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- 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



Lesson 1: Concrete and Masonry Construction (Part 1)

Lesson Focus

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

- Describe the general requirements pertaining to the following concrete tools and operations:
  - Post-Tensioning Operations
  - Concrete Buckets
  - Bulk Concrete Storage
  - Concrete Pumping Systems
  - Power Concrete Trowels
  - Concrete Buckets
  - Bull Floats
  - Masonry Saws
- Describe the requirements for shoring operations

General Requirements

Employers must not place construction loads on a concrete structure or portion of a concrete structure unless the employer determines, based on information received from a qualified person, that the structure or portion of the structure is capable of supporting the intended loads. All protruding reinforcing steel must be guarded to eliminate the hazard of impalement.

Post-Tensioning Operations

Employees (except those essential to the post-tensioning operations) must not be permitted to be behind the jack during tensioning operations. Signs and barriers must be erected to limit employee access to the post-tensioning area during tensioning operations. No non-essential employees are allowed access to the work zone.

Concrete Buckets

Employees must not be permitted to ride on or work under concrete buckets while the buckets are being elevated or lowered into position. To the extent practicable, elevated concrete buckets must be routed so that no employee, or the fewest employees possible, are exposed to the hazards associated with falling concrete buckets.

Bulk Concrete Storage

Bulk storage bins, containers, and silos must be equipped with conical or tapered bottoms, and mechanical or pneumatic means of starting the flow of material. Employees must not be permitted to enter storage facilities unless the ejection system



has been shut down, locked out, and tagged to indicate that the ejection system is not to be operated.

Concrete Mixers

Concrete mixers with lading skips that are one cubic yard, or larger, must be equipped with a mechanical device to clear the skip of materials and guardrails installed on each side of the skip.

Concrete Pumping Systems

Concrete pumping systems using discharge pipes must be provided with pipe supports designed for 100 percent overload. Compressed air hoses used on a concrete pumping system must be provided with positive fail-safe joint connectors to prevent separation of sections when pressurized.

Power Concrete Trowels

Powered and rotating type concrete troweling machines that are manually guided must be equipped with a control switch that will automatically shut off the power whenever the hands of the operator are removed from the equipment handles.

Concrete Buggy Handles

Concrete buggy handles must not extend beyond the wheels on either side of the buggy.

Concrete Buckets

Concrete buckets equipped with hydraulic or pneumatic gates must have positive safety latches or similar safety devices installed to prevent premature or accidental dumping. Concrete buckets should be designed to prevent concrete from hanging up on top of the sides.

Tremies

Sections of tremies and similar concrete conveyances must be secured with wire rope (or equivalent materials) in addition to the regular couplings or connections.

Bull Floats

Bull float handles, used where they might contact energized electrical conductors, must be constructed of nonconductive material or insulated with a nonconductive sheath having electrical and mechanical characteristics that provide the equivalent protection of a handle constructed of nonconductive material.

Masonry Saws

Masonry saws must be guarded with a semicircular enclosure over the blade. A method for retaining blade fragments must be incorporated in the design of the semicircular enclosure.

Shoring

All shoring equipment (including equipment used in reshoring operations) must be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings. Damaged shoring equipment must not be used for shoring. Erected shoring equipment must be inspected immediately prior to, during, and immediately after concrete placement. Shoring equipment that is found to be damaged or weakened after erection must be immediately reinforced. The sills for shoring must be sound, rigid, and capable of carrying the maximum intended load. All base plates, shore heads, extension devices, and adjustment screws must be in firm contact and secured, when necessary, with the foundation and the form.

If single-post shores are used one on top of another (tiered), then additional shoring requirements must be met. The shores must be as follows:

- Designed by a qualified designer and inspected by an engineer qualified in structural design
- Vertically aligned
- Spliced to prevent misalignment
- Adequately braced in two mutually perpendicular directions at the splice level
- Diagonally braced in the same two directions

Adjustment of single-post shores to raise formwork must not be made after the placement of concrete. Reshoring must be erected, as the original forms and shores are removed, whenever the concrete is required to support loads in excess of its capacity.

Lesson Summary

- Employers must not place construction loads on a concrete structure or portion of a concrete structure unless the employer determines, based on information received from a qualified person, that the structure or portion of the structure is capable of supporting the intended loads. All protruding reinforcing steel must be guarded to eliminate the hazard of impalement.
- Employees (except those essential to the post-tensioning operations) must not be permitted to be behind the jack during tensioning operations. Signs and barriers must be erected to limit employee access to the post-tensioning area during tensioning operations. No non-essential employees are allowed access to the work zone.
- Employees must not be permitted to ride on or work under concrete buckets while the buckets are being elevated or lowered into position.



- Concrete mixers with lading skips that are one cubic yard, or larger, must be equipped with a mechanical device to clear the skip of materials and guardrails installed on each side of the skip.
- Powered and rotating type concrete troweling machines that are manually guided must be equipped with a control switch that will automatically shut off the power whenever the hands of the operator are removed from the equipment handles.
- All shoring equipment (including equipment used in reshoring operations) must be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings. Damaged shoring equipment must not be used for shoring.

Lesson 2: Concrete and Masonry Construction (Part 2)

Lesson Focus

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

- Explain lockout/tagout procedures
- Describe the general requirements for formwork
- Describe shoring and re-shoring operations
- Describe tiered single-post shores
- Describe vertical slip forms
- Explain requirements pertaining to reinforcing steel, the removal of form work, and the use of pre-cast concrete
- Describe proper lift-slab operations
- Explain limited access zones for masonry construction

Lockout/Tagout Procedures

No employee should be permitted to perform maintenance or repair activities on equipment (such as compressors, mixers, and screens or pumps used for concrete and masonry construction activities) when the inadvertent operation of the equipment or the inadvertent energization of the equipment could occur and cause injury, unless all potentially hazardous energy sources have been locked out and tagged. Tags should read "Do Not Start" or have similar language to indicate the equipment is not to be operated.

General Requirements for Formwork

Formwork must be designed, fabricated, erected, supported, braced, and maintained so that it will be capable of supporting, without failure, all vertical and lateral loads that might be applied to the formwork. Formwork that is in compliance with the non-mandatory Appendix to 1926.703 is deemed to be in compliance with the provision of 1926.703(a)(1).



Drawings or plans, including all revisions for the jack layout, formwork (including shoring equipment), working decks, and scaffolds, must be available at the jobsite.

Shoring and Re-Shoring

All shoring equipment (including equipment used in re-shoring operations) must be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings.

Shoring equipment that is damaged such that its strength is reduced to less than that required by OSHA's general requirements for formwork stated in 1926 703(a)(1), must not be used for shoring. Erected shoring equipment must be inspected immediately prior to, during, and immediately after concrete placement. Shoring equipment that is found to be damaged or weakened after erection must be reinforced immediately.

Sills used for shoring should be sound, rigid, and capable of carrying the maximum intended load.

All base plates, shore heads, extension devices, and adjustment screws must be in firm contact, and secured when necessary, with the form and foundation.

Tiered Single-Post Shores

If single-post shores are used one on top of another (tiered), then the employer must comply with the following specific requirements, in addition to the general requirements for formwork. The shores must be designed as follows:

- The shores must be designed by a qualified designer, and the erected shoring must be inspected by an engineer qualified in structural design.
- Single post shoring must be vertically aligned.
- Single post shores must be spliced to prevent misalignment.
- Single post shores must be adequately braced in two mutually perpendicular directions at the splice level. Each tier also must be diagonally braced in the same two directions.

The adjustment of single-post shores to raise formwork must not be made after the placement of concrete.

Vertical Slip Forms

The steel rods or pipes on which jacks climb or by which the forms are lifted must be:

- Specifically designed for that purpose.
- Adequately braced when not encased in concrete.



Forms must be designed to prevent excessive distortion of the structure during the jacking operation. All vertical slip forms must be provided with scaffolds or work platforms where employees are required to work or pass. Jacks and vertical supports must be positioned in such a manner that the loads do not exceed the rated capacity of the jacks.

Reinforcing Steel

Reinforcing steel for walls, piers, columns, and similar vertical structures must be adequately supported to prevent overturning and collapse.

Employers must take measures to prevent unrolled wire mesh from recoiling. Such measures may include, but are not limited to, securing each end of the roll or turning over the roll.

Removal of Form Work

Forms and shores (except those used for slabs on grade and slip forms) must not be removed until the employer determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Such a determination must be based on one of the following:

- The plans and specifications stipulate conditions for the removal of forms and shores (and such conditions have been followed).
- The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Pre-Cast Concrete

Pre-cast concrete wall units, structural framing, and tilt-up wall panels must be adequately supported to prevent overturning and to prevent collapse until permanent connections are completed.

Lifting inserts that are embedded or otherwise attached to tilt-up wall panels must be capable of supporting at least two times the maximum intended load applied or transmitted to them; lifting inserts for other pre-cast members, excluding tilt-up members, must be capable of supporting four times the load. Lifting hardware members must be capable of supporting five times the maximum intended load applied to the lifting hardware.

Lift-Slab Operations

Lift-slab operations must be designed and planned by a registered professional engineer who has experience in lift-slab construction. Such plans and designs must be implemented by the employer, and must include detailed instructions and sketches

indicating the prescribed method of erection. The plans and designs must also include provisions for ensuring the lateral stability of the building or structure during construction.

Jacks or lifting units must be marked to indicate their rated capacity and must not be loaded beyond this capacity.

Jacking equipment must be capable of supporting at least two and one-half times the load being lifted during jacking operations, and the equipment must not be overloaded. For the purpose of this provision, jacking equipment includes any load bearing component that is used to carry out the lifting operation(s). Such equipment includes, but is not limited to, the following: threaded rods, lifting attachments, lifting nuts, hook-up collars, T-caps, shear heads, columns, and footings.

No employee, except those essential to the jacking operation, must be permitted in the building/structure while any jacking operation is taking place, unless the building/structure has been reinforced sufficiently to ensure its integrity during erection. "Reinforced sufficiently to ensure its integrity" means that a registered professional engineer, independent of the engineer who designed and planned the lifting operation, has determined from the plans that if there is a loss of support at any jack location that loss will be confined to that location and the structure as a whole will remain stable.

If used, manual leveling controls shall be centrally located and attended by a competent person while the lifting is in progress. The competent person must be experienced in the lifting operation and with the lifting equipment being used.

Under no circumstances must any employee who is not essential to the jacking operation be permitted immediately beneath the slab while it is being lifted.

Limited Access Zone for Masonry Construction

Whenever a masonry wall is being constructed, employers must establish a limited access zone prior to the start of construction. The limited access zone should meet the following requirements:

- It should be equal to the height of the wall to be constructed plus four feet, and run the entire length of the wall.
- It should be located on the side of the wall that will be unscaffolded.
- Entry should be restricted to only those employees actively engaged in constructing the wall.
- All masonry walls over 8 feet in height should be adequately braced to prevent overturning and to prevent collapse unless the wall is adequately supported so that it will not overturn or collapse. The bracing should remain in place until permanent supporting elements of the structure are in place.

Lesson Summary

- Tags should read "Do Not Start" or have similar language to indicate the equipment is not to be operated.
- Formwork must be designed, fabricated, erected, supported, braced, and maintained so that it will be capable of supporting, without failure, all vertical and lateral loads that might be applied to it.
- Shoring equipment should be inspected and maintained properly. If its strength is not at the level required by the OSHA standard, it should be removed from use.
- Reinforcing steel for walls, piers, columns, and similar vertical structures must be adequately supported to prevent overturning and collapse. Employers must take measures to prevent unrolled wire mesh from recoiling. Such measures may include, but are not limited to, securing each end of the roll or turning over the roll.
- Forms and shores (except those used for slabs on grade and slip forms) must not be removed until the employer determines that the concrete has gained sufficient strength to support its weight and superimposed loads.

- Whenever a masonry wall is being constructed, employers must establish a limited access zone prior to the start of construction.

Module 8: Confined Spaces

Module Description

This module covers the safety regulations for spaces meeting the OSHA definitions of a "confined space" and/or a "permit-required confined space." It instructs about the hazards that may occur during work in these spaces.

A confined space is a space whose configuration and/or contents may present special dangers not found in normal work areas. Confined spaces may be poorly ventilated and, as a result, contain insufficient oxygen or hazardous levels of toxic gases. Working in a tight space can prevent a worker from keeping a safe distance from mechanical and electrical hazards in the space. Fumes from a flammable liquid that is used in a poorly ventilated area can reach explosive levels. Such hazards endanger both the workers in the confined space and others who become exposed to the hazards when they attempt to rescue injured workers.

Module Learning Objectives

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

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- Identify the characteristics of confined spaces
- Discuss atmospheric conditions found in confined spaces



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