



Excavation and Trenching Safety Training Program



Goal

This program provides information on the Occupational Safety and Health Administration's (OSHA) general safety requirements for excavation and trenching work as published in [29 Code of Federal Regulations \(CFR\) 1926 Subpart P](#).

Objectives

This program familiarizes workers with the risks and hazard controls required to safely work in and around excavations and trenches.

Definitions

Benching - A method of protecting employees from cave-ins by digging the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near vertical surfaces between levels.

Cave-in - A mass of soil or rock material that

separates from the side of an excavation, or soil from under a trench shield or support system that is lost, causing a sudden fall or slide into the excavation capable of entrapping, burying, immobilizing, or otherwise injuring a person.



Competent person - one who is capable of identifying existing or predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has the authority to take prompt corrective action to eliminate them.

Duration of exposure - The longer an excavation is open, the longer other factors can cause a collapse.

Excavation is any man-made cut, cavity, trench, or depression made in the earth's surface formed by soil and rock removal.

Hazardous atmosphere - An explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful atmosphere that may cause death, illness, or injury.

Protective system- A method of protecting employees from cave-ins and material that could fall or roll from an excavation or collapse adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the needed protection.

Registered professional engineer is any person who by education and training, having passed the requirements for registration, is registered as a professional engineer in the state the work is being performed.

Shield - A structure that is capable of withstanding the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. All shields must comply with [29 CFR 1926.652\(c\)3 or \(c\)4](#).

Shoring - A structure such as a metal hydraulic, mechanical, or timber system that supports the sides of an excavation and is designed to prevent cave-ins.

Sloping - A method of protecting workers from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences such as soil type, length of exposure, and application of surcharge loads.

Surcharge loads – These are loads generated by the weight of anything close to the excavation that can push-start a cave-in (anything on top pushing down). Common



surcharge loads are the weight of the:

- spoil (excavated earth) pile;
- nearby buildings, poles, pavement, or other structural objects; and
- material and equipment.

Trench - A narrow excavation made below the surface of the ground. In general, the depth is greater than the width, but the width is no greater than 15 feet.

Undermining - Undermining can be caused by such things as leaking, leaching, caving, or over-digging. Undermined walls can be dangerous.

Vibration - A force that is present on construction sites and must be considered. The vibrations caused by backhoes, dump trucks, compactors, and traffic on job sites can be substantial.

Background

Before the 1970s, most excavations were shored with timber. Timber shoring was expensive, time-consuming to install, and required adjustment with shims and wedges several times a day. Entering an unsupported excavation to install or remove the timber shoring was a major hazard. The development of lightweight hydraulic and pneumatic shoring greatly reduced the hazard of entering an unsupported excavation, as did the trench box, which can be placed in a trench before employees enter the excavation.

Hazards

A competent person is required on-site during excavations and trenching because many possible hazards can be created. Hazards may include, but are not limited to:

- electrocution;

- gas explosion;
- entrapment;
- struck by equipment; and
- suffocation.

Hazard Controls

All employees exposed to soil excavations deeper than 5 feet should **"Slope It. Shore It. Shield It."** SLOPE or bench trench walls; SHORE trench walls with supports; and SHIELD trench walls with trench boxes. These steps along with the following guidelines and standards can save lives.

- **Plan the dig.**
A basic rule for excavation is, "Plan your dig, then dig your plan." If you encounter something unplanned, stop and replan. Before digging, know everything possible about the excavation route. Survey and map the route.



- Identify underground utilities.**
 Determine if there are underground utilities such as sewer, water, gas, communications, or electric lines by contacting the local utility companies or the Texas Railroad Commission (RRC) at **811**. Usually, the RRC and utility companies require at least 48 hours advance notice. When located, the utility lines must be carefully and physically exposed. Once the utility is uncovered, it becomes the excavation company's responsibility to support, protect, or remove the utility. Though preventable, the consequences of digging into a petroleum gas line or buried electrical utility can be fatal.
- Remove overhead hazards.**
 Overhead hazards, known as surface encumbrances, can create hazards for employees. Remove, brace, shore, or otherwise support all surface encumbrances, such as buildings, trees, signs, sidewalks, power poles, parking lots, and walls, to prevent hazards.
- Conduct soil borings.**
 Soil borings determine the soil classes along the route. Although OSHA does not require soil borings, it is a good engineering practice, which provides information on water table levels and possible soil contamination from leaking underground storage tanks.
- Use cave-in protection.**
 Adequate protective systems must be used to protect employees. This can be accomplished through sloping, shoring, or shielding. Shoring adds support to the sides of the excavation. Sloping angles the sides of the excavation away from the trench. Shielding stops



movement if the earth starts to shift. These steps protect workers from the pressure and weight of soil in the event of a cave-in. One cubic yard of soil can weigh as much as a car: 3,000 pounds.¹

- Ensure a safe entry and exit from the trench.**
 Any trench or excavation 4 feet or deeper must have ladders, steps, or ramps within 25 feet of all employees to ensure a safe entry and exit. Ladders must extend 3 feet above the surface of the excavation and should be tied off if necessary. If the excavation is over 20 feet deep, it must be designed in advance by a professional engineer who is registered in the state where the work will be performed.

¹ Occupational Safety and Health Administration, "Soil Classification Transcript," <https://www.osha.gov/vtools/construction/soil-testing-fnl-eng-web-transcript>. Accessed July 26, 2022.

- **Keep materials away from the edge of the trench.**

Spoil, materials, tools, equipment, and any load that puts extra pressure on the earth must be kept at least 2 feet from the edge of the excavation. The spoil piles must not block the safe means of exit. Rock and soil should be scaled or retained by shoring or other acceptable methods to prevent the material from falling and striking workers.

- **Protect employees from traffic.**

If work is in or around traffic, employees must be supplied with and wear high-visibility vests or clothing. Signs, barricades, and a flag person to direct traffic must be used to ensure the safety of employees, vehicular traffic, and pedestrians.

- **Prevent exposure to falling loads.**

Workers must never stand under loads raised by lifting or digging equipment. Keep all workers away from vehicles during loading and unloading; keep the vehicle operators inside the cab constructed in compliance with [29 CFR 1926.601\(b\)\(6\)](#).

- **Install warning systems on all mobile equipment.**

All front-end loaders, bulldozers, dump trucks, and other mobile equipment must be equipped with a warning device such as a backup alarm. There must also be a method to warn operators when they are nearing the edge of the excavation. This may include hand signals from a flag person, stop logs, barricades, or other mechanical signals. When practical, also grade the slope away from the excavation to keep equipment and vehicles from rolling into the excavation and rainwater away from the excavation.

- **Conduct air testing.**

In excavations and trenches deeper than 4 feet with the potential for low-oxygen or hazardous vapors and gases, conduct air testing before workers enter the excavation and as often as needed to ensure the atmosphere remains safe. Ventilation or respiratory protection may be needed to protect workers from harmful atmospheres.

- **Look for standing water.**

Water in a trench can weaken its sides and make it more difficult for workers to get out of the excavation. OSHA does not allow workers to enter an excavation containing water without:

- special support or shield systems to prevent cave-ins;
- water removal to control the water level;
- the use of a safety harness or lifeline; and
- careful monitoring by a competent person.



- **Never enter a trench unless it has been inspected.**

A competent person must inspect the excavation and its support system at the start of each shift and following a rainstorm to prevent cave-ins and to ensure the trench is free of standing water and other dangers, such as low oxygen or hazardous atmospheres. Additional inspections may be needed throughout the day, such as when soil changes appear. When an inspection finds a possible hazard to the worker, exposed workers must be removed from the hazardous area until needed precautions are taken.

- **Provide fall protection.**

In areas where personnel or equipment must cross an excavation, a walkway or bridge must be engineered to withstand the maximum expected load. The walkway or bridge must have standard guardrails that meet the requirements in OSHA [29 CFR 1926 Subpart M](#). In addition, all unattended excavations or those in remote areas should have barriers or physical protection to prevent people from falling into the

excavation. All trenches, wells, pits, or shafts must be backfilled as soon as practical after completion.

- **Wear personal protective equipment (PPE) as needed.**

Workers must be supplied with and wear any PPE deemed necessary to ensure their protection. No person shall work on the sides of the slope or benched excavation above other workers unless the lower workers are protected from falling materials. OSHA [29 CFR 1926.100\(a\)](#) requires the use of hard hats where there is a possible danger of head injury from falling objects. Excavation operations expose workers to these hazards in every work zone.

Conclusion

Even with the introduction of new equipment and strict enforcement of OSHA standards, dozens of excavation workers die each year in the United States, and hundreds are seriously injured. These steps can protect workers from the pressure and weight of soil in the event of a cave-in. **To report an unsafe trench call 1-800-321-6742.**



Soil Mechanics

(See [OSHA Technical Manual](#) for more information.)

Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench, measured from the top of the vertical face of the trench.

Sliding or sluffing may occur as a result of tension cracks.

Toppling occurs when the trench's vertical face shears along the tension crack line and topples into the excavation.

Subsidence and bulging can occur in an unsupported excavation due to unbalanced stress in the soil. This, in turn, causes subsidence at the surface and bulging of the vertical face of the trench. If uncorrected, this condition can cause face failure and entrapment of workers in the trench.

Heaving or squeezing is caused by the downward pressure created by the weight of adjoining soil. This pressure causes a bulge in the bottom of the cut. Heaving and squeezing can occur even when shoring or shielding has been properly installed.

Boiling, as related to excavation, is an upward water flow into the bottom of the cut. A high water table is one of the causes of boiling. Boiling produces a rapid condition in the bottom of the cut, and can occur even when shoring or trench boxes are used

Unit weight of soils refers to the weight of one unit of a soil, which varies by type and moisture content. One cubic foot of soil can weigh from 110 pounds to 140 pounds or more, and one cubic meter (35.3 cubic feet) of soil can weigh more than 3,000 pounds.

Review questions

1. In excavations deeper than ____ feet with the potential for a hazardous atmosphere or oxygen deficiency, conduct air testing before workers enter the excavation and as often as necessary to ensure the atmosphere remains safe.
 - a. 4
 - b. 10
 - c. 7
 - d. 6
2. If an underground utility is accidentally dug into, the only danger is that you may have to pay for any damage to it.
 - a. True
 - b. False
3. OSHA requires a ladder or ramp to be in place for exit from a trench if the excavation is__ feet or deeper.
 - a. 3 feet
 - b. 4 feet
 - c. 6 feet
4. All mobile equipment working around an excavation must be equipped with a warning device such as a backup alarm.
 - a. True
 - b. False

Answers:

1. a 2. false (electrocution) 3. B 4. true



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1-800-252-7031, Option 2

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