

Excavations

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Knowledge to Go Places

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Introduction

Excavation and trenching are among the most hazardous construction operations. The Occupational Safety and Health Administration's (OSHA) Excavation and Trenching standard, *Title 29 of the Code of Federal Regulation (CFR)*, Part 1926.650, covers requirements for excavation and trenching operations. This booklet highlights key elements of the standard, shows ways to protect employees against cave-ins, and describes safe work practices for employees.

What is the difference between an excavation and a trench?

OSHA defines an excavation as any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal. This can include excavations for anything from cellars to highways. A trench is defined as a narrow underground excavation that is deeper than it is wide, and no wider than 15 feet (4.5 meters).

What are the dangers of trenching and excavation operations?

Trenching and excavation work presents serious hazards to all workers involved. Cave-ins pose the greatest risk and are much more likely than other excavation-related accidents to result in worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres, and incidents involving mobile equipment.

OSHA's Excavation and Trenching Standard

What does the OSHA standard cover, and what protections does it offer?

The rule applies to all open excavations made in the earth's surface, including trenches. Strict compliance with all sections of the standard will prevent or greatly reduce the risk of cave-ins as well as other excavation-related accidents.

What kinds of excavations and trenches are not covered?

The standard does not apply to house foundation/basement excavations, including those that become trenches by definition when constructing formwork, foundations, or walls. For this exemption to apply, all the following conditions must exist:

- The excavation is less than 7-1/2 feet (2.5 meters) deep or is benched for at least 2 feet (.61 meters) horizontally for every 5 feet (1.52 meters) or less of vertical height;
- The bottom of the excavation, from the excavation face to the formwork or wall, is at least 2 feet (.61 meters) wide, and wider if possible;
- No water, surface tension cracks, or other environmental conditions reduce the excavation's stability;
- No heavy equipment is vibrating the excavation while employees are in it;

- Soil, equipment, and material surcharge loads are no closer to the top edge of the excavation than the excavation is deep. When you use front-end loaders to dig the excavations, place the soil surcharge load as far back from the edge of the excavation as possible, but never closer than 2 feet (.61 meters);
- The fewest crew members possible are performing the work; and
- Workers spend the minimum time possible in the excavation.

This exemption does not apply to utility excavations or trenches, which are covered by *29 CFR* 1926.652.

Preplanning

Why is it important to preplan the excavation work?

No matter how many trenching, shoring, and backfilling jobs you have done in the past, it is important to approach each new job with the utmost care and preparation. Many on-the-job accidents result directly from inadequate initial planning. Waiting until after the work has started to correct mistakes in shoring or sloping slows down the operation, adds to the cost, and increases the possibility of a cave-in or other excavation failure.

What safety factors should you consider when bidding on a job?

Before preparing a bid, you will want to know as much as possible about the jobsite and the materials you will need to have on hand to perform the work safely and in compliance with OSHA standards. A safety checklist may prove helpful when you consider specific site conditions such as the following:

- Traffic,
- Proximity and physical conditions of nearby structures,
- Soil,
- Surface and ground water,
- Location of the water table,
- Overhead and underground utilities, and
- Weather.

You can determine these and other conditions through jobsite studies, observations, test borings for soil type or conditions, and consultations with local officials and utility companies. This information will help you determine the amount, kind, and cost of safety equipment you will need to perform the work in the safest manner possible.

How can you avoid hitting underground utility lines and pipes during excavation work?

Before starting work, the OSHA standard requires you to do the following:

- Determine the approximate location of utility installations—sewer, telephone, fuel, electric, and water lines; or any other underground installations;
- Contact the utility companies or owners involved to inform them of the proposed work within established or customary local response times; and
- Ask the utility companies or owners to find the exact location of underground installations. If they cannot respond within 24 hours (unless the period required by state or local law is longer) or cannot find the exact location of the utility installations, you may proceed with caution.

If your excavation work exposes underground installations, OSHA regulations require you to protect, properly support, or remove them.

What should you tell workers before they start the project?

When you share the details of your safety and health program with employees, it is important to emphasize the critical role you expect them to play in keeping the jobsite safe. You may want to emphasize specific rules to help reduce the risk of on-the-job injuries. These rules may include requirements that workers

- Remove or minimize all surface obstacles at the worksite that may create a hazard,
- Wear warning vests or other reflective or high-visibility garments that you provide when they are exposed to vehicular traffic,
- Wear or use prescribed protective gear and equipment correctly,
- Operate equipment only if they have been trained properly in its use and alerted to its potential hazards, and
- Follow safe work practices.

It also is important to establish and maintain a safety and health management system for the worksite that provides adequate systematic policies, procedures, and practices to protect employees from, and allow them to recognize, job-related safety and health hazards. For more information about establishing such a system, see page 18.

Protective Systems

How can you prevent cave-ins?

OSHA requires that all excavations in which employees could potentially be exposed to cave-ins be protected by

- Sloping or benching the sides of the excavation,
- Supporting the sides of the excavation, or
- Placing a shield between the side of the excavation and the work area.

How do you choose the most appropriate protective system design?

Designing a protective system can be complex because you must consider many factors: soil classification, depth of cut, water content of soil, changes due to weather and climate, or other operations in the vicinity. You are free to choose the most practical design approach for any particular circumstance. Once you have selected an approach, however, the system must meet the required performance criteria.

The OSHA standard describes methods and approaches for designing protective systems such as the following:

Method 1 — Slope the sides to an angle not steeper than 1-1/2 degrees horizontal to 1 degree vertical (34 degrees measured from the horizontal). All simple slope excavations 20 feet (6.11 meters) or less deep should have a maximum allowable slope of 1-1/2:1. These slopes must be excavated to form configurations similar to those for Type C soil, as described in Appendix B of the standard. A slope of this gradation or less is safe for any type of soil.

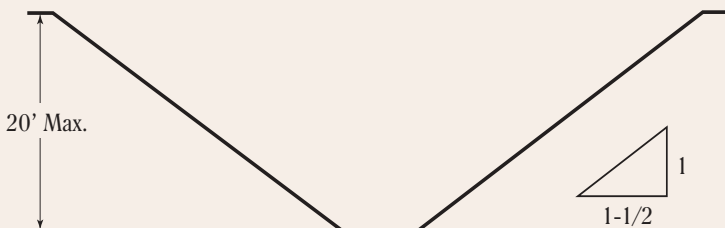


Figure 1. Excavations Made in Type C Soil

Method 2 — Use tabulated data such as tables and charts approved by a registered professional engineer to design the excavation. These data must be in writing and must include enough explanatory information, including the criteria for making a selection and the limits on the use of the data, for the user to make a selection. At least one copy of the data, including the identity of the registered professional engineer who approved it, must be kept at the worksite during construction of the protective system. After the system is completed, the data may be stored away from the jobsite, but a copy must be provided upon request to the Assistant Secretary of Labor for OSHA.

Method 3 — Use a trench box or shield designed or approved by a registered professional engineer or based on tabulated data prepared or approved by a registered professional engineer. Timber, aluminum, or other suitable materials may also be used. OSHA standards permit the use of a trench shield (also known as a welder's hut) if it provides the same level of protection or more than the appropriate shoring system.

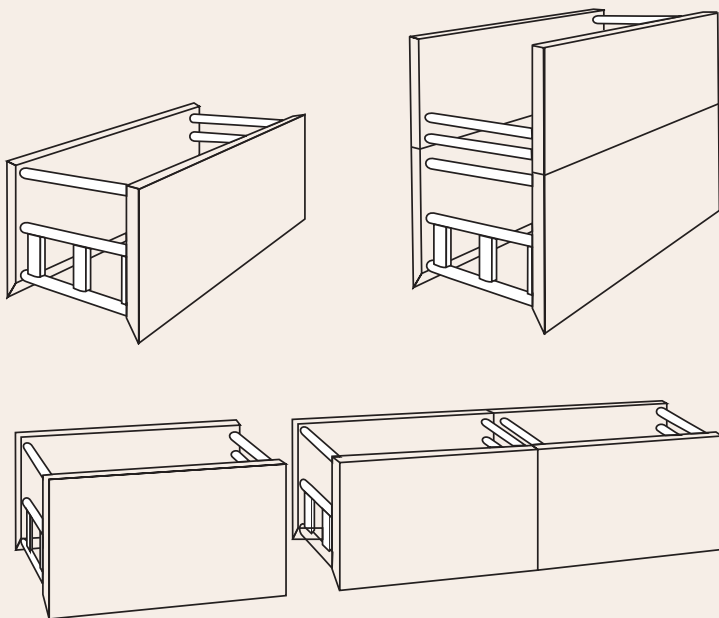


Figure 2. *Trench Shields*

Employers can choose the most practical method for the particular circumstance, but that system must meet the required performance criteria. The standard does not require a protective system when an excavation is made entirely in stable rock or is less than 5 feet (1.52 meters) deep, if a competent person has examined the ground and found no indication of a potential cave-in.

What other safety precautions are you required to take?

The standard requires you to provide support systems such as shoring, bracing, or underpinning to ensure that adjacent structures such as buildings, walls, sidewalks, or pavements remain stable. The standard also prohibits excavation below the base or footing of any foundation or retaining wall unless

- You provide a support system such as underpinning,
- The excavation is in stable rock, or
- A registered professional engineer determines that the structure is far enough away from the excavation and that excavation will not pose a hazard to employees.

Excavations under sidewalks and pavements are prohibited unless you provide an appropriately designed support system or another effective means of support.

How do you safely install and remove protective systems?

The standard requires you to take the following steps to protect employees when installing support systems:

- Connect members of support systems securely,
- Install support systems safely,
- Avoid overloading members of support systems, and
- Install other structural members to carry loads imposed on the support system when you need to remove individual members temporarily.

In addition, the standard permits excavation of 2 feet (.61 meters) or less below the bottom of the members of a

support or shield system of a trench if the system is designed to resist the forces calculated for the full depth of the trench. In addition, there must be no indications, while the trench is open, of a possible cave-in below the bottom of the support system. Also, you must coordinate the installation of support systems closely with the excavation work.

As soon as work is completed, you are required to backfill the excavation when you dismantle the protective system. After the excavation is cleared, remove the protective system from the bottom up, taking care to release members slowly.

How should you maintain materials and equipment used for protective systems?

You are responsible for maintaining materials and equipment used for protective systems. Defective and damaged materials and equipment can cause failure of a protective system and other excavation hazards.

To avoid possible failure of a protective system, you must ensure that

- Materials and equipment are free from damage or defects;
- Manufactured materials and equipment are used and maintained consistent with the manufacturer's recommendations, so as to prevent employee exposure to hazards; and while in operation,
- A competent person examines any damaged materials and equipment. You must remove unsafe materials and equipment from service until a registered professional engineer evaluates and approves them for use.

Additional Hazards and Protections

What other excavation hazards do you need to protect workers against?

In addition to cave-ins and related hazards, workers involved in excavation work also are exposed to hazards involving falls, falling loads, and mobile equipment. To protect employees from these hazards, OSHA requires you to take the following precautions:

- Keep materials or equipment that might fall or roll into an excavation at least 2 feet (.61 meters) from the edge of excavations, or use retaining devices, or both.
- Provide warning systems such as mobile equipment, barricades, hand or mechanical signals, or stop logs to alert operators to the edge of an excavation. If possible, keep the grade away from the excavation.
- Provide scaling to remove loose rock or soil, or install protective barricades and other equivalent protection to protect employees against falling rock, soil, or materials.
- Prohibit employees from working on faces of sloped or benched excavations at levels above other employees unless you provide the employees at the lower levels adequate protection from the hazard of falling, rolling, or sliding material or equipment.
- Prohibit employees from standing or working under loads being handled by lifting or digging equipment. Require workers to stand away from vehicles being loaded or unloaded to protect them from being struck by any spillage or falling materials. You may permit operators to remain inside cabs of vehicles if they provide adequate protection from falling loads during loading and unloading operations.

What is the effect of water accumulation on excavation safety?

Among the additional hazards stemming from water in an excavation are undermining the sides and making it more difficult to get out of the excavation. The OSHA standard prohibits employees from working without adequate protection in excavations where water has accumulated or is accumulating. If you use water removal equipment to control or prevent water accumulation, you must ensure that a competent person monitors the equipment and its operation to ensure proper use. OSHA standards also require the use of diversion ditches, dikes, or other suitable means to prevent surface water from entering an excavation and to provide adequate drainage of the adjacent area. In addition, a competent person must inspect excavations subject to runoffs from heavy rains.

How can you protect workers against hazardous atmospheres inside excavations?

Before an employee is permitted to enter an excavation, a competent person must test any excavation deeper than 4 feet (1.22 meters) or where an oxygen deficiency or a hazardous atmosphere is present or could reasonably be expected. If there are any hazardous conditions, you must provide the employee controls such as proper respiratory protection or ventilation. In addition, you are responsible for regularly testing all controls used to reduce atmospheric contaminants to acceptable levels.

If unhealthful atmospheric conditions exist or develop in an excavation, you must provide emergency rescue equipment such as a breathing apparatus, safety harness and line, and basket stretcher and ensure that it is readily available. This equipment must be attended when in use.

What means of access and egress are you required to provide?

OSHA requires you to provide safe access and egress to all excavations, including ladders, steps, ramps, or other safe means of exit for employees working in trench excavations 4 feet (1.22 meters) or deeper. These devices must be located within 25 feet (7.62 meters) of the excavation.

Any structural ramps you use in your operation must be designed by a competent person if they are used for employee access or egress, or by a competent person qualified in structural design if they are used for vehicles. Also, structural members used for ramps or runways must be uniform in thickness and joined in a manner to prevent tripping or displacement.

What protective equipment are employees in pier holes and confined footing excavations required to use?

An employee who enters a bell-bottom pier hole or similar deep and confined footing excavation must wear a harness with a lifeline. The lifeline must be attached securely to the harness and must be separate from any line used to handle materials. Also, while the employee wearing the lifeline is in the excavation, an observer must be on hand to ensure that the lifeline is working properly and maintain communication with the employee.

When should you conduct a site inspection?

The standard requires that a competent person inspect an excavation and the areas around it daily for possible cave-ins, failures of protective systems and equipment, hazardous atmospheres, or other hazardous conditions. Inspections also are required after natural events such as heavy rains or manmade events such as blasting that may increase the potential for hazards. If the inspector finds any unsafe conditions during an inspection, you must clear employees from the hazardous area until you take safety precautions.

The standard also requires that a competent person inspect excavations and the adjacent areas daily for possible cave-ins, failures of protective systems and equipment, hazardous atmospheres, and other hazardous conditions. If the competent person finds these conditions, all exposed employees must leave the hazardous area until necessary safety precautions are taken.

Larger and more complex operations should have a full-time safety official who makes recommendations to improve implementation of the safety plan. In a smaller operation, the safety official may be part-time and usually will be a supervisor.

Supervisors are the contractor's representatives on the job. Supervisors should conduct inspections, investigate accidents, and anticipate hazards. They should ensure that employees receive on-the-job safety and health training. They also should review and strengthen overall safety and health precautions to guard against potential hazards, get the necessary worker cooperation in safety matters, and make frequent reports to the contractor.