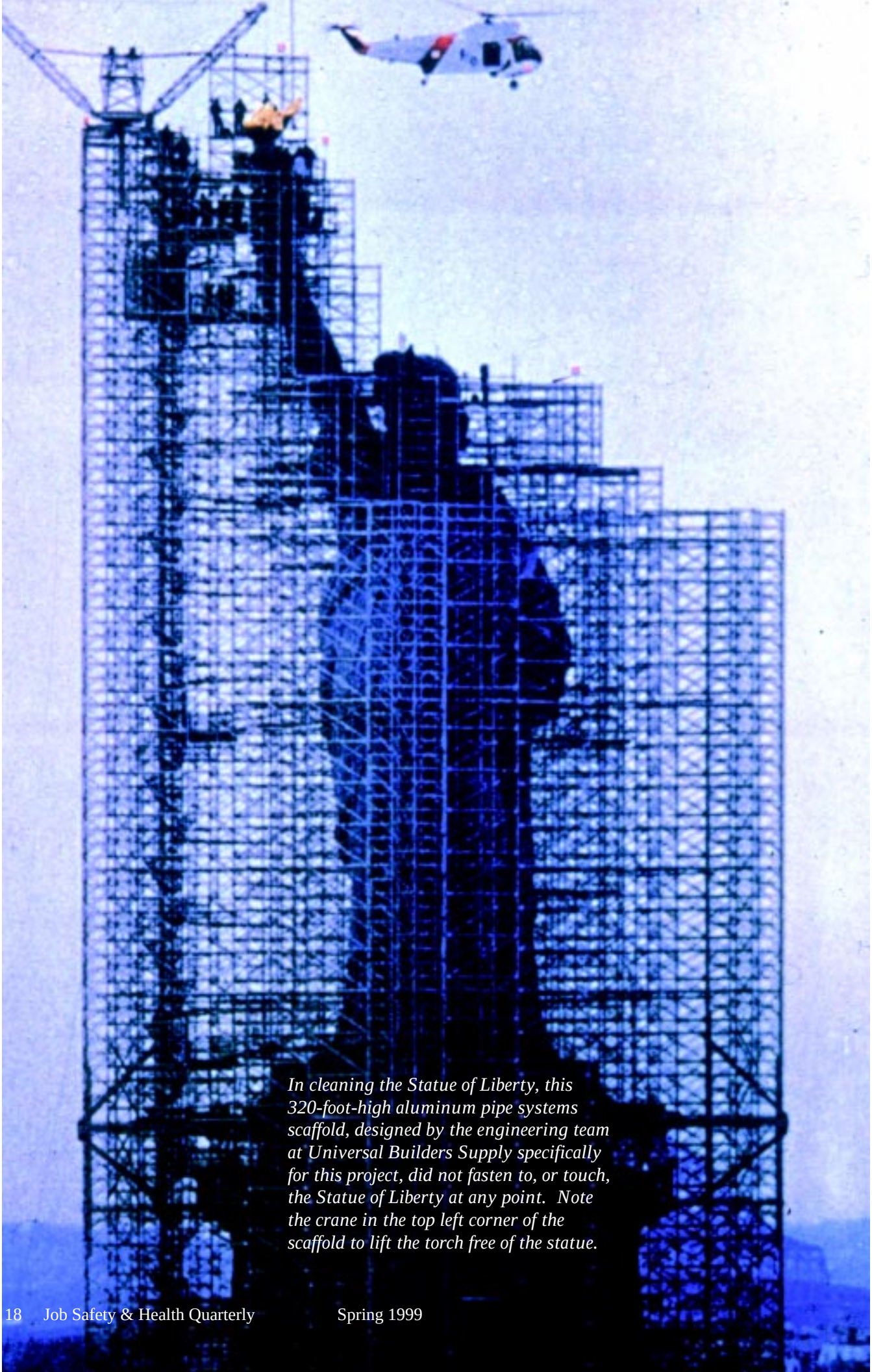


In cleaning the Statue of Liberty, this 320-foot-high aluminum pipe systems scaffold, designed by the engineering team at Universal Builders Supply specifically for this project, did not fasten to, or touch, the Statue of Liberty at any point. Note the crane in the top left corner of the scaffold to lift the torch free of the statue.

Working with Scaffolds—Using Them Properly to Prevent Hazards

by Louis Rowe

An estimated 2.3 million construction workers, or 65 percent of the construction industry, work on scaffolds frequently.[1] In 1996, when OSHA issued the revised Scaffold Standard[2] for construction, the agency estimated that by protecting these millions of workers from scaffold falls, 4,500 injuries and 50 deaths from scaffold-related accidents would be prevented every year.[3] In addition to this human savings, working safely on scaffolds also has financial rewards, with an estimated annual savings of $90 million for American employers in workdays not lost.[4]

By definition a scaffold is a temporary, elevated platform that construction workers use for working safely at elevations. Scaffolds have been around for thousands of years, and there are myriad types and uses. Some simple scaffolds are little more than planks and guardrails over two sawhorses; others are much more complex, such as the scaffolds erected hundreds of feet in the air to build skyscrapers or repair monuments like the Statue of Liberty. Scaffolds are fabricated from many materials—some common, and others not so common. As an example, even in this day of steel and iron, scaffolds made from bamboo sticks are still used in some Asian countries to erect large multistory structures. In the United States and Canada, most scaffolds

Examples of Scaffolding Rules

- Workers will use only the installed ladders for access and will never climb a scaffold using the cross braces or guardrails as ladders.
- Scaffolds must never be modified by anyone without permission from the *competent person*, including "just removing that brace for a minute to paint behind it...." or doing other seemingly harmless activities.
- Any damage to the scaffold will be reported to the *competent person* immediately.
- Scaffolds will not be used in high winds or electrical storms; the *competent person* has the final word on what constitutes these prohibited conditions.
- Snow and ice must be cleared from the scaffold before workers attempt to use it.

[1] U. S. Department of Labor, Office of Public Affairs, *OSHA National News Release*, USDL 96-352, August 29, 1996.
[2] *Title 29 Code of Federal Regulations (CFR)*, Part 1926.450-454. Under Section 18 of the *Occupational Safety and Health Act of 1970*, states have the authority to develop state occupational safety and health plans that are at least as effective as Federal OSHA standards. There are 25 states and territories operating their onw state plan program. These states programs may be more stringent than the federal regulations. The scaffold competent person should contact state agency Consultative Services for specific information on his or her state. See also **Outreach** on OSHA's website at www.osha.gov.
[3] U. S. Department of Labor, Office of Public Affairs, *OSHA National News Release*, USDL 96-513, December 12, 1996.
[4] *OSHA National News Release*, USDL 96-352, August 29, 1996.

Clearance must be maintained between scaffolds and any electrical hazards. If clearance cannot be maintained, the lines can be deenergized and grounded by the utility company. The scaffolding shown here is in violation.

found at jobsites are made of steel, aluminum, or less commonly, wood. Frequently used types of scaffolds include the *fabricated frame scaffold*, the *mobile scaffold*, the *tube and coupler scaffold*, the *system scaffold*, and the *suspended scaffold*. There are many other scaffolds in use as well, each with advantages and disadvantages. The knowledgeable user knows how to select the right scaffold for the job, and he should—his life depends on it.

Using scaffolds properly can help prevent workplace accidents and injuries. Knowing what to do and when to do it can save lives. A thorough understanding of all aspects of constructing, using, and dismantling a scaffold is vital to protecting workers. Each has potential hazards that employers and workers need to be aware of so they can take the proper measures to protect against or prevent accidents and injuries.

Like all OSHA regulations, this responsibility is placed on the employer who must have a *competent person*, who is, by definition, the "one capable of identifying existing and predictable hazards...and who has authorization to take corrective measures to eliminate them."[5] A scaffold can only be erected, moved, dismantled, or altered under the supervision and direction of a *competent person* qualified in such activities.[6] The *competent person* selects, directs, and trains the employees who erect, dismantle, move, or alter scaffolds. He or she also determines the feasibility of fall protection[7] and safe access[8] during erection. The *competent person* also inspects the scaffold before each work shift and after occurrences that could affect the integrity of the scaffold, such as a carpenter having removed a brace to reach his work, or discovering broken components.

Let's look at the three stages of scaffolding—building, using, and dismantling—and identify their hazards.

Building Scaffolds

Before building a scaffold, all persons involved in the process must wear required, appropriate *personal protective equipment*, or PPE,[9] for protection from the hazards present at the job site. Generally, safety boots or shoes, eye protection, and hard hats meeting OSHA standards[10] are a minimum requirement on a construction

[5] *Title 29 of the Code the Federal Regulations (CFR),* Part 1926.450(b).
[6] 29 *CFR* 1926.451(f)(7).
[7] 29 *CFR* 1926.451(e)(9).
[8] 29 *CFR* 1926.451(g)(2).
[9] 29 *CFR* 1926.28(a) and (b).
[10] **Note:** The American National Standards Institute (ANSI) updated its ANSI Z89.1 *Standard for Industrial Head Protection* in 1997 and made significant changes in the types and classes of hardhats.

Fabricated Metal Frame Scaffold

Design

- Uses cross braces to connect prefabricated frames together. The size of the frames, as well as the length and type of the planks laid between them, dictate the maximum load possible.

Use

- Widely used at many jobsites due to simple assembly, rigid construction, low cost, and durability.
- Can be erected up to 125 feet in height.
- Available in different configurations and weight ratings to accommodate many types of work such as masonry and plaster work.

Limitations/Hazards

- Rigid prefabricated construction makes it less adaptable to unusual building shapes than other scaffold types such as the tube and coupler or the system scaffold.
- Fabricated frame scaffolds more than 125 feet high must be designed by a registered professional engineer per *29 CFR* 1926.452(c)(6).
- Deenergize, guard, or mark all electrical hazards and keep all conductive materials at least 3 feet from electrical hazards (10 feet or more above 300 volts).
- Scaffold frames and panels must be attached together with pins, couplers, or equivalent devices.
- Scaffolds must rest on baseplates and mudsills, or other firm foundations capable of supporting the loaded scaffold without settling or displacing.

site. Other specialized equipment may also be required under certain circumstances, such as gloves, fall protection harnesses and equipment, and personal flotation devices.

The first step in building a scaffold includes a *site inspection* to identify site-specific hazards not identified in the preplanning stage and to ensure that the characteristics of the site are considered in the scaffold design. Meanwhile, erectors should inspect all scaffold parts before use, checking for cracks, dents, bends, breaks, corrosion, and bad welds on all metal pieces. Fittings need to be scrutinized for distorted, stripped, missing, or bent parts, and scaffold planks need to be checked for cracks, splits, or other damage. To prevent the use of inappropriate planking, the *competent person* should specify that all planks be marked "scaffold grade or equivalent." Planks **should not be coated** with opaque paints, because the paint may hide defects. Any damaged scaffold parts that are found need to be tagged, set aside, and repaired or replaced per the manufacturer's directions.

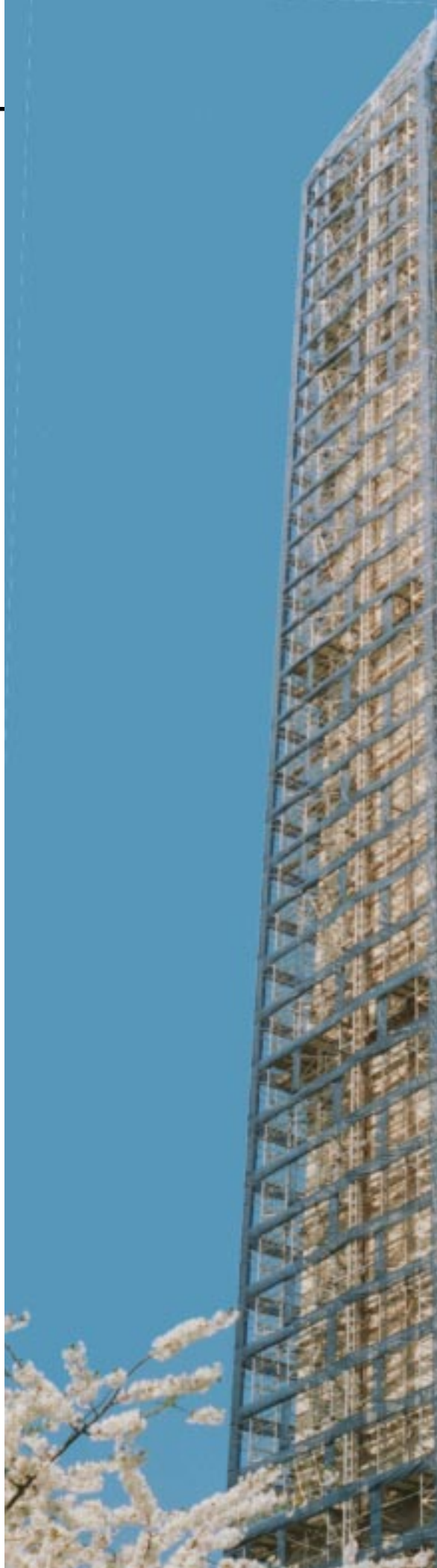
Under the supervision and direction of the *competent person*, the process of building the scaffold now begins. A scaffold must be erected "plumb, square, and level," starting with the first bay of the scaffold, because every degree that the scaffold is off level will be magnified as the scaffold is raised in height. The resulting instability will cause the weight of the scaffold to shift, potentially causing overload of one leg and eventual collapse of the scaffold. All diagonal, horizontal, or other bracing recommended by the manufacturer or qualified person must be installed as the scaffold is erected. Supported scaffolds with a height

An estimated 2.3 million construction workers, or 65 percent of the construction industry, work on scaffolds frequently.

more than four times the minimum base width (4:1) must be tied, guyed, or braced. These shall be installed according to the manufacturer's recommendations, but at a minimum, the scaffold must be tied closest to the 4:1 height and then repeated every 20 feet vertically for a scaffold 3 feet wide or less, and every 26 feet for a scaffold greater than 3 feet wide. The guys, ties, or braces must be placed horizontally at each end and at 30-foot intervals measured from one end only.[11]

As the scaffold is built level by level, builders must have a means of *safe access*. There are specific OSHA requirements for safe access[12] for scaffold builders, dismantlers, and users. Some frame scaffolds meet these requirements with built-in ladders that have the proper spacing between rungs. For scaffolds without this feature, builders must install ladders. Using cross braces for access is not permitted by the OSHA scaffold standard.[13] Decking or planking used by the builders must be at least 18 inches wide. After the building process is complete, it is important that all "working" levels of the scaffold are fully planked.[14] Unless the employer can demonstrate that wider spacing is necessary in a particular scaffold installation, there should be no more than a 1-inch space between planks. Scaffold levels used only as a walkway must have planking or decking at least 18 inches wide[15] or fall protection must be provided and used.

[11] 29 *CFR* 1926.451(c).
[12] 29 *CFR* 1926.451(e).
[13] 29 *CFR* 1926.41(e)(1).
[14] 29 *CFR* 1926.451(b)(1).
[15] 29 *CFR* 1926.451 (b)(2).



The Washington Monument scaffolding, designed by the engineering team at Universal Building Supply, is an aluminum pipe systems scaffold. It is more than 555 feet high and is not mechanically fastened to the monument. All four sides follow the shape of the obelisk, tilting inwards 10 feet from base to tip.

Before builders can permit the use of a scaffold, *fall protection systems and falling object protection* must be installed on any scaffold more than 10 feet above a lower level. The fall protection system can consist of guardrails, a personal fall protection system with a body harness, lifelines, and anchor points, or other equally effective means of preventing falls from

Mobile Scaffold (Manually Propelled Rolling Tower)

Use

- Ideal for work involving repetitive tasks at the same height in different places, such as checking the fire sprinkler heads in a warehouse.

Design

- Can be a specifically designed construction, but often is simply a fabricated frame scaffold mounted on locking wheels known as casters.
- Has additional diagonal bracing for rigidity.
- Can use outrigger supports to widen the base for greater stability.

Limitations/Hazards

- Use on flat, smooth surfaces.
- This scaffold can be easily pushed into electrical wires. Deenergize, guard, or mark all electrical hazards and keep all conductive materials at least 3 feet from electrical hazards (10 feet or more for electrical hazards exceeding 300 volts).
- Rubber casters often have a limited load capacity compared to metal casters of the same size, and this may limit the maximum load the scaffold can support.
- Limited in height to two times the minimum base dimension, or a maximum height of 20 feet when employees remain on it while it is moved.*
- Casters must be locked after each move.
- Apply manual force as low as possible, and no higher than 5 feet from the floor surface when pushing the scaffold from one position to another.

* It is possible to ride a taller mobile scaffold, but it must be designed and constructed to meet or exceed nationally recognized stability test standards listed in Appendix A of the OSHA regulations for scaffolds. See *29 CFR*, Part 1926.450-454.

Tube and Coupler, or Tube and Clamp, Scaffold

Use

- For placing elevated work platforms around structures with complex shapes.
- Can be erected up to 125 feet in height before requiring approval from a qualified engineer.
- Can be erected around and in tight places such as petrochemical or power-generating plants.

Design

- Four basic parts—baseplate, tube, right-angle clamp, and swivel clamp—combine to form a scaffold of almost infinite shape and size.

Limitations/Hazards

- Tube and coupler scaffolds over 125 feet high shall be designed by a registered professional engineer per *29 CFR* 1926.452(b)(10).
- Deenergize, guard, or mark all electrical hazards and keep all conductive materials at least 3 feet from electrical hazards (10 feet or more for electrical hazards exceeding 300 volts).
- Follow the blueprints for erection, install all bracing exactly as drawn.
- Scaffolds must rest on baseplates and mudsills, or other firm foundations capable of supporting the loaded scaffold without settling or displacing.

the scaffold. The guardrail system[16] must protect all open sides and ends of the scaffold. If the decision to use personal fall protection systems is made, it is important that a person who is competent in fall protection review the plan and approve any anchor points. The scaffold could potentially collapse if an employee "tied off" to the scaffold falls, so the *competent person* will have to consult with the scaffold manufacturer before making a decision regarding anchor points on a scaffold. To protect employees from falling objects, toeboards[17] or other effective means—such as debris nets, canopies, or screens—need to be installed.

[16] 29 *CFR* 1926.451(g)(4).
[17] 29 *CFR* 1926.451(h).

Using Scaffolds

All persons who build or use scaffolds must receive *training* in the proper use of the scaffold and hazards associated with this activity.[18] During this training, in addition to the mandatory items in the OSHA regulations, the *competent person* should establish and communicate the jobsite rules to the scaffold users. These and any other rules to be implemented should be put in writing, taught to all employees, and made part of the corporate culture.

Removing Scaffolding

Scaffolds should only be dismantled by employees who have been trained by the *competent person* to recognize the hazards inherent in scaffold erection and dismantling. Dismantling is the reverse of the building process with the same potential exposures to falls, electrocution, and other hazards. All work should be conducted from the top down. It is very important that workers at lower levels not get ahead of the dismantlers by removing braces, planking, or guardrails to "speed up the job." When lowering the scaffold components to the ground, care must be taken not to damage the components by dropping them or throwing them around. Finally, the scaffold components should be cleaned as necessary, inspected, repaired, and stored in a manner that will prevent corrosion or other damage.

For more information on scaffolding regulations, please see OSHA regulations found in *Title 29 of the Code of Federal Regulations*, Part 1926.450-454. These are available on OSHA's website at www.osha.gov. See also OSHA Publication 3150, *A Guide to Scaffold Use in the Construction*

[18] 29 *CFR* 1926.454(a).

This scaffold is a prescription for a fall. Note lack of guardrails, innovative, but improper, stacking technique and employee access method through the window to reach the improperly positioned ladder.

Industry. This publication is available for purchase from the Superintendent of Documents, Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15250-7954, phone: (202) 512-1800; fax: (202) 512-2250. Specify Order No. 029-016-00179-4; cost is $4.00.

Other resources for safe scaffold use include training courses given by various organizations. The OSHA Training Institute (OTI) provides a 4-day course, *Principles of Scaffolding*, which focuses on the safety aspects of scaffolding and current OSHA requirements. Students learn the basics of scaffolding operations from installing to dismantling. Topics include built-up scaffolds, suspension scaffolds, and interpretation of related standards. The training includes a demonstration of scaffold installing and dismantling method as well as a 1-day field exercise.

System Scaffold

Use

- Like the tube and coupler scaffold, this system can be used to erect platforms around complex structures.

Design

- Similar to the tube and coupler scaffold except that instead of couplers (clamps) specialized end-fasteners function as an integral unit of the scaffold component, allowing for quick and easy erection of scaffolding in less time.
- Proponents of the system scaffold believe that the relatively high initial purchase cost is more than offset by the savings in time and manpower required each time the scaffold is assembled and disassembled.

Limitations/Hazards

- End-fasteners are unique to each manufacturer, and a variety of specialized parts may be required, thereby increasing the initial cost of the scaffold inventory.
- Deenergize, guard, or mark all electrical hazards and keep all conductive materials at least 3 feet from electrical hazards (10 feet or more for electrical hazards exceeding 300 volts).
- Scaffolds must rest on baseplates and mudsills, or other firm foundations capable of supporting the loaded scaffold without settling or displacing.
- Consult the manufacturer before mixing components from different manufacturers.

Suspended Scaffold

Design

- Rigged on cable or rope so that it hangs down from a structure. Can have single or multiple points of attachments on the structure.

Use

- A single-point suspended scaffold like a bosun's chair is simply a rope attached to a special harness that a worker sits in as he or she is raised and lowered up and down the structure.
- A two-point suspended scaffold consists of a platform and two ropes and hoists, such as that frequently used by window washers on large buildings.
- Multipoint suspended scaffolds consist of two or more ropes, hoists, and platforms that can be linked together in a straight line or at angles to conform to buildings with unusual shapes.

Limitations/Hazards

- This assembly can be very complex, and multiple hoists present hazards when raising and lowering work platforms since it is possible to raise one side and lower the other or to create gaps between platforms through which employees can fall.
- Because this type of scaffold is suspended from the structure, great care also must be used to ensure that the roof and parapet of the structure can support the additional weight imposed by the scaffold.
- Only items specifically designed as counterweights shall be used to hold down scaffold outriggers. Construction materials such as bags of sand or rolls of roofing felt are not acceptable for this use.

This mobile scaffold is not 10 feet tall, but the hole beneath it subjects employees to a fall of more than 10 feet to the next lower level, so guardrails must be used.

Another OTI scaffold safety course now available is offered as a result of a unique partnership with OSHA's Directorate of Construction, OTI, and the United Brotherhood of Carpenters and Joiners of America (UBC). Since 1996, more than 550 train-the-trainers and 21,000 UBC carpenters and millwrights have taken this 40-hour scaffold course to gain the knowledge necessary to safely erect and perform work on scaffolds.

The Scaffold Industry Association (SIA), which represents scaffolding manufacturers, also provides scaffold training. This organization may be reached by writing to the Scaffold Industry Association, 20335 Ventura Blvd, Suite 310, Woodland Hills, CA 91364, or calling (818) 610-0320. JSHQ

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Competent Person Scaffold Inspection Checklist

The *competent person* should use this checklist for daily inspections of the scaffold. It is not all-inclusive and should be used as a starting point for the *competent person* to develop a checklist specific to the type of scaffold and jobsite conditions encountered.

- Are scaffolds and scaffold components inspected before each work shift by a competent person?
- Have employees who erect, disassemble, move, operate, repair, maintain, or inspect the scaffold been trained by a *competent person* to recognize the hazards associated with this type of scaffold and the performance of their duties related to this scaffold?
- Have employees who use the scaffold been trained by a qualified person to recognize the hazards associated it with this scaffold and know the performance of their duties relating to it?
- Is the maximum load capacity of this scaffold known and communicated to all employees?
- Is the load on the scaffold (including point loading) within the maximum load capacity of this particular scaffold?
- Is the scaffold plumb, square, and level?
- Is the scaffold on base plates and are mudsills level, sound, and rigid?
- Is there safe access to all scaffold platforms?
- Are all working platforms fully planked?
- Do planks extend at least 6 inches and no more than 12 inches over the supports?
- Are the planks in good condition and free of visible defects?
- Does the scaffold have all required guardrails and toeboards?
- Are 4:1 (height to width) scaffolds secured to a building or structure as required?

Detach Here

Pre-Planning Tips for Building Scaffolds

Before building a scaffold you need to do some pre-planning to ensure that you choose the correct scaffold for the job. Pre-planning includes determining the type of scaffold you'll need for the job, its maximum load, what constitutes a good foundation, and how to avoid electrical hazards.

The Type of Work and the Scaffold Needed

Your type of work may require a specific type of scaffold. For instance, the heavy weight of brick and mortar, with the possibility of point loading materials in one spot while plastering or laying brick, can require that you will need a heavier rated mason's scaffold. Installing lighting in a gymnasium, however, may be done most quickly with a mobile scaffold. Preventing the escape of lead-contaminated paint chips on a lead abatement job might call for a scaffold enclosed with plastic sheeting, which also can increase the wind load and potentially cause the scaffold to collapse. Other examples could be scaffolds of unusual configuration requiring system or tube and coupler construction, or scaffolds of great height requiring a specific design by a professional engineer.

The Maximum Load

The maximum intended load on the scaffold must be known before selecting the proper scaffold. This includes the weight of scaffold itself plus the weight of all workers and tools[19] plus the weight of materials and any other loads that will be placed on the scaffold. The scaffold must be able to support its own weight and four times the intended load.[20] Because scaffolds are of different sizes with different load ratings, scaffold manufacturers will provide the maximum load information for their products. Scaffold planks also have with three different ratings: *Light Duty*—25 pounds per square foot maximum load; *Medium Duty*—50 pounds per square foot maximum load; *Heavy Duty*—75 pounds per square foot maximum load. If scaffold components have had the manufacturer markings painted over, it is important to research the model numbers and manufacturers of these scaffolds. You will need this information to consult the manufacturer's charts or call the manufacturer to ensure the scaffold is suitable for the intended use.

A Good Foundation

The scaffold will rest upon a foundation of some type, usually dirt, asphalt, or concrete. The foundation must be adequate to support the scaffold and four times the intended weight of its load. There have been instances of scaffolds sinking into dirt, mud, or asphalt, or punching through a thin foundation such as a sidewalk into a basement or underground storage tank the scaffold erector was not aware of. Base plates are an integral member of the scaffold and should always be used. Mudsills, usually made of wood planks, also can provide additional support on soft surfaces or uneven terrain. They should be sized appropriately for the expected load.

Electricity and Scaffolds

Scaffold builders and users have been electrocuted while working close to electrical hazards. You must plan your job to prevent contact with energized circuits, either by keeping the scaffold and workers away from the hazard (to include warning signs or barriers for mobile scaffolds), or by de-energizing the circuit when working around it.

Detach Here

[19] ANSI A10.8, *Scaffolding-Safety Requirements*, recommends using an estimate of 200 pounds per worker and 50 pounds for his or her tools.
[20] 29 *CFR* 1926.451(a)(1).