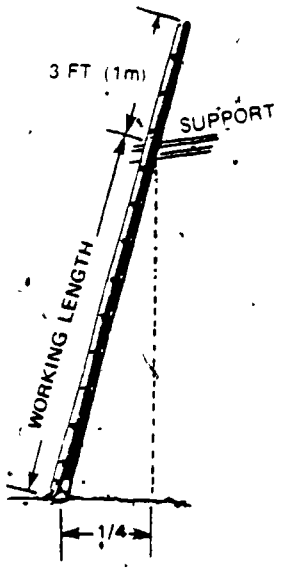

Figure 2. Correct placement of a straight ladder.

An easy way to estimate where the base of a ladder should be placed is to follow this procedure: (1) place the ladder on a firm, level surface and lean it against a solid support, (2) set the distance of the base about one foot for every four feet of the length of the ladder from where it touches the solid support, (3) place your toes on the safety feet of the ladder, (4) reach forward with both hands to grasp the siderails of the ladder.

If the grasp is comfortable, the setting is probably correct. If you had to lean forward, the angle of the ladder is too flat. If you are not at all extended and you can easily reach the rungs, the angle is too steep.

Placing a ladder too close to the support will make the ladder unstable and likely to fall. If the base is too far from the structure, the base might slip. Also when a ladder is placed with the base too far from the structure, more stress and weight are placed on the rails than they are designed to support. This added stress could cause the rails to break.

The bottom of a ladder should always rest on a solid surface to prevent the ladder from slipping or tilting. The top should extend three feet above the upper point of support as shown in Figure 2. The safe working length of

a straight ladder is limited to the part of the ladder between the top and bottom points of support. If the top of the ladder that extends above the upper support is used for climbing, too much downward pressure will be placed on the ladder, causing the base of the ladder to be pushed outward.

Before using a straight ladder, check the steps or rungs for looseness and the siderails for weakness. A ladder that has a defective part must never be used. A straight ladder is designed to be used in a vertical position and should not be used horizontally as a scaffold. The rails are not strong enough to support a worker's weight. If the ladder is used horizontally, it will probably crack and cause a fall.

Recommended safe procedures for placing a straight ladder for use are the following:

- Do not place a ladder in front of a door that opens toward the ladder unless the door is locked.
- Do not lean a ladder against a windowpane or sash. (A board of sufficient length should be secured to the back of the top of the ladder to give support on each side of the opening.)
- Place the ladder so that both siderails have a secure footing.
- If the ladder is to be placed against a metal surface, use nonslip safety feet on the siderails to prevent slipping.
- Have another worker steady the ladder as you climb up and down.
- Do not place the top of the ladder against stacked materials that could shift and cause a fall.
- Place barricades and warning signs around the ladder to protect you as well as those passing by.

It is extremely hazardous to strap straight ladders together to make a longer ladder. A ladder designed for the required height should be used.

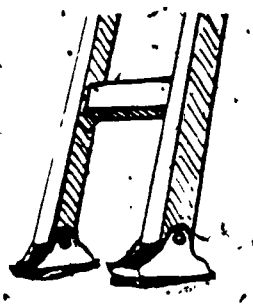

Figure 3. Nonslip safety feet.

Extension ladders are more dangerous than other straight ladders, primarily because they are used at greater heights; and the greater the height, the farther the fall - thus, the worse the injury. Use of an extension ladder over 60 feet in height is prohibited by OSHA.

The upper section of an extension ladder rests on the lower section. For proper support, the overlap of the top section must be a

minimum of three feet on a ladder 36 feet long and under; four feet on a ladder extended over 36 and under 48 feet; and five feet on a ladder extended over 48. An extension ladder should never be adjusted while anyone is on it.

To safely set up an extension ladder, the base must first be secured from slipping, and then the top may be raised to a vertical position, as shown in Figure 4. While the ladder is in a vertical position, it should be walked to the place desired (Figure 4), and then extended to the required height. A heavy extension ladder should never be raised without help.

Extension ladders should always be checked carefully before use to ensure that the extension locks work properly. The ropes for raising and

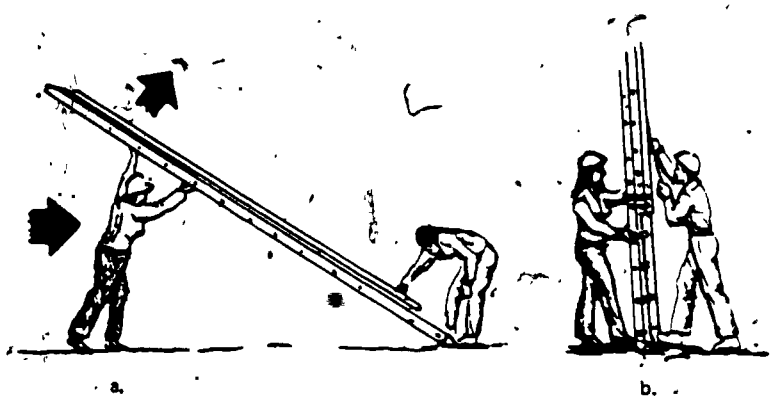

Figure 4. Raising an extension ladder.

lowering the extension sections should be in good condition so they will not break, allowing a section to fall back and cause an injury. The ladder should have nonslip safety feet, as illustrated in Figure 3, or be tied at the base to keep it from slipping.

When using any portable ladder, whether self-supporting or not, avoid reaching too far to the side. It may take a few more seconds to climb down and move the ladder, but it could prevent a serious accident.

Figure 5. Decals warn workers of hazards of metal ladders.

When positioning a metal ladder, it is particularly important to avoid placing the ladder near electrical equipment or power lines. Contact with energized lines result in an electrical shock. Only ladders made of wood or other non-conductive material, such as fiberglass, should be used around electrical equipment.

Decals similar to the one in Figure 5 warning workers of the hazard of using metal ladders around electrical equipment, should be placed at eye level on the inside of the ladder's siderails.

ACTIVITY 4:

1. If the working length of a straight ladder is 20 feet, name the distance the base should be placed from the structure the ladder is leaning against.

   _____

2. List three steps in safely setting up an extension ladder.

   a. _____

   b. _____

   c. _____

3. Extension ladders should be checked to ensure what two things:

   a. _____

   b. _____

OBJECTIVE 5: State four features of the correct storage of ladders.

An important part of portable ladder safety is the care that the ladder receives when it is not in use. When a new ladder arrives at the workplace,

it should be inspected for material defects that could cause the ladder to break, such as the following:

- Pitch pockets - an opening, extending parallel to the annual growth rings, containing either solid or liquid pitch.
- Knots - a branch or limb embedded in the tree and cut through in the manufacturing process.
- Cross grain - a deviation of the fiber direction from a line parallel to the sides of the piece.
- Compression failure - a deformation or buckling of the fibers due to excessive compression along the grain.

If an inspection shows that the ladder is free of defects, the ladder should be coated with a transparent varnish, shellac, or other clear preservative.

When not in use, ladders, particularly wooden ladders, should be stored in a well-ventilated area away from damp places, heaters, radiators, and steam pipes that could cause warping.

Ladders should never be left lying about the work area where someone might trip over them. They should be stored where they are out of the way, yet easily accessible. Rather than being stored flat, ladders should be placed on the side on racks, or suspended on brackets against a wall. Long ladders should be suspended by more than two brackets to prevent warping.

A ladder should not be subjected to falls or severe shocks that could weaken it. Ladders must be inspected monthly and any noted defects repaired immediately. If the ladder cannot be repaired, it must be destroyed. A defective ladder must never be left where a person unaware of the hazard might pick it up and use it.

ACTIVITY 5:

Describe how a ladder should be stored, including the condition of the storage area and the two methods of hanging it.

OBJECTIVE 6: Describe three types of protection that can be used with fixed ladders to prevent a worker's uninterrupted fall.

A fixed ladder, as illustrated in Figure 6, is one that is permanently attached to a structure and is positioned vertically. As with portable ladders, a fixed ladder can be either wood or metal, with the rungs spaced not more than 12 inches apart. The minimum clear length of rungs or cleats of a fixed ladder must be at least 16 inches. The top and bottom of a fixed ladder must be firmly anchored, and intermediate supports must be provided to keep the ladder from wobbling.

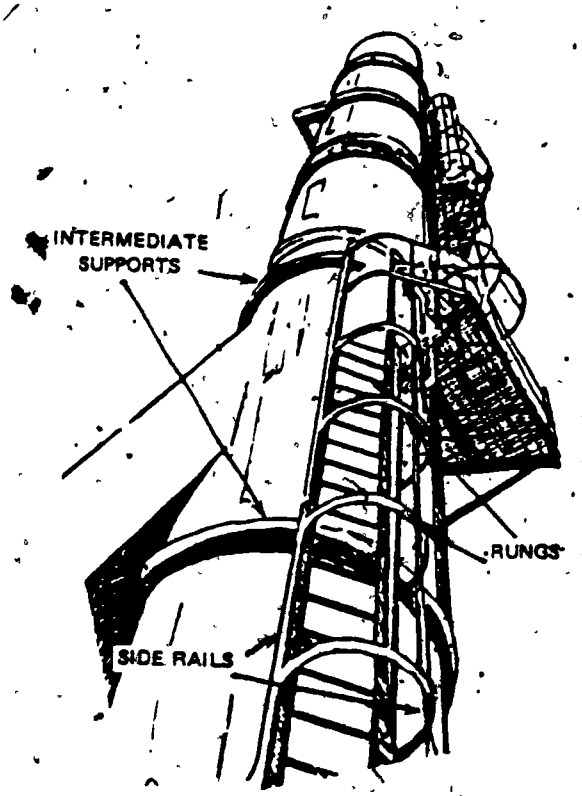

Figure 6. A fixed ladder.

Fixed ladders are subject to damage from vehicle traffic at their bases and from deterioration due to constant exposure to the weather. Therefore, they should be inspected regularly to ensure that the anchoring points from top to bottom are secure, and that the siderails and rungs are not loose, worn, or damaged. Metal ladders must be inspected for rust and corrosion, which will weaken the ladder, and for any sharp edges that could cause injury to a worker. Worn or damaged parts should be reported and repaired before the ladder is used.

OSHA standards require that a fixed ladder more than 20 feet high be equipped with with a cage (Figure 7) or a ladder safety device. For full protection, however, cages or safety devices should be installed even on shorter fixed ladders.

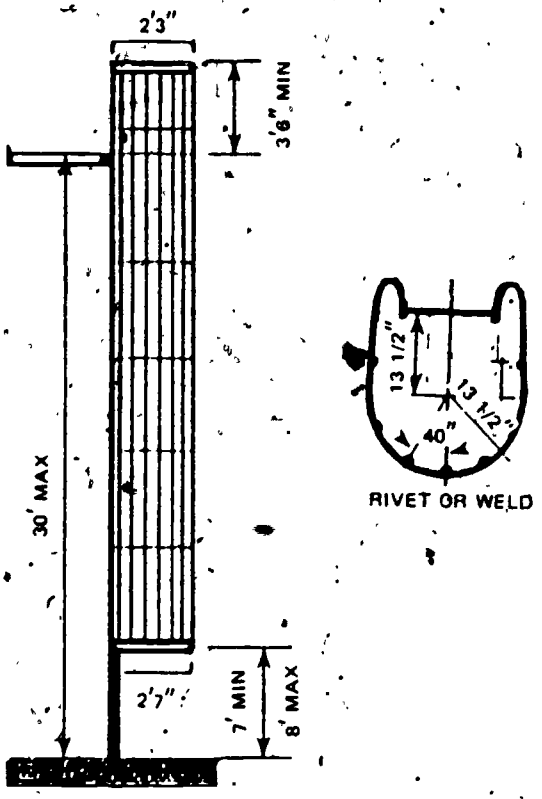

Figure 7. Fixed ladder with cage.

A cage or safety device will stop a fall to ground level. If a worker should fall backward or away from the ladder, the cage will provide something to break the fall and allow the former position to be regained.

A fixed ladder cage should begin seven feet above ground to allow room for workers on vehicles to pass under it. It should extend to at least three and a half feet above the top landing to protect the workers until they are actually on the landing.

A safety cage must be no less than 27 inches in diameter so that it allows room for easy up and down passage. At the same time, it must be close enough to the ladder to prevent a dangerous fall against the cage itself.

A ladder safety device, such as a safety belt with a friction brake lock, will also protect a worker from an interrupted fall. Figure 8 shows one type of ladder safety device. Any safety device cannot afford much protection unless the worker wears the device. Consequently, unless both the employer and the employee realize the need for safety devices and the work rules for wearing them is strictly enforced, a cage would be better protection.

Fixed ladders are also required to have landing platforms provided for each 30 feet of height if the ladder is more than 20 feet high. This

Figure 8. A safety belt.

requirement does not apply, however, in cases where a ladder safety device is used on a tower, water tank, or chimney ladder. A landing platform serves two purposes: (1) it is a means of interrupting a free fall, and (2) it provides a resting place for workers during long climbs. For maximum safety, it is a good idea to install a cage or safety device even when platforms are provided.

Platforms should be at least 24 inches long and 30 inches wide and must be equipped with sturdy guardrails that include midrails and toeboards. Guardrails must be made of structural steel and be able to withstand at least 200 pounds of pressure applied to the top rail. Toeboards are 4-inch high barriers that are secured at no more than 1/4 inch above platform level around all open sides of the platform. The use of a toeboard will prevent materials from being kicked off the floor of the platform.

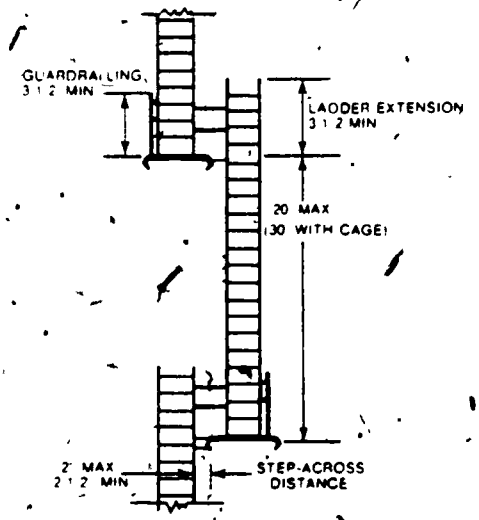

Figure 9. Fixed ladder with sections between platform offsets.

If a fixed ladder is equipped with platforms, each section of the ladder must be offset from the next, as illustrated in Figure 9, to further protect the worker from an uninterrupted fall.

In order to ensure a safe foothold, there must be at least a seven-inch clearance space between the rungs of a fixed ladder and the surface to which the ladder is attached. The step-across distance to the structure or to another section of the ladder must not be less than two and a half inches or more than 12 inches. These standards help prevent loss of balance and falling as you step from the ladder to the structure.

least 200 pounds of pressure applied to the top rail. Toeboards are 4-inch high barriers that are secured at no more than 1/4 inch above platform level around all open sides of the platform. The use of a toeboard will prevent materials from being kicked off the floor of the platform.

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ACTIVITY 6:

List three types of protection that can be used with fixed ladders to prevent a worker's uninterrupted fall, and one feature of each.

1. _____
2. _____
3. _____

OBJECTIVE 7: Name four hazards connected with scaffolds.

A scaffold is a temporary, elevated platform designed to hold workers and their materials. Anytime something is erected as a temporary structure, it is more hazardous than a permanent structure, which has been tested, inspected, and maintained regularly. The fact that scaffolds are elevated also presents safety problems. On a scaffold, workers are subject to serious injuries from falls, and workers below the scaffold are exposed to injuries from objects accidentally dropped.

Scaffolds must be firmly constructed and strong enough to support four times the maximum intended load; that is, four times the expected maximum weight of the workers and the materials that will be on the platform.

The footing for a scaffold should be constructed of sound, rigid material and be capable of carrying the maximum intended load without settling or displacement. Unstable objects, such as boxes, or loose bricks or concrete, should never be used to support a scaffold, as they could possibly give way, causing the scaffolding and workers to fall.

The working platform must have planks that are laid with their edges close enough together that no tools or materials can slip through and perhaps strike someone below. A four-inch-high toeboard around the exposed edges of the working platform will also prevent materials from being knocked over the edge. The planks of a platform must span only a distance of six to 10 feet without support, depending upon the type and width of the plank used. Plank ends must be overlapped at least 12 inches, so that the planks will not move when someone walks on them. Scaffold planks must not extend more than 18 inches, or less than six inches, beyond the end supports. If the plans extend more than 18 inches, the worker risks walking on unsupported plank ends. At least a six-inch extension is needed to keep the planks from slipping off the support.

OSHA requires that guardrails with midrails and toeboards be installed around the open sides of a working platform that is over 10 feet from the ground. However, it is a good safety practice to erect a standard guardrail around any elevated working surface. The guardrail will prevent workers from accidentally stepping or falling off the platform. Where persons are required to walk or work under scaffolds, a screen should be placed along the entire opening between the toeboard and the midrail or top rail, to prevent materials from being knocked off the scaffold.

An important point to remember when erecting a scaffold is that power lines near scaffolds are dangerous. If a scaffold must be set up near electric power lines, it must be done only <u>after</u> the power company has turned off the electricity.

Safe construction of a scaffold will not ensure its safety. Safe use is also necessary to prevent serious and often fatal injuries that result from falls from a scaffold. Safe use means keeping the work platform clear of tools, materials, and debris that a worker might trip over. All scaffold parts, especially the platform, should be kept free of ice, snow, oil,

grease, and other slippery substances. Scaffolds should be inspected periodically for structural damage and rust. Damaged scaffolds should be repaired before use.

Caution must be used when raising materials, tools, and equipment to the working platform, to avoid dropping items onto someone working below the scaffold. A line should be attached to the load to keep it from swinging and striking a worker or damaging the scaffold.

A safe means of access to the scaffold must be provided. In some instances, the scaffold can be reached from floors that are adjacent to the scaffold. If this is not the case, a ladder that conforms to the standards mentioned earlier in this module must be used.

ACTIVITY 7:

1. Name two features of a scaffold that contribute to its being hazardous.
   a. _____
   b. _____
2. Fill in the blanks.
   a. Safe use of a scaffold means keeping the work platform clear of _____, _____, and debris.
   b. Caution must be used when raising items to the working platform to _____ anything onto workers below.
   c. A _____ should be attached to the load to keep it from _____.

OBJECTIVE 8: Define three types of scaffold.

Most scaffolds can be classed in one of three groups: built-up, rolling, or suspended. All scaffolds should be designed by a professional engineer, and should not be assembled in a makeshift fashion. Any flaw in the design of a scaffold could cause it to collapse.

A built-up scaffold is called "built-up" because it is built up higher as the work progresses. It can be made of either wood or metal. It is important that the footing on a built-up scaffold be sound, rigid, and strong enough to support, without settling or shifting, a load four times the maximum intended load. Unstable objects, such as barrels, boxes, or loose bricks, should never be used as support for scaffolds or planks, because they could slip and cause the scaffolding and worker to fall.

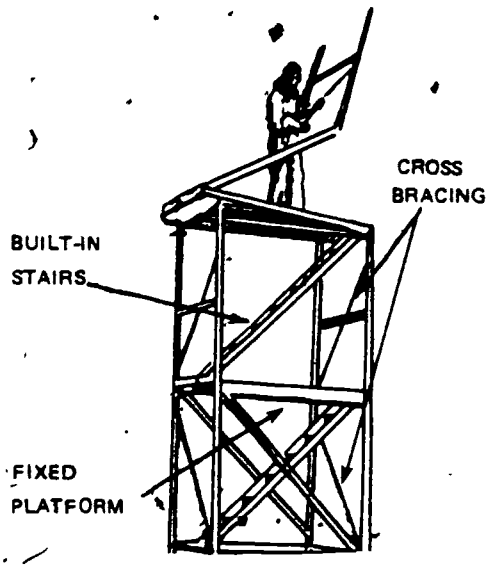

Figure 10. A built-up scaffold.

Built-up scaffolds, as illustrated in Figure 10, must have vertical members that are straight up and down, and horizontal members that are level. A built-up scaffold could collapse under an uneven load. Cross-bracing, or diagonal bracing, will keep the scaffold erect, level, and rigid.

Built-up scaffolds are classified according to their loading capacity. This classification is important because it enables the correct choice of a scaffold appropriate to the job and also provides a means for recognizing dangerous overloading.

Built-up scaffolds designed for light duty can handle a maximum load of 25 pounds per square foot of platform surface. Light-duty scaffolds are safe only for a limited number of jobs. Workers must be particularly careful when working on this type of scaffold because it can be easily overloaded.

A medium-duty, built-up scaffold can handle a maximum of 50 pounds per square foot of working surface, and a heavy-duty scaffold can handle a 75-pound load per square foot. One point that requires mentioning is that all maximum intended load figures are based on evenly distributed loads.

The loading capcity of a built-up scaffold can be determined by the spacing of its supports. The following are spacing requirements for 2 x 10 commercial size lumber:

- For a light-duty scaffold, the supports are spaced not more than 10 feet apart along the length of the scaffold.
- For a medium-duty scaffold, supports are spaced not more than 8 feet apart.
- For a heavy-duty scaffold, supports are spaced not more than 6 feet apart.

The maximum safe load of a scaffold is determined by measuring its platform area and multiplying the area by the platform's capacity per square foot. For example, if the platform of a medium-duty scaffold measures five feet by eight feet, it will support up to 2,000 pounds, because a medium-duty scaffold has a maximum capacity of 50 pounds per square foot. However, this load must be evenly distributed, not concentrated in one area of the platform.

ACTIVITY 8:

1. Fill in the blanks.
   a. A built-up scaffold is so called because it is _____ _____ as the work _____.
   b. Built-up scaffolds can be classified according to their _____ _____.
   c. Light-duty scaffolds are safe for a maximum load of _____ _____ per square foot of platform surface.
   d. All maximum load figures are based on _____ _____ loads.
2. Name three types of scaffold.
   a. _____
   b. _____
   c. _____

OBJECTIVE 9: Define rolling scaffolds and list three safety rules that apply to them.

A rolling, or mobile, scaffold (illustrated in Figure 11) is similar to a built-up scaffold, except that it is mounted on wheels. The safety

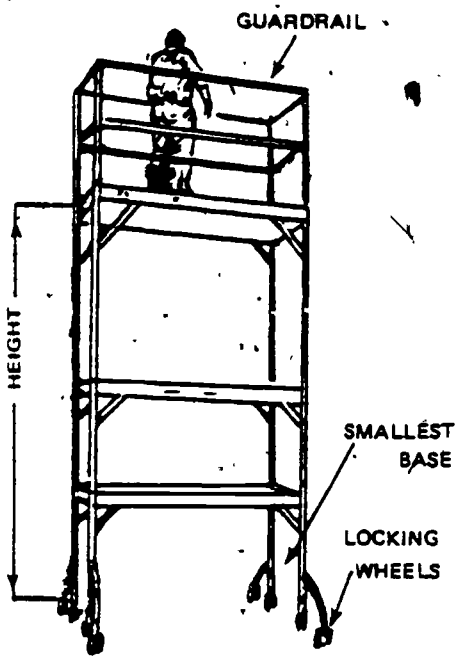

Figure 11. A rolling, or mobile scaffold.

requirements that apply to built-up scaffolds also apply to rolling scaffolds. Some additional regulations apply because of the rolling scaffold's mobililty.

A rolling scaffold can be a very dangerous piece of equipment if not properly used. It should never be treated as a toy by workers who might attempt to ride it.

When a rolling scaffold is moved, all tools, equipment, and workers must first be removed from the platform to prevent falling accidents. The floor that the scaffold will be moved along should be level and free of obstructions. Overhead obstructions should also be watched for. Once the scaffold has been positioned, the wheels must be locked to prevent any sudden movement of the scaffold.

Rolling scaffolds must have design and construction features that will prevent their tipping. For example, the height of the working platform must not exceed four times the smallest dimension of the base. In other words, if the base of a rolling scaffold is eight feet by ten feet, the maximum height at which the scaffold can be used is 32 feet, which is four times the smallest dimension of the base (eight feet).

ACTIVITY 9:

1. List two procedures that must be carried out when moving a rolling scaffold.

   a. _____

   b. _____

2. Name the rule used for determining the maximum height at which a rolling scaffold can be used.

_____

_____

OBJECTIVE 10: Describe suspension scaffolds and three safety procedures that relate to them.

The third type of scaffold is the suspension scaffold. There are two basic styles of suspension scaffolds. The first is the two-point suspension scaffold, sometimes called the swinging, or stage scaffold. It is designed only for light-duty use, and is primarily for workers using hand tools. The two-point suspension scaffold is suspended from the roof by roof irons or hooks.

The second style of suspension scaffold is the multiple-point suspension scaffold. This type is used for heavy-duty work and is designed to handle work loads of not more than 50 pounds per square foot. The work platform is supported by wire ropes suspended from overhead outrigger beams. The outrigger beam (Figure 12) must be at least 15 feet long and should not extend more than six and a half feet beyond the bearing point. The outrigger beams must be made of structural metal, with the inside end anchored to the frame or floor system of the building by large U-bolts and anchor plates.

Because suspension scaffolds can swing and move in the wind, the platform must be tied to the building while workers are on it.

All suspended scaffolds are hung from either fiber or wire ropes. These ropes must meet safety requirements. Any rope used for scaffold suspension must be able to support six times the intended load, which includes the weight of the scaffold itself, as well as any workers or materials it carries.

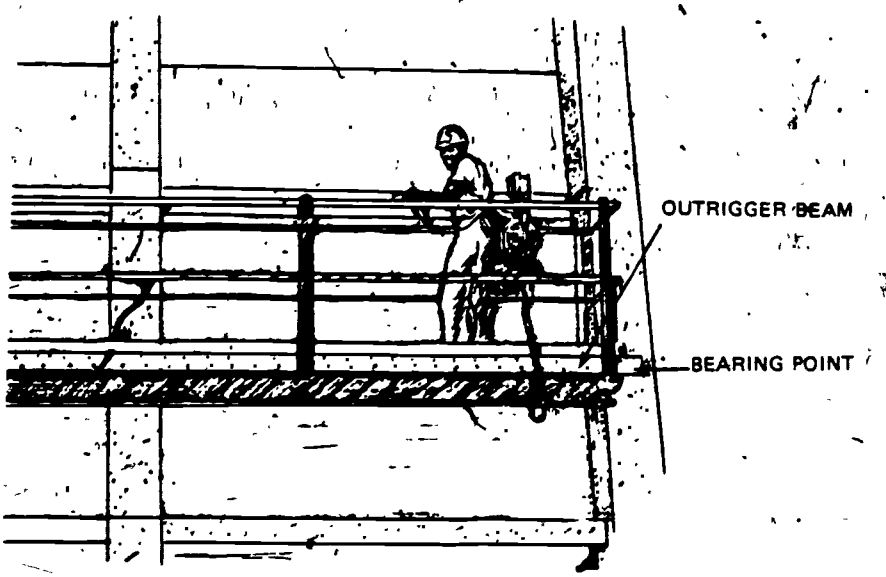

Figure 12. A powered suspension scaffold.

Ropes supporting a swinging scaffold should be comparable to first grade manila fiber (not less than 3/4 inch in diameter). They must be properly rigged into a set of six-inch blocks consisting of at least one double and one single block. If the scaffold is to be used with acids, torches, or open flames that will weaken manila rope, then wire rope, not less than 9/16 inch in diameter, must be used. Where wire rope is used, a hoisting mechanism must be provided on the end of the scaffold platform.

Rope needs to be carefully checked for damage each time it is used, otherwise the damage will not be discovered until it is too late. Checking can be done by twisting the rope until the strands spread apart. If there is a powdery appearance or broken strands, the rope is damaged and must be thrown away. Knots and kinks cause damage to a rope and should be avoided. If usage requires that a rope be continuously twisted in one direction, compensating turns in the opposite direction should be made to avoid damage to the rope. When not in use, rope should be stored in dry, well-ventilated areas away from extreme temperatures, humidity, or dryness. A damp rope will rot, and a dry rope will become brittle, thus losing its strength and durability.

Most suspended scaffolds are raised and lowered with some type of hoisting mechanism. This mechanism must be checked before each use to make certain it is operating safely. There should always be at least three turns of rope left on the hoisting drum, to reduce the force exerted on the rope where it connects with the drum. This measure will lessen the possibility of the rope slipping from the drum and breaking.

As with any elevated working surface, the platform of a suspended scaffold must be equipped with a standard guardrail and toeboard, and overhead protection where needed to protect workers from being hit by falling objects.

Scaffold planks should be inspected before each use to ensure their safety. Some workers proof-test their scaffold by lowering it to just above the ground and loading it with a load several times as great as the intended load. This method of testing planks is not recommended, because it may cause damage to the platform that remains concealed until the planks fail.

There are visible signs indicating that planks are unsafe. Some of the signs are large knots, excessive grain slope, and decay. Any plank that contains these or other defects should be discarded.

Safety procedures for scaffold use do not end with a guarantee that a scaffold is safe. Many falls and serious injuries have occurred from extremely safe scaffolds, because the workers were not protected by safety devices. Any worker on a suspended scaffold must wear a safety belt and lanyard. The lanyard must be fastened either to a substantial member of the structure to which the scaffold is suspended, or to a securely rigged lifeline that will safely support the worker if he or she falls or if the scaffold falls. A lanyard should never be attached to the scaffold itself, or there will be no protection for the worker if the scaffold falls. The lifeline must be entirely separate from the scaffold and must reach the ground, as illustrated in Figure 13.

A fall to a lower level is one of the most dangerous accidents in a workplace. This fact plus the fact that scaffolds are normally used at great heights makes it necessary that all scaffolds, whether built-up, mobile, or suspended, be properly constructed, used, and maintained to ensure their safe use and the safety of the workers who use them.

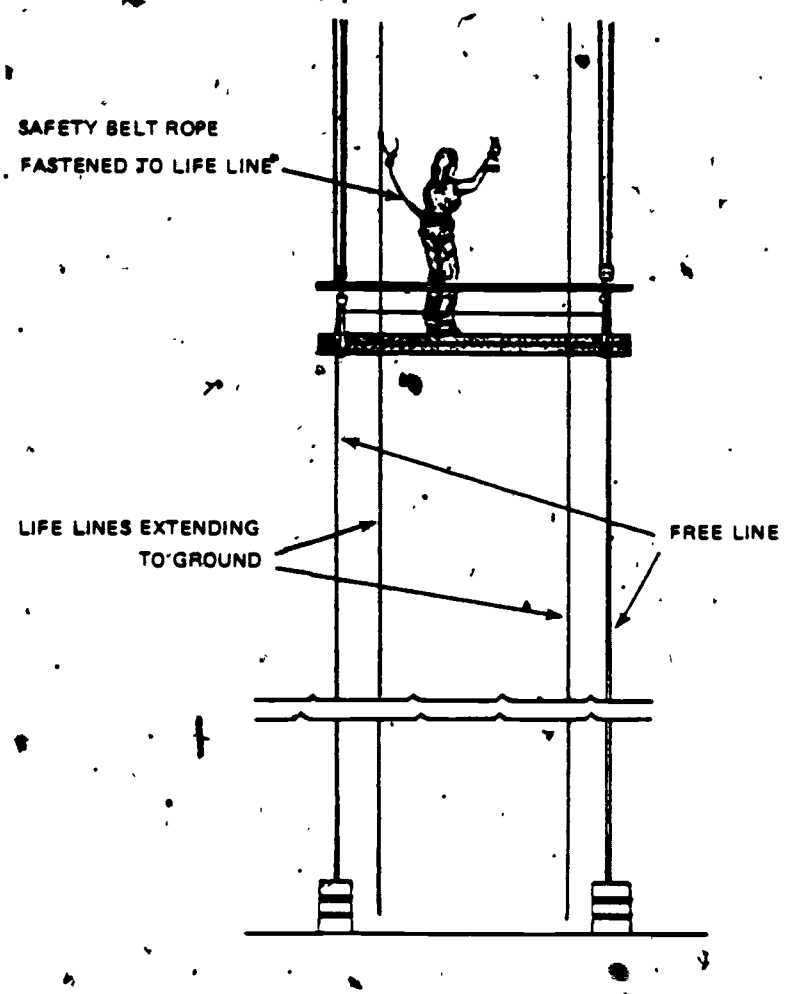

Figure 13. Suspension scaffold with lanyard and lifeline.

ACTIVITY 10:

1. Name two types of suspension scaffolds.
   a. _____
   b. _____
2. Name two places to which a worker's lanyard can be attached.
   a. _____
   b. _____

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ANSWERS TO ACTIVITIES

ACTIVITY 1

1. a. Eliminate the use of unsafe ladders.
   b. Eliminate unsafe acts on ladders.
2. a. Any serious heart condition.
   b. A severe hearing impairment.

ACTIVITY 2

1. A stepladder - portable, nonadjustable and self-supporting.
2. A single ladder - portable, nonadjustable in length and contains only one section.
3. A sectional ladder - portable, nonadjustable in length, with two or more sections that can be combined to function as a single ladder.
4. Extension ladder - portable, adjustable in length, with two or more sections that travel in brackets.

ACTIVITY 3

1. a. The top step of the stepladder.
   b. The back of the stepladder.
2. Any five:
   a. Broken, loose, or missing steps.
   b. Split or broken siderails.
   c. Broken or missing spreaders.
   d. Too light construction.
   e. Poor material (such as wood not being straight grained).
   f. Loose hinges.

ACTIVITY 4

1. Five feet.
2. a. Secure the base.
   b. Raise the top to a vertical position.
   c. Walk the ladder into place.
3. Any two:
   a. That extension locks work properly.
   b. That ropes for raising and lowering the sections are in good condition.
   c. That it has safety feet.

ACTIVITY 5

1. A ladder should be stored in a well-ventilated area away from damp places, heaters, radiators, and steam pipes that could cause warping.
2. A ladder can be supported along its entire length to prevent sagging; a ladder can be hung from the top.

ACTIVITY 6

1. A cage - begins 7 feet above ground; reaches to 3 1/2 feet above the top of the structure; is at least 27" in diameter (any one).
2. A platform - must be at least 24" x 30"; must have guardrails, midrails, and toeboards.
3. A safety device, belt - has a friction belt.

ACTIVITY 7

1. a. A scaffold is temporary.
   b. A scaffold is elevated.
2. a. Tools, materials.
   b. Avoid dropping.
   c. Line, swinging.

ACTIVITY 8

1. a. built-up higher; progresses.
   b. loading capacity.
   c. 25 pounds per square foot.
   d. evenly distributed.
2. built-up, rolling, suspended (suspension).

ACTIVITY 9

1. Any two.
   a. All tools, equipment, and workers must be removed from the platform.
   b. Overhead obstructions should be watched out for.
   c. The floor the scaffold will be moved along should be level and free of obstructions.
2. The maximum height at which a rolling scaffold may be used must not exceed four times the smallest division of the base. (If a scaffold is 8' x 10', the maximum height at which the scaffold can be used is 32 feet.)

ACTIVITY 10

1. a. Two-point (swinging or stage) suspension scaffold.
   b. Multiple-point suspension scaffold.
2. a. A securely rigged lifeline.
   b. A solid part of the structure.

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