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## Trenching and Excavation Basics

On average, two workers are killed every month in trench collapses. 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 cause worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres, and incidents involving mobile equipment. A few precautions can take most of the risk out of trench construction.

### Numbers to Remember

- Trenches five feet deep or greater are required to have a protective system unless the excavation is made entirely in stable rock.
- If trenches are less than five feet deep, a Competent Person may determine that a protective system is not required.
- Trenches 20 feet deep or greater are required to have a protective system designed by a registered professional engineer (PE).

### Planning Before You Dig

Planning reduces the chance that something will go wrong when you start a job. Consider the following before you start excavating:

- Debris near the excavation site that could create a hazard
- How employees will get in and out of the excavation
- How to protect people from falling into the excavation
- Location of overhead power lines and underground utility lines
- Possibility of atmospheric hazards in the excavation
- Possibility of water in the excavation
- Stability of soil at the excavation site and structures adjacent to the excavation site
- Vehicles and other mobile equipment that will operate near the excavation

### Competent Person

OSHA requires that Competent Persons inspect trenches daily and as conditions change. The OSHA Construction Standard defines a Competent Person as someone who is:

- Capable of identifying existing and predictable hazards in the surroundings
- Capable of identifying working conditions which are unsanitary, hazardous, or dangerous to employees, soil types, and protective systems required
- Someone who has authorization to take prompt corrective measures to eliminate the hazards mentioned above





## Soil and Stability

A Competent Person must conduct visual and manual soil tests before anyone enters an excavation.

- **Visual testing** involves looking at the soil and the area around the excavation site for signs of instability.
- **Manual testing** involves evaluating a sample of soil from the excavation to determine qualities such as cohesiveness; granularity; and unconfined compressive strength, which is the load per unit area at which soil will fail in compression.

OSHA categorizes soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C in decreasing order of stability.

- **Stable Rock** is natural, solid mineral matter that can be excavated with vertical sides and remain intact while exposed. It is usually identified by a rock name such as granite or sandstone. Determining whether a deposit is of this type may be difficult, unless it is known whether cracks exist and whether or not the cracks run into or away from the excavation.
- **Type A Soils** are cohesive soils with an unconfined compressive strength of 1.5 tsf or greater. Examples of Type A cohesive soils include clay, silty clay, sandy clay, clay loam, and, in some cases, silty clay loam and sandy clay loam. (No soil is Type A if it is fissured; subject to vibration of any type; has previously been disturbed; is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or has seeping water.)
- **Type B Soils** are cohesive soils with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. Examples of other Type B soils include angular gravel; silt; silt loam; previously disturbed soils unless otherwise classified as Type C; soils that meet the unconfined compressive strength or cementation requirements of Type A soils but are fissured or subject to vibration; dry, unstable rock; and layered systems sloping into the trench at a slope less than 4H:1V (only if the material would be classified as a Type B soil).
- **Type C Soils** are cohesive soils with an unconfined compressive strength of 0.5 tsf or less. Type C soils include granular soils such as gravel, sand and loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable. Also included in this classification is material in a sloped, layered system where the layers dip into the excavation or have a slope of 4H:1V or greater.

## Protective Systems

There are different types of protective systems, including:

**Benching** means a method of protecting workers from cave-ins by excavating 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. (Benching cannot be done in Type C soil.)

**Sloping** involves cutting back the trench wall at an angle inclined away from the excavation.

Sloping requires installing aluminum hydraulic or other types of supports to prevent soil movement and cave-ins.

**Shielding** protects workers by using trench boxes or other types of supports to prevent soil cave-ins.

Designing a protective system can be complex because you must consider many factors, such as soil classification, depth of cut, water content of soil, changes caused by weather or climate, surcharge loads (e.g., spoil, other materials to be used in the trench), and other operations in the vicinity.

## References

OSHA standard 1926 Subpart P - Excavations

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**Project:**

**Location:**

**Date:**

**On-Site Competent Person:**

**Site Assessment - Before Digging**

Yes No N/A

- If excavation will be deeper than 20 feet, was it designed by a registered engineer?
- Has competent person reviewed job plans to make sure proper safety equipment will be on site?
- Are protective systems and materials in good working condition?
- Have utilities been located and marked?
- Are employees aware of areas that will need to be dug by hand?
- Could hazardous atmospheres be expected?
- Have area surface encumbrances been removed or supported (i.e., boulders, trees, sidewalks)?
- Has traffic control been planned?
- Has the mobile equipment been inspected by the operator?

**Site Assessment - After Digging**

Yes No N/A

- Did competent person do a visual test to determine soil type?
- What manual test was done to determine soil type?
- Based on tests, the soil was determined to be (stable rock; type A, B, C; or combo).
- Is there water in the trench?
- If there's water in the trench, how will the water be removed?
- Did the water in the trench change soil type?
- Are spoil piles and other materials two feet from the edge of the trench?
- Have any underground installations been protected, supported, or removed?
- Is there any mobile equipment that could create a sidewall failure?
- Are there warning systems in place for mobile equipment operating near the trench?
- If the trench is four feet or deeper, does it have a means of egress?
- If ladders are being used for egress, do they extend three feet above the top?
- Is the egress no more than 25 feet of lateral travel for employees?
- Were the structural ramps designed by a competent person?
- Are structural members used for ramps uniform in thickness and joined in a manner to prevent tripping or displacement?
- If the trench is five feet or deeper, what protection system is being used?
- Were protective systems installed without exposing employees to the hazards of cave-ins?
- Are protective systems installed according to the manufacturer's specifications?
- If trench boxes are used, are they at least 18 inches above the soil?
- Do hazardous atmospheres exist?
- If hazardous atmospheres are detected:
  - Are test instruments calibrated?
  - Have employees been trained for exposure?
  - Is proper Personal Protective Equipment (PPE) for exposure being used?
  - Is a plan in place for continuous monitoring?
  - Is emergency response equipment readily available?
- Are employees allowed to work under suspended loads?
- Are walkways and bridges over excavations six feet or more in depth equipped with guardrails, mid-rails, and toeboards?
- Are employees prohibited from working on faces of sloped or benched excavations above other employees?

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OSHA requires that a competent person (CP) performs daily inspections of excavations, the adjacent areas, and protective systems. The CP is looking for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall also be conducted by the competent person as needed throughout the shift and after every rainstorm or other hazard-increasing occurrence.

**Project:** \_\_\_\_\_ **Date:** \_\_\_\_\_ **Weather:** \_\_\_\_\_ **Soil Type:** \_\_\_\_\_

**Trench Depth:** \_\_\_\_\_ **Length:** \_\_\_\_\_ **Width:** \_\_\_\_\_ **Type of Protective System:** \_\_\_\_\_

## Protective Systems

Yes No N/A

Means of access and egress are spaced properly, clear of obstructions, and provided every 25 feet.  
 Surface Encumbrances are supported or removed.  
 Personnel are protected from loose rock or soil.  
 Required Personal Protective Equipment (PPE) is being worn.  
 Spoils, materials, and equipment are set back a minimum of two feet from the edge of the excavation.  
 Barricades and traffic control are provided  
 Walkways and bridges over excavations six feet or more deep are installed properly and with guardrails.  
 Personnel are prohibited from working above other personnel in the trench.  
 Are there tension cracks or fissured materials on any excavation faces?  
 Are soil masses separating and falling from excavation faces?  
 Maximum allowable slope is maintained for sloping or benching.  
 Protective systems show no signs of strain, damage, or corrosion.

## Utilities

Yes No N/A

All underground utilities have been located and are safe.  
 Safe approach distances to energized overhead power lines are maintained.

## Wet Conditions

Yes No N/A

Precautions are taken to protect personnel from accumulation of water.  
 Water removal equipment is monitored by a competent person.  
 Surface water is controlled or diverted.  
 Inspections are completed after each rainstorm.

## Hazardous Atmospheres

Yes No N/A

Prior to entry, atmosphere testing has been conducted to check oxygen, flammable gas, and toxic gas levels.  
 Oxygen levels are over 19.5% and less than 23.5%.  
 Flammable gas levels are below 10% Lower Explosive Limit.  
 Are toxic gas levels OK (H2S under 10 ppm, CO under 15 ppm)?  
 Emergency response equipment and personnel are available.  
 Personnel are trained in the use of PPE and emergency response equipment.

**Competent Person:** \_\_\_\_\_ **Date:** \_\_\_\_\_

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