# Occupational Safety Program

## Excavation Safety – Trenching & Shoring Plan

Manual


Department of Environmental Health & Safety
Phone: (410) 704-2949
Fax: (410) 704-2993
Email: safety@towson.edu
Website: https://www.towson.edu/public-safety/environmental-health-safety/
Emergency: 911
TUPD: (410) 704-4444



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## Purpose & Policy

The purpose of the plan is to comply with regulations established by OSHA, as enforced by MOSH, the Maryland Underground Utility Damage Prevention Act, and the International Building Code, Chapter 33, Section 3304 “Site Work”. The University is dedicated to providing safe work facilities for students and employees, and complying with federal and state occupational health and safety standards. Administrators, faculty, staff, and students all share a responsibility to reduce the hazards associated with excavations.

## Scope

This plan will apply to all faculty, staff, and students who are involved in excavation operations on property owned and/or operated by Towson University and operations associated with the campus that are located in the State of Maryland. Provisions of OSHA regulations 29 CFR 1926.650, 1926.651, and 1926.652 for "Excavation, Trenching and Shoring" will apply, unless more stringent safety regulations for that jurisdiction are in effect. Contractors involved in excavation operations on University property are required to comply with all applicable provisions of OSHA/MOSH regulations as per their contract.

## Definitions

*Accepted engineering practices*: Those requirements which are compatible with standards of practice required by a registered professional engineer.

*Aluminum Hydraulic Shoring:* A pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

*Bell-bottom pier hole:* A type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

*Benching (Benching system):* A method of protecting employees 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.

*Cave-in*: The separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

*Competent person*: One who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

*Cross braces:* The horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

*Department:* Any department or unit at the university that conducts work in excavations.

*Designated Supervisor:* The individual within the department that will oversee excavation work and that is responsible for assuring compliance with the Trenching and Shoring Plan.

*Excavation*: Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

*Faces or sides*: The vertical or inclined earth surfaces formed as a result of excavation work.

*Failure*: The breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

*Hazardous atmosphere*: An atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

*Kickout*: The accidental release or failure of a cross brace.

*Layered Geological Strata:* Where soil types are configured in layers. The soil should be classified on the basis of the weakest soil layer classification. Each layer may be classified individually if a more stable layer lies below a less stable layer. See “Soil Types”.

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

*Ramp:* An inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

*Registered Professional Engineer:* A person who is registered as a professional engineer in the state where the work is to be performed, in this case, the State of Maryland. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

*Soil Types:*
Type A - Most stable: clay, silty clay, and hardpan. No soil is Type A if it is fissured, is subject to vibration, has previously been disturbed or has seeping water.

Type B - Medium stability: silt, sandy loam, medium clay, and unstable dry rock. Previously disturbed soils, except those that would be classified as Type C. Soil that meets the requirement of Type A soil but is fissured or subject to vibration.
Type C - Least stable: gravel, sand, loamy sand, soft clay, submerged soil or dense unstable rock, or soil from which water is freely seeping.

*Sheeting:* The members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

*Shield (Shield system):* A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with §1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

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

*Sides*. See "Faces."

*Sloping (Sloping system):* A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

*Stable rock*: Natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

*Structural ramp:* A ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

*Support system:* A structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

*Tabulated data:* Tables and charts approved by a registered professional engineer and used to design and construct a protective system.

*Trench (Trench excavation):* A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the

forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

*Trench box*. See "Shield."

*Trench shield*. See "Shield."

*Uprights:* The vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

*Wales*: Horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

## Responsibilities

**A. Environmental Health & Safety (EHS)**

1. EHS will provide consultation.
2. EHS will prepare the Trenching & Shoring Plan with periodic review and revisions as needed.
3. EHS will distribute the Trenching & Shoring Plan to each affected department for distribution to all individuals who are authorized by the department to perform excavations.
4. EHS will approve locks to be used by individual departments.
5. EHS will investigate and document all reported accidents and/or near-miss accidents that are directly or indirectly related to excavation, trenching, and shoring.
6. EHS will coordinate training and retraining of those who may be involved in excavations.

**B. Department Heads**

1. Department Heads will designate Supervisors to be in charge of each excavation.
2. Department Heads will assure that necessary resources are available to the Designated Supervisor to allow for compliance with this plan.

**C. Designated Supervisors**

1. Supervisors will implement all provisions of the Trenching & Shoring Plan for work areas under their control.
2. Supervisors will receive Competent Person Training for trenching as defined by OSHA.
3. Supervisors will act as the competent person for excavation sites under their control.
4. Supervisors will assure that the equipment necessary to complete an excavation safely is available and in good condition.

5. Supervisors will assure that all underground utility installations such as sewer, telephone, fuel tanks, electric, gas, and water lines are located and marked before excavation begins.
6. Supervisors will receive written approval from the Department of Facilities Management and EHS for digging, trenching, or excavation on the TU campus.
7. Supervisors will conduct soil tests to determine soil type.
8. Supervisors will ensure that underground installations are protected, supported, or removed while the excavation is open.
9. Supervisors will notify Facilities Management when utility systems are exposed during the excavation process to allow the location and condition of the utility to be evaluated.
10. Supervisors will ensure worker protection and compliance with other applicable safety plans, programs, and guidelines.
11. Supervisors will ensure protection of the public with appropriate barricades.
12. Supervisors will determine what protective systems will be used to prevent cave-ins.
13. Supervisors will conduct daily inspections of excavations, the adjacent areas, and protective systems for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.
14. Supervisors will immediately notify Work Control and the TUPD in the event a utility system is damaged during the excavation process on the TU campus.
15. Supervisors will report all workplace injuries, unsafe conditions, and near-misses to EHS.
16. Supervisors will comply with necessary documentation requirements.

**D. Department of Facilities Management (FM)**

1. Facilities Management will review project concepts and designs for potential impact to utility systems on Towson University property.
2. Facilities Management will approve project as appropriate from a utility standpoint, or recommend changes to projects if there are conflicts with utility systems.
3. Facilities Management will provide written authority to proceed with excavation if the project impact to utilities is acceptable.
4. Facilities Management will coordinate the marking of underground utilities on TU campus.
5. Facilities Management will provide for the marking of underground utilities under its authority.
6. Facilities Management will notify TUPD, EHS, and the appropriate utility in the event of a broken utility line, (i.e. contact BGE in case of a broken gas line).
7. Facilities Management will inspect utility systems exposed during the excavation process.
8. Facilities Management will review utility repair proposals and approve if acceptable, or recommend repair procedures.
9. Facilities Management will inspect utility repairs after they are completed and prior to covering them.

10. Facilities Management will interface with contractors under its control to monitor compliance with this OSHA/MOSH regulation.
11. Facilities Management will provide assistance with the identification and marking of underground telecommunications lines.

**E. Employees**

1. Employees will complete all safety training requirements and request further instruction, if unclear on any part of the Trenching and Shoring Plan.
2. Employees will use appropriate safety and personal protective equipment (PPE).
3. Employees will adhere to the requirements of the Trenching and Shoring Plan.
4. Employees will report all workplace injuries and unsafe conditions to their Designated Supervisor.

## Introduction

Excavation and trenching are extremely hazardous operations that expose workers to the possibility of serious injury or death and are among the most hazardous construction operations. The greatest hazard associated with trenching is the cave-in of the surrounding soil on workers in the trench, the result often being fatal. Other hazards involved in trenching include falls, confined spaces, and exposure to underground utilities such as electricity, water, sewer, steam, gas, and communications. Employees involved in excavation operations should be knowledgeable about how to minimize these hazards.

OSHA defines an excavation as any man-made cut, cavity, trench, or depression in the Earth's surface formed by earth removal. A trench is defined as a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth of a trench is greater than its width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). Trenches are typically classified based on their purpose and depth. Here are a few types of trenches in construction.

- **Utility Trenches:** Dug to install or repair utility lines such as water, sewer, or electrical lines. They may be shallow but can vary in depth.
- **Foundation Trenches:** Excavated to provide a base for building foundations. These trenches are deeper and require careful planning and preparation.
- **Drainage Trenches:** Constructed to manage surface water or groundwater. They are designed to redirect water away from structures or areas prone to flooding.
- **Access Trenches:** Used to provide access to underground structures such as basements or tunnels. They are often deeper and may require additional support.

Each type of trench has specific requirements for safety and construction practices to prevent cave-ins and other hazards.

Trenching and excavation work presents serious hazards to all workers involved. Trenching and excavation hazards continue to be a prominent cause of worker injuries and fatalities in the United States. Between 2019 and 2021, 38 workers died due to trench collapses alone as cited in OSHA's Fatality Inspection Data. Engulfments by cave-in pose the greatest risk and are more

likely than some other excavation-related incidents to result in worker fatalities from being asphyxiated and/or crushed. One cubic yard of soil can weigh as much as a car. Other potential hazards associated with trenching work include falls, crush from falling loads/objects, asphyxiation/poisoning, drowning, vibration, electrocution/shock, or explosion/fire.

Other potential sources of hazards associated with trenching work include falling loads, hazardous atmospheres, and hazards from mobile equipment.

**Source of Hazards**

*Atmospheric Hazards*

Trenches and excavation sites are prone to atmospheric hazards due to the worksite being underground. Workers can be exposed to oxygen deficiency or enrichment, flammable gases, or toxic gases.

*Collapse/Cave-In*

A trench collapse or a cave-in occurs when the walls of the trench or excavation site collapse inwards due to instability or improper use of safety techniques. Some of the most common reasons for trench or excavation collapses are attributed to unstable soil, vibrations due to machinery being used nearby, vibrations from heavy traffic passing close to the trench, flooding, heavy rainfall, and excessive pressure placed on the edge of a trench.

*Electrical Hazards*

Often working underground results in workers being exposed to underground electrical wiring, underground power lines, or other underground utilities such as telephone lines and water. This is a cause of concern as workers could be exposed to electrical hazards such as shocks and electrocutions as well as fires and explosions. To safeguard workers, employers should contact the utility companies and the location of the underground utility and put in barriers to avoid the area when working in the trench or get the water supply or power shut down before work begins in trenches.

*Falls*

Workers in trenches and excavations may fall into the trench or excavation if traveling along the edge above it or crossing over them.

*Surface Encumbrances*

Surface encumbrances are objects on the ground that could be hazardous to workers in an excavation or trench from falling or related striking hazards. These objects may include the following: equipment and tools, materials or supplies, permanent installations (e.g. playground equipment, statues, street signs), facilities or buildings, roadways, trees and tree parts (e.g. roots, leftover stumps), other plants, boulders, excavated soil (spoils), or debris.

*Water Intrusion/Flooding*

Water in an excavation can undermine the sides of the excavation and make it more difficult for workers to get out of the excavation. Workers are not allowed to enter an excavation where

water has accumulated or is accumulating unless adequate precautions are taken to protect workers. Flooding can occur due to ruptured water pipes in the excavated area or heavy rainfall or storms causing runoff.

**Hazard Controls**

Adequate protections must be in place to ensure that hazardous atmospheres are not present and that cave-ins are prevented. A site assessment is conducted to understand the terrain and geology of the work site where the trench is to be located. Workers should ensure the utility underground locations are identified in advance, and barriers placed around them with relevant safety signage when work is being carried out to avoid danger to utilities that could lead release of hazardous materials, water, or other material leading to engulfment, explosion, fire, or electrocution. Designated Supervisors should ensure that personnel wear proper PPE, including high-visibility or other suitable clothing when exposed to vehicular traffic during this and other related trench work.

Loads should be kept secured and away from the edge of trenches. Barriers shall be placed at the edge of the trench and excavation areas to prevent tools and equipment from accidentally falling into trenches, and putting up safety signs and installing guardrails for walkways that are 6 feet or higher from the bottom of the trench or the lower level may prevent falls. Proper techniques for securing the trench will include sloping, benching the sides of the trench (cutting horizontal steps into the excavation), shoring (supporting the sides of the excavation), or placing a shield between the sides of the excavation/trench and the work area.

Other precautions such as 4-gas meter use and weather monitoring should be implemented. For flooding or other water intrusion concerns, inclusion of special support or shield systems to prevent cave-ins, water removal to control the water level, or the use of a safety harness and lifeline should be implemented. If water removal equipment is used to control or prevent water accumulation, the equipment and operations must be monitored by a competent person to ensure proper use. If excavation work interrupts the natural drainage of surface water, workers are required to use diversion ditches, dikes, or other suitable means to prevent surface water from entering the excavation and to provide adequate drainage of the adjacent area. In addition, a competent person must inspect excavations, including those subject to runoffs from heavy rains.

Inspections by a competent person must also take place when the trench will be occupied. All potential hazards will be checked and prevented. Use of a 4-gas meter will be required to check for hazardous atmospheres, and adequate PPE is to be provided to all workers.

## Applicable Regulations

- 29 CFR 1926 Subpart P – Excavations (specifically, 29 CFR 1926.650 – 29 CFR 1926.652, and all Appendices)

## Procedure

### A. General Guidelines

1. The Designated Supervisor (competent person) shall:
   a) Be in charge of each excavation who is trained to identify hazardous conditions and who has the authority to take corrective action.
   b) Classify soil.
   c) Inspect excavations on a daily basis and after every rain.
   d) Identify any equipment or activities that could affect trench stability and inspect protective systems.
   e) Test for atmospheric hazards such as low oxygen, hazardous fumes, and toxic gases when workers are more than 4 feet deep. In addition, when controls such as ventilation or respiratory protection are used to reduce the level of atmospheric contaminants to acceptable levels, testing must be conducted as often as necessary to ensure that the atmosphere remains safe.
   f) Monitor water removal equipment.
   g) Ensure that personnel wear high-visibility or other suitable clothing when exposed to vehicular traffic.

2. Preparation & Setup
   a) Before excavation, underground utilities shall be located and marked. Adjacent structures shall be stabilized.
   b) Heavy equipment shall be kept away from trench edges.
   c) Excavated soil (spoils) or other material shall be retained 2 feet or more from the edge of the excavation.
   d) Appropriate barricades, fences, protected walkways, and signs shall be provided to protect the public.
   e) Workers shall be protected from cave-ins by either an adequate sloping system or an adequate support or protective system.
   f) Stairs, ladders, or ramps shall be provided when workers enter excavations that are four (4) feet or deeper. The means of exiting the trench shall be provided every 25 feet. The means will not be more than 25 feet laterally (trench length) within the trench.
   g) Workers shall wear all required personal protective equipment including hard hats, safety footwear, gloves, eye protection, hearing protection, and fall protection devices as needed.

3. Awareness
   a) Workers shall stay away from any equipment loading or unloading material.
   b) Workers shall not enter or work in trenches with hazardous atmospheres without adequate controls.
   c) Do not work under suspended or raised loads and materials.

**B. Excavation Procedures**

1. Project Development and Impact to Utilities
   a) The Designated Supervisor will ensure that a campus project is coordinated with Facilities Management and EHS early in the programming and development stages, so that conflicts with utilities can be resolved early. The Designated Supervisor will obtain written approval from Facilities Management indicating that the impact to utilities has been reviewed and approved before proceeding with excavation.

2. Utilities and Pre-work Site Inspection
   a) The Designated Supervisor will inspect the site before the excavation is started to determine what safety measures are to be taken.
   b) Underground Facilities Identification & Protection
      *i. Underground sewer, telephone/communications, gas, water, and electric lines will be located and clearly marked. The Designated Supervisor will arrange to have these utilities protected, removed, or relocated as directed by Facilities Management and as may be needed to do the work safely. Excavation will be done in a manner that does not endanger the underground installations or those engaged in the work. Barricades, shoring, suspension, or other means as necessary will protect utilities left in place during trenching activities.*
      *ii. Miss Utility*
         *1) Miss Utility (800-257-7777) will be notified for sites in the State of Maryland, to arrange for the marking of underground utilities.*
         *2) The Maryland Statute "Underground Utility Damage Prevention Act" states that utilities have two (2) business days from the time the locate request was registered to mark the underground facilities.*
         *3) If there are underground utilities near the excavation site, they will be marked with paint and/or flags on the ground. Marking paint or flag colors will follow the color coding in Table 1 below.*
         *4) State law also requires that hand digging begin at 18 inches from the marked sites.*

**Table 1. APWA Uniform Color Code.** The list is used to mark underground utility lines or related excavation actions.

| | |
|---|---|
| WHITE | Proposed Excavation |
| PINK | Temporary Survey Markings |
| RED | Electric Power Lines, Cables, Conduit, and Lighting Cables |
| YELLOW | Gas, Oil, Steam, Petroleum, or Gaseous Materials |
| ORANGE | Communication, Alarm, or Signal Lines, Cables, or Conduit |
| BLUE | Potable Water Systems |
| PURPLE | Reclaimed Water, Irrigation, and Slurry Lines |
| GREEN | Sewers and Drain Lines |

3. Stability of Adjacent Structures
    a) The Designated Supervisor will take precautions as needed to protect workers, nearby buildings, or other structures. A Registered Professional Engineer should evaluate these structures and recommend precautions such as shoring, bracing, or underpinning. The Designated Supervisor will ensure that the recommendations of the engineer are carried out. Plans that outline the design of such precautions approved by the engineer will be maintained on site while the work is in progress.

4. Protection of the Public
    a) Barricades, walkways, lighting, and signs will be provided for the protection of the public before the start of excavation operations. Guardrails, fences, or barricades will be provided adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares.

5. Protection of Workers in Excavations
    a) The Designated Supervisor will assure that workers are protected from hazards that may arise during excavation work.
    b) Stairs, ladders, or ramps will be provided when workers enter excavations over four (4) feet deep. Two (2) or more means of exit will be provided if the excavation is more than 20 feet in length. A means of exit will be provided every 25 feet of trench length.
    c) A competent person, qualified in structural design, will design structural ramps used for egress or access of equipment. The ramp will be constructed in accordance with the design. Ramps with two (2) or more structural members will have the structural members that are uniform thickness and connected together to prevent displacement and will not present a tripping hazard.
    d) Those workers exposed to vehicular traffic will wear warning vests made of high visibility material.
    e) No one will work underneath loads handled by lifting or digging equipment. Workers will stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.
    f) A warning system will be used when mobile equipment is operated next to the edge of an excavation if the operator does not have a clear, direct view of the edge of the excavation.
    g) Materials and equipment should be kept at least two (2) feet from the edge of the excavation with the proper protective system in place.

6. Hazardous Atmospheres and Confined Spaces
    a) Workers will not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with the following:
        *i. Atmospheric oxygen concentration below 19.5% or above 23.5%.*

ii. *Combustible gas concentration greater than 10% of the lower flammability limit.*
iii. *Concentrations of hazardous substances that exceed those specified in the Threshold Limit Values (TLVs) for airborne contaminants established by the American Conference of Industrial Hygienists (ACGIH).*

b) If there is any possibility that the trench or excavation could contain a hazardous atmosphere, the Designated Supervisor will ensure that atmospheric testing is conducted before worker entry and continuously during work. Excavations near underground storage tanks or those that contain gas pipelines will be monitored.
c) Suitable precautions will be taken as necessary to protect workers. These precautions may include the following:
   i. *Engineering controls such as ventilation.*
   ii. *Respiratory protection. Those required to wear respiratory protection must be enrolled in the Respiratory Protection Program. Enrollment in the program requires workers to:*
      1) *Complete respiratory protection training (air-purifying respirators);*
      2) *Obtain a respiratory fit test provided by EHS;*
      3) *Complete a medical examination; and*
      4) *Maintain annual re-certification.*

7. Full-Body Harnesses and Lifelines
   a) Some trenches qualify as permit-required confined spaces. The Designated Supervisor will ensure compliance with the Confined Space Entry Program when an excavation has one or more of the following characteristics:
      i. *Contains or has the potential to contain a hazardous atmosphere, OR*
      ii. *Contains a material that has the potential for engulfing or suffocating an entrant, OR*
      iii. *Has an internal configuration such that an entrant could be entrapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section, OR*
      iv. *Contains any other recognized serious or health hazard.*

8. Personal Protective Equipment (PPE)
   a) The Designated Supervisor will ensure that all workers wear all required safety equipment as detailed below. Hard hats, safety eyewear, gloves, hearing protection, safety footwear, and fall protection devices will be furnished by the worker's department or the contractor's employer. The department or employer must ensure that anyone conducting work in excavations wears PPE approved by the American National Standards Institute (ANSI).
   b) Everyone working in trenches or excavations will wear ANSI-approved hard hats at all times.
   c) Everyone working in trenches or excavations will wear ANSI approved steel-toed shoes or boots.

d) Those exposed to flying fragments, dust, or other materials produced by drilling, sawing, sanding, grinding, and similar operations will wear ANSI approved safety glasses with side shields.
e) Those exposed to hazards produced by welding, cutting, or brazing will wear approved eye protection or a welding face shield or helmet. The Designated Supervisor will obtain a Hot Works Permit by contacting the Fire Safety Manager at 410-704-6380.
f) Those workers entering deep and confined footing excavations, such as shafts and bell-bottomed holes, will wear a harness with a lifeline securely attached to it. The lifeline will be separate from any line used to handle materials. The lifeline will be attended by a person at all times while the employee wearing the lifeline is in the excavation.
g) All workers will wear gloves or other suitable hand protection as determined by the supervisor or EHS.
h) Workers at the edge of an excavation four (4) feet or deeper will be protected from falling by guardrail systems, fences, barricades, or other approved means.
i) The Designated Supervisor or other qualified person will conduct a Workplace Hazard Assessment according to the requirements described in the Personal Protective Equipment Program.

9. Walkways and Guardrails
   a) Walkways will be provided where workers or equipment are allowed to cross over excavations.
   b) Guardrails will be provided on walkways used by the general public regardless of the height above the excavation.
   c) Guardrails will be provided on walkways used only by on-site personnel if the walkway is six (6) feet or more above lower levels. Guardrails and toe boards will be provided when/if workers pass below a walkway.

10. Hazards Associated with Water Accumulation
    a) No one will work in excavations with standing water or where water is collecting unless the Designated Supervisor gives prior approval or instruction.
    b) Methods for controlling water accumulation will be provided and will consist of the following if anyone must work in the excavation:
       i. *Use of special support or shield systems approved by a Registered Professional Engineer.*
       ii. *Water removal equipment, such as well pointing, used and monitored by the Designated Supervisor.*
       iii. *Use of safety harnesses and lifelines.*
       iv. *No one will work in excavations during a rainstorm.*
       v. *Trenches will be inspected by the Designated Supervisor after each rain and before anyone is permitted to re-enter the excavation.*

11. Protection of Workers from Falling Objects
    a) The Designated Supervisor will ensure that workers are protected from loose rock or soil that could fall or roll from an excavation face. Such protection will consist of the following:
        i. *Scaling to remove loose material;*
        ii. *Installation of barricades such as wire mesh or timber as needed to stop and contain falling material; OR*
        iii. *Sloping. Sloping will be used instead of barricades when practical.*
    b) Workers will be protected from excavated materials, equipment, or other objects that could pose a hazard by falling or rolling into excavation.
        i. *These materials or equipment will be kept at least two (2) feet from the edge of the excavation or otherwise restrained.*
        ii. *Materials piled, grouped, or stacked near the edge of an excavation must be stable and self-supporting.*

12. Inspections
    a) The Designated Supervisor will conduct daily inspections of excavations, adjacent area, and protective systems for evidence of a situation that could result in a cave-in, failure of protective systems, hazardous atmospheres, or other hazardous conditions.
    b) Inspections will be conducted before the start of work and as needed throughout the shift.
    c) Inspections will also be made after every rainstorm.
    d) These inspections are only required when the trench will be or is expected to be occupied.
    e) When a hazardous condition is found, exposed workers will be removed from the area until precautions have been taken to assure their safety.
    f) These inspections will be documented in writing and kept on-site. They will be made available to EHS or any other authority upon request.

**C. Protective Systems Requirements**

1. Selection of Protective Systems
    a) Personnel working in an excavation will be protected from cave-ins by using either an adequate sloping and benching system or an adequate support or protective system.
    b) The only exceptions to Step C1a are when the excavation is made entirely in stable rock or the excavation is less than four (4) feet in depth where examination of the ground by the Designated Supervisor provides no indication of a potential cave-in.
    c) The decision tree in 29 CFR 1926 Subpart P, Appendix F (See Appendix A of this Plan) will be used to determine the appropriate section of protective systems used in excavations 20 feet or less in depth.
    d) A registered professional engineer must design all excavations greater than 20 feet in depth.

**Table 2. OSHA Rock & Soil Deposit Categories.** Per 29 CFR 1926 Subpart P - Appendix A, OSHA categorizes rock and soil deposits based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure. The table is listed in decreasing order of stability, with Type C being least stable. Descriptions and examples of each type are provided. The last entry is provided for clarification.

| Type | Description | Examples |
|---|---|---|
| Stable Rock | Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed. Determining this deposit type may be difficult unless it is known whether cracks exist and if the cracks run into or away from the excavation | Usually identified by a rock name (e.g. granite, sandstone) |
| Type A | Cohesive soils with an unconfined compressive strength of ≥ 1.5 tons per square foot (tsf) | Clay, silty clay, sandy clay, clay loam; some cases, silty clay loam and sandy clay loam |
| Type B | Cohesive soils with an unconfined compressive strength between 0.5-1.5 tsf | Angular gravel, silt, silt loam |
| Type C | Cohesive soils with an unconfined compressive strength ≤ 0.5 tsf | Granular soils, gravel, sand and loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable |
| Layered Geological Strata | a) Where soils are configured in layers (where a layered geologic structure exists), the soil must be classified on the basis of the soil classification of the weakest soil layer. b) Each layer may be classified individually if a more stable layer lies below a less stable layer. | a) Type B layered with Type C results in overall Type C classification. b) Where Type C soil rests on top of stable rock, each may be classified individually. |

2. <u>Soil Classification</u>
   a) In order to design the most appropriate protective system, the Designated Supervisor will determine the soil type using a visual test with one or more manual tests.
   b) The soils in the State of Maryland have been found to be Type B and Type C (See Table 2 for description).
   c) If the soil is subject to vibration or previously disturbed or saturated, a Type B soil must be downgraded to a Type C classification.
   d) Visual Test
      *i. During the visual test, the entire excavation site including the soil adjacent to the site will be observed.*
      *ii. The Designated Supervisor will check for crack-line openings along the failure zone that indicate tension crack and observe the open side of the excavation for indications of layered geologic structuring.*
      *iii. Other conditions to look for are signs of bulging, boiling, or sloughing, as well as signs of surface water seeping from the side of the excavation or from the water table.*

e) Manual Tests
   i. *Thumb Penetration Test*
      1) *When the thumb is pressed firmly into the soil and penetrates no further than the length of the nail, it is probably Type B soil.*
      2) *If the thumb penetrates the full length of the thumb, it is Type C.*
      3) *This is the **least accurate** of the manual test methods.*
   ii. *Dry Strength Test*
      1) *If a sample of dry soil is crumbled freely or with moderate pressure into individual grains it is considered granular, or Type C.*
      2) *Dry soil that falls into clumps that subsequently break into smaller clumps is probably clay in combination with gravel, sand, or silt (Type B).*
   iii. *Plasticity or Wet Thread Test*
      1) *A moist sample of the soil is molded into a ball and then rolled into a thin thread approximately 1/8 inch in diameter by two inches in length.*
      2) *If the soil sample does not break when held by one end, it may be considered Type B.*
      3) *If the soil sample does break, it is considered Type C.*

f) A pocket penetrometer, shearvane, or torvane may also be used to determine the unconfined compression strength of soils.
g) Additional testing information may be found in Appendix D of this Plan.

3. Types of Protective Systems
   a) The following systems will be used to protect workers from cave-ins in trenches of more than four (4) feet deep.
   b) The Designated Supervisor should select the method of protection that is most suitable for the particular job site, taking into consideration soil type and surrounding structures. If the soil is not classified, then the excavation must be sloped at an angle not steeper than one-and-a-half horizontal to one vertical (1.5: 1).
   c) Sloping
      i. *Maximum allowable slopes for excavations less than 20 feet deep based on soil type and angle to the horizontal are as follows in Table 3:*

**Table 3. Maximum Allowable Slope by Soil Type.** The table lists soil type, appropriate ratios for run and rise for trench, and resultant slope angles.

| Soil Type | Height/Depth Ratio | Slope Angle |
|---|---|---|
| Type B | 1:1 | 45° |
| Type C | 1.5:1 | 34° |

      ii. *For example, a ten-foot deep trench in Type B soil would have to be sloped to a 45- degree angle, or sloped 10 feet back in both directions. Total distance*

*across a trench ten feet deep would be 20 feet plus the width of the trench. In Type C soil, the trench would be sloped at a 34-degree angle or 15 feet in both directions for a total of 30 feet across plus the width of the trench for the same ten-foot deep trench. See Figure 1 below for illustrative purposes.*

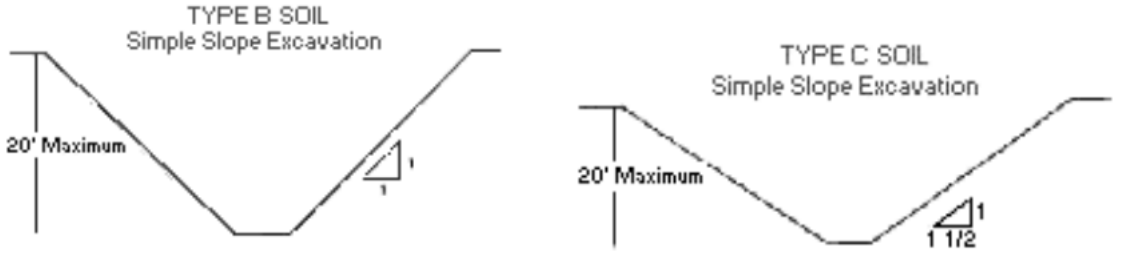


**Figure 1. Simple Slope Illustrations by Soil Type.** Each soil type shown lists appropriate height/depth ratio and acceptable maximum depth for method used. Type C soil is comparably less stable, hence shallower slope is used.

d) Benching
   - *i. There are two types of benching:*
     - *1) Single. One level or step, not exceeding 4 feet in height.*
     - *2) Multiple. More than one level or step, each not to exceed four feet in height.*
   - *ii. Benching can be used in conjunction with simple sloping.*
   - *iii. Benches must be below the maximum allowable slope for that soil type. For example, a ten-foot deep trench in Type B soil must be benched back 10 feet in each direction with the maximum of a 45-degree angle.*
   - *iv. Benching is <u>not</u> permitted in Type C soil.*

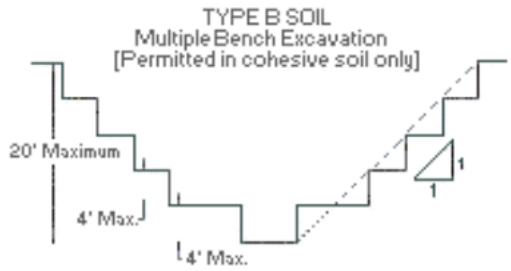


**Figure 2. Multiple Benching Illustration.** The figure shows the maximum allowable step height, overall acceptable maximum depth for the trench. The method is only acceptable in cohesive, Type B soil.

e) Shoring
   - *i. Shoring is used when the location or depth of the trench makes sloping back to the maximum allowable slope impractical.*
   - *ii. There are two basic types of shoring:*
     - *1) Timber Shoring*
       - A) The Designated Supervisor will use the information in the tables of 29 CFR 1926 Subpart P Appendix C - Timber Shoring for Trenches.
       - B) The members of the shoring system that are to be selected using the tables are the cross braces, the uprights, and the wales where wales are required.
       - C) The Designated Supervisor will select the size and spacing of members using the appropriate table.

D) The selection will be based on the depth and width of the trench where the members are to be installed.
E) In most instances, the selection is also based on the horizontal spacing of the cross braces.
F) Where a choice is available, the horizontal spacing of the cross braces must be chosen before the size of any member can be determined.

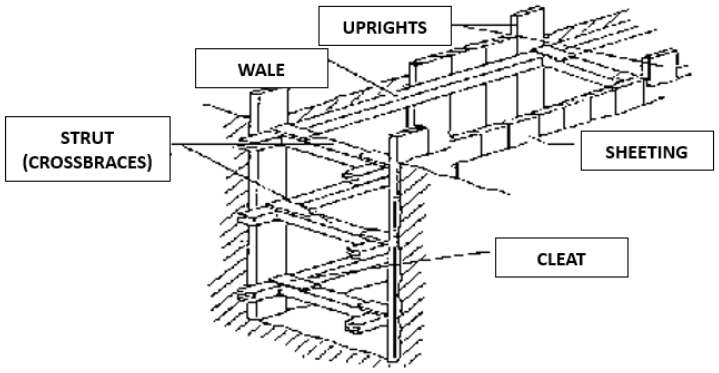


**Figure 3. Timber Shoring.** The figure shows an example of timber shoring with all components labeled.

## *2) Hydraulic Aluminum Shoring*

A) Hydraulic shoring provides a critical advantage over timber shoring because workers do not have to enter the trench to install them. They are also light enough to be installed by one worker, they are gauge-regulated to ensure even distribution of pressure along the trench line and they can be adopted easily to various trench depths and widths.
B) Hydraulic aluminum shoring will be used over timber shoring at Towson University whenever feasible.
C) Hydraulic Shoring Support Systems will be constructed and used in accordance with all specifications, recommendations and limitations issued by the manufacturer.
D) Hydraulic shores will be installed in accordance with the 1926 Subpart P - Appendix D - Aluminum Hydraulic Shoring for Trenches. The Designated Supervisor will use the tables in this standard to determine the maximum vertical and horizontal spacing that may be used with various aluminum member sizes and various hydraulic cylinder sizes.
E) All shoring will be installed from the top down and removed from the bottom up. The Designated Supervisor will inspect all hydraulic shoring at least once per shift for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, and any other damaged or defective parts. This inspection will be documented in writing. The top cylinder of hydraulic shoring will be no more than two feet from the top edge of the excavation. Two feet of trench may be exposed beneath the bottom of the rail or plywood sheeting, if used. See Figure 4 for illustrative purposes.

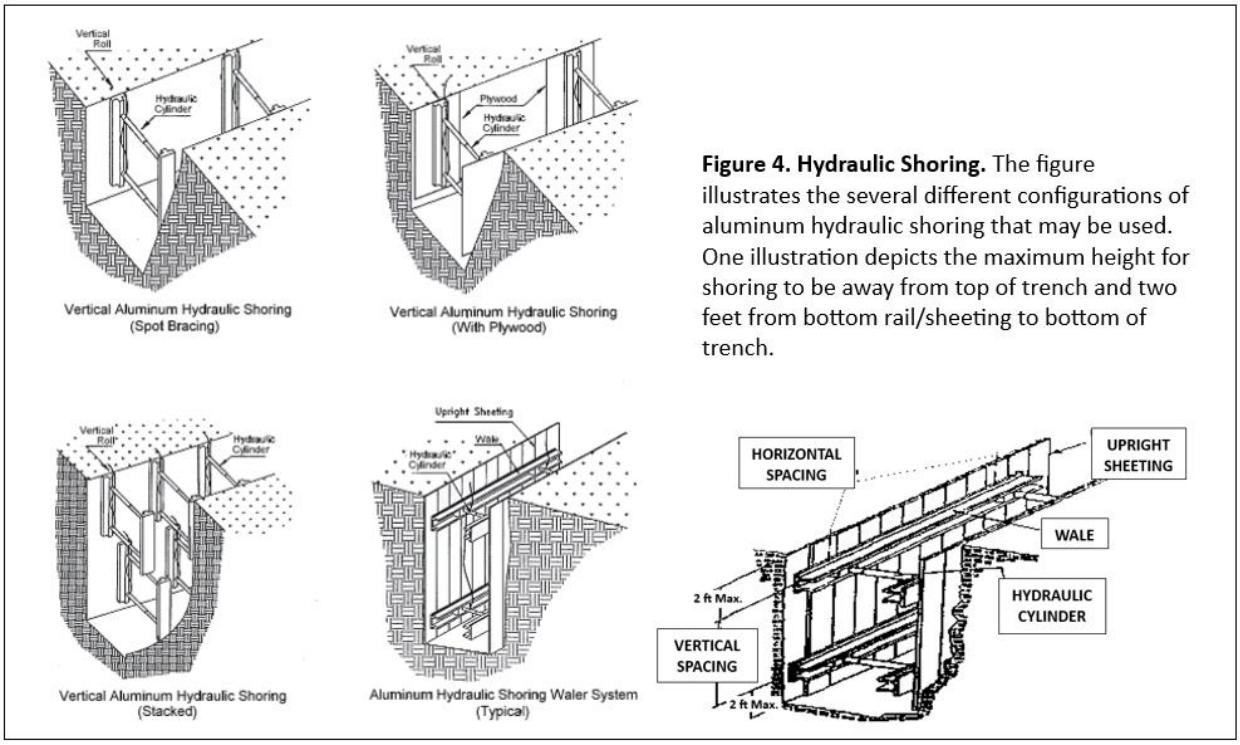


**Figure 4. Hydraulic Shoring.** The figure illustrates the several different configurations of aluminum hydraulic shoring that may be used. One illustration depicts the maximum height for shoring to be away from top of trench and two feet from bottom rail/sheeting to bottom of trench.

f) Shielding

*i. Trench boxes are different from shoring because instead of shoring up or otherwise supporting the trench face, they are intended primarily to protect workers from cave-ins.*

*ii. Trench boxes are generally used in open areas, but they may be used in combination with sloping and benching.*

*iii. Examples of trench box configurations may be found in Figure 5.*

*iv. The Designated Supervisor will ensure that the following safety measures are taken:*

*1) Inspect trench boxes for good condition before each use.*

*2) Minimize the excavated area between the outside of the trench box and the face of the trench.*

*3) Backfill the space between the trench box and the excavation side to prevent lateral movement of the box.*

*4) Ensure the trench box is extending at least 18 inches above the surrounding area if there is sloping toward the excavation, providing a sloped area adjacent to the box.*

*5) Ensure the shields ride two feet above the bottom of the excavation provided they are calculated to support the full depth of the excavation and there is no caving under or behind the shield.*

*6) The manufacturer must approve any modifications to the shields.*

*7) Workers must enter and leave the shield in a protected manner, such as by a ladder.*

*8) Workers may not remain in the shield while it is being moved.*

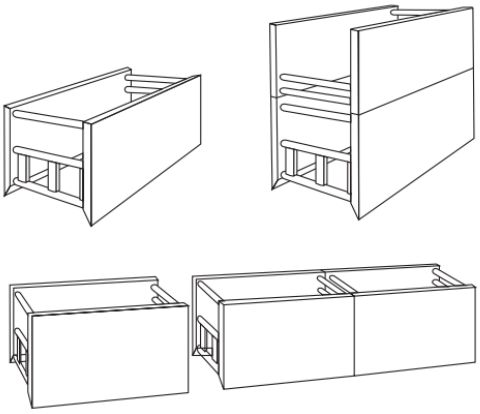

**Figure 5. Trench Shields.** Trench shields or trench boxes are used to protect workers from a cave-in from sliding or falling soil/rock.

g) Protective Methods Using Other Tabulated Data
   *i. Other tabulated data, such as tables and charts, may be selected for the design of sloping, benching, shoring, or shielding systems.*
   *ii. The tabulated data used must be written and include the following:*
      *1) Identification of the factors that affect the selection of a protective system;*
      *2) Identification of the limits of use of the data;*
      *3) Information needed by the user to make a correct selection of a protective system from the data; and*
      *4) At least one copy of the tabulated data, which identifies the Registered Professional Engineer who approved the data, will be maintained at the job site during construction of the protective system.*

4. Design by Registered Professional Engineer
   a) A Registered Professional Engineer may design sloping, benching, shoring, and shielding systems.
   b) The design will be written and must include the following:
      *i. A plan indicating the sizes, types, and configurations of the materials to be used in the protective system.*
      *ii. The identity of the Registered Professional Engineer approving the design.*
      *iii. At least one copy of the design must be maintained at the job site during construction of the protective system.*
   c) A Registered Professional Engineer must approve all excavations more than 20 feet in depth.

**D. Reporting**

1. On campus, contact Facilities Management - Work Control Center to locate and mark underground electric, telecommunications, steam, gas, sewer, and water mains at 410-704-2481.
2. For off-campus locations, call Miss Utility at (800) 257-7777 to locate and mark all underground utilities. Call at least 48 hours before the excavation work is to begin.

**E. Inspections**

1. The Designated Supervisor (competent person) must inspect all excavations, adjacent areas, and protective systems daily for possible cave-ins, indications of failures in protective systems and equipment, hazardous atmospheres, and other hazardous conditions.
2. Inspections must be done prior to the start of work and as needed throughout the shift. Inspect trenches at the start of each shift.
3. Inspections are also required after natural events, so inspect trenches following a rainstorm, other precipitation, or flooding occurs. Heavy winds, landslides, drought, and seismic activity such as earthquakes may also affect an excavation site.
4. Inspect trenches after any occurrence that could have changed conditions in the trench such as water intrusion from the surrounding soil or facilities, or hazard-increasing occurrences, such as blasting work.
5. If an inspector finds any unsafe conditions during an inspection, the employer must clear workers from the hazardous until the necessary safety precautions have been taken.

**F. Recordkeeping**

1. Facilities Management and the Designated Supervisor shall maintain records of employee training, documentation of daily trench inspections, and any protective system designed by an engineer. A copy of protective systems designed by an engineer shall be maintained on the job site.
2. Copies of training documentation of competent persons shall be maintained at EHS.

**G. Contractors**

1. Contractors hired by any agent of the University to perform excavation operations must have their own trenching safety policies that comply with federal (OSHA) and state (MOSH) regulations.
2. Contractors must coordinate with Facilities Management and EHS early in the programming and development stages of excavation to determine all project impacts to utilities.
3. The contractor must obtain written approval from Facilities Management and EHS indicating that the impact to utilities has been reviewed and approved before bidding the work or proceeding with excavation.
4. The contractor must coordinate with Miss Utility and Facilities Management the identification and marking of underground utilities including, but not limited to, sewer, telecommunication, gas, water, steam, and electric. The contractor will arrange to have these utilities protected, removed, or relocated as directed by Facilities Management and Miss Utility.

**H. Emergency Procedures**

1. Emergency Rescue
   a) For emergency situations that include the injury or entrapment of a worker, the breaking of a gas line or the uncontrolled release of any other hazardous material, call 911.
   b) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, will be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during working in an excavation. This equipment will be attended when in use.
   c) In the event of any emergency requiring rescue from an excavation, Towson University personnel will not attempt to enter an unprotected trench to perform rescue. Contact the University Police via two-way radio or dial 911. At the emergency blue-light and yellow phones located around campus, press the emergency button to be connected to the University Police who can contact 911 for you, or dial 911 on the keypad to be connected directly to the 911 Center. Give the dispatcher all of the requested information.
   d) Rescue services that can be performed safely from outside the excavation, such as hoisting a harnessed victim, will be undertaken until BCFD arrives. Other personnel in the excavation will exit immediately, providing assistance only when not endangering their own safety.
   e) Baltimore County Fire Department (BCFD) will provide emergency rescue services for all trench emergencies on the TU campus. Local fire and rescue services will provide their own equipment and training in accordance with federal and state regulations.

**I. Training**

1. Training requirements apply to employees who perform excavations. All personnel involved in trenching or excavation work will be trained in the requirements of this excavation safety plan. Training will be performed before anyone is assigned duties in excavations. Call EHS at (410) 704-2949 for assistance in training arrangements.

2. <u>Designated Supervisor Training</u>
   a) All Designated Supervisors of trenches and excavations will meet the OSHA requirements for a competent person.
   b) Designated Supervisors will attend Competent Person Training conducted by an EHS approved training source such as the Maryland Fire and Rescue Institute (MFRI) or MOSH.

3. <u>Worker Training</u>
   a) Personnel who perform work in excavations will comply with the requirements of this plan and receive appropriate training that includes at a minimum:
      *i. Safe work practices that must be followed during work in excavations;*

ii. *The use of personal protective equipment (PPE) that will typically be required during work in excavations, including but not limited to safety shoes, hard hats, and fall protection devices;*
iii. *Procedures to be followed if a hazardous atmosphere exists or could reasonably be expected to develop during work in an excavation; and*
iv. *Emergency and non-entry rescue methods, and procedures for calling rescue services.*

4. Retraining will be performed whenever work site inspections conducted by the Designated Supervisor or EHS indicate that a worker does not have the necessary knowledge or skills to safely work in or around excavations.
5. Basic training may be accessed virtually through Vector Solutions SafeColleges found at the following URL: https://towsonehs-md.safecolleges.com/training/home. Employees shall request training by emailing safety@towson.edu or by calling the Environmental Health & Safety (EHS) office at 410-704-2949.

## Resources

**A. Miss Utility**

1. Code of Maryland, Public Utilities, Division I, Title XII (Miss Utility Dig Law)
2. Maryland Underground Facilities Damage Prevention Authority FAQs
3. Miss Utility of Maryland Webpage (For Facilities West of the Chesapeake Bay)

**B. OSHA**

1. Trenching & Excavation Safety Manual
2. Trench/Excavation Competent Person Quick Reference Guide

**C. Environmental Health & Safety**

To request documents, reviews for procedures, processes, or equipment, or general inquiries, contact EHS by emailing safety@towson.edu or by calling the Environmental Health & Safety (EHS) office at 410-704-2949.

# Appendix A: Emergency Contact Telephone Numbers

## FIRE - RESCUE - EMERGENCY MEDICAL SERVICE : 911

At the emergency blue-light and yellow phones located around campus, press the emergency button to be connected to the University Police who can contact 911 for you, or dial 911 on the keypad to be connected directly to the 911 Center. Give the dispatcher all of the requested information.

## Towson University Police Department [TUPD]: (410) 704-4444

For Other Emergencies

## Department of Environmental Health and Safety: (410) 704-2949

## Concentra Urgent Care [Timonium, MD]: (410) 252-4015

For Occupational Health, Medical Consultation and Evaluation

## Facilities Management - Work Control Center: (410) 704-2481

## MISS UTILITY: (800) 257-7777 or 811

(Marking of all underground utilities in Maryland, Washington, D.C., Delaware, and Northern Virginia)

# Appendix B: Excavation Safety Standards & Regulations

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**29 CFR 1926.650-652: Excavations**
https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.650
https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.651
https://www.osha.gov/laws-regs/regulations/standardnumber/1926/1926.652

**29 CFR 1926 Subpart P Appendix A: Soil Classification**
https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20A%20to%20Subpart%20P%20of%20Part%201926

**29 CFR 1926 Subpart P Appendix B: Sloping & Benching**
https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20B%20to%20Subpart%20P%20of%20Part%201926

**29 CFR 1926 Subpart P Appendix C: Timber Shoring for Trenches**
https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20C%20to%20Subpart%20P%20of%20Part%201926

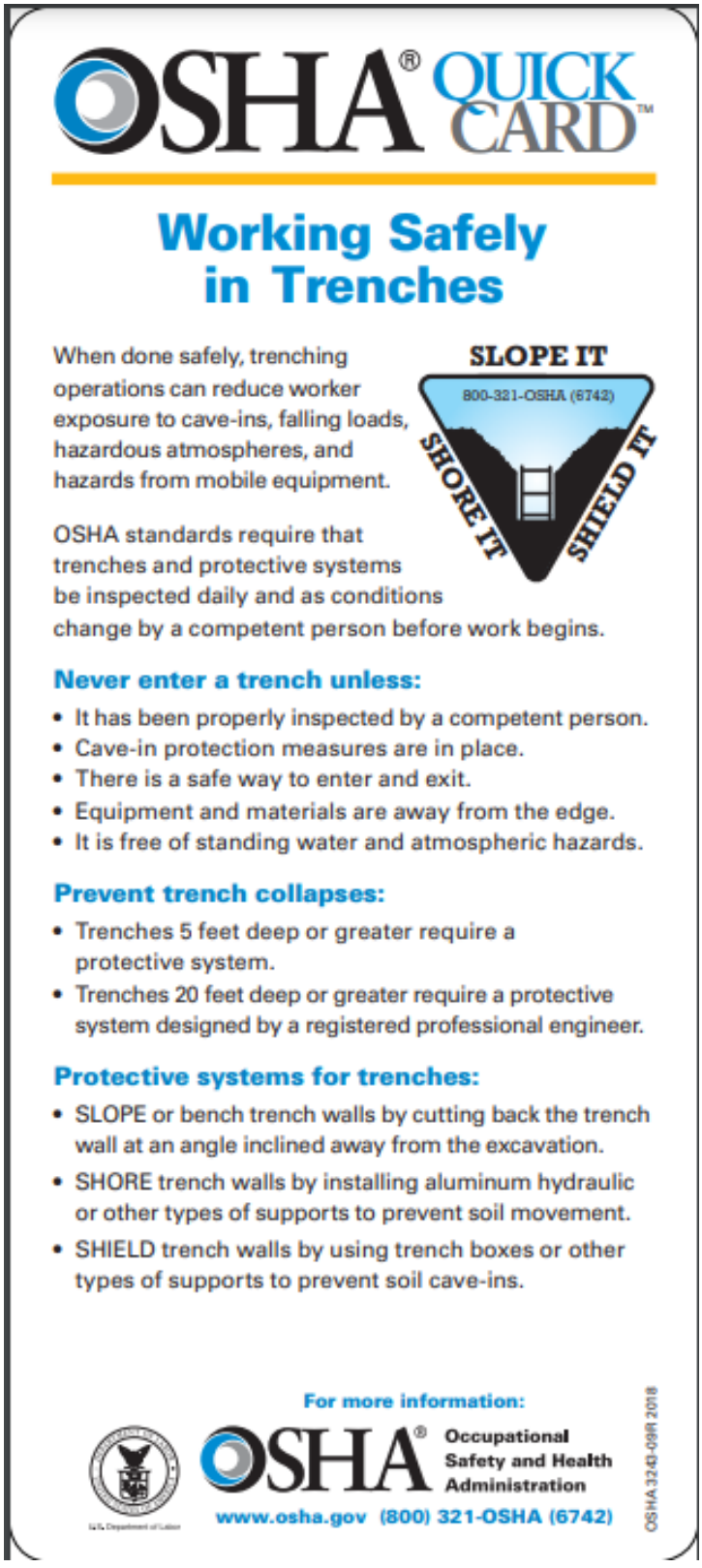
**29 CFR 1926 Subpart P Appendix D: Aluminum Hydraulic Shoring for Trenches**
https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20D%20to%20Subpart%20P%20of%20Part%201926

**29 CFR 1926 Subpart P Appendix E: Alternatives to Timber Shoring**
https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20E%20to%20Subpart%20P%20of%20Part%201926

**29 CFR 1926 Subpart P Appendix F: Selection of Protective Systems**
https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926/subpart-P/appendix-Appendix%20F%20to%20Subpart%20P%20of%20Part%201926

**International Building Code, Chapter 33 - Safeguards During Construction, Section 3304 (Site Work)**
https://codes.iccsafe.org/content/IBC2024P1/chapter-33-safeguards-during-construction

# Appendix C: OSHA Quick Card for Working Safely in Trenches



OSHA® QUICK CARD™

## Working Safely in Trenches

When done safely, trenching operations can reduce worker exposure to cave-ins, falling loads, hazardous atmospheres, and hazards from mobile equipment.

SLOPE IT
800-321-OSHA (6742)
SHORE IT
SHIELD IT

OSHA standards require that trenches and protective systems be inspected daily and as conditions change by a competent person before work begins.

### Never enter a trench unless:

- It has been properly inspected by a competent person.
- Cave-in protection measures are in place.
- There is a safe way to enter and exit.
- Equipment and materials are away from the edge.
- It is free of standing water and atmospheric hazards.

### Prevent trench collapses:

- Trenches 5 feet deep or greater require a protective system.
- Trenches 20 feet deep or greater require a protective system designed by a registered professional engineer.

### Protective systems for trenches:

- SLOPE or bench trench walls by cutting back the trench wall at an angle inclined away from the excavation.
- SHORE trench walls by installing aluminum hydraulic or other types of supports to prevent soil movement.
- SHIELD trench walls by using trench boxes or other types of supports to prevent soil cave-ins.

For more information:

OSHA® Occupational Safety and Health Administration

www.osha.gov (800) 321-OSHA (6742)

OSHA 3243-09R 2018

# Appendix D: Test Equipment and Methods for Evaluating Soil Type

Many kinds of equipment and methods are used to determine the type of soil prevailing in an area, as described below.

**A. Pocket Penetrometer**

Penetrometers are direct-reading, spring-operated instruments used to determine the unconfined compressive strength of saturated cohesive soils. Once pushed into the soil, an indicator sleeve displays the reading. The instrument is calibrated in either tons per square foot (tsf). However, Penetrometers have error rates in the range of ± 20-40%.

1. Shearvane (Torvane). To determine the unconfined compressive strength of the soil with a shearvane, the blades of the vane are pressed into a level section of undisturbed soil, and the torsional knob is slowly turned until soil failure occurs. The direct instrument reading must be multiplied by 2 to provide results in tons per square foot (tsf).
2. Thumb Penetration Test. The thumb penetration procedure involves an attempt to press the thumb firmly into the soil in question. If the thumb makes an indentation in the soil only with great difficulty, the soil is probably Type A. If the thumb penetrates no further than the length of the thumb nail, it is probably Type B soil, and if the thumb penetrates the full length of the thumb, it is Type C soil. The thumb test is subjective and is therefore the least accurate of the three methods.
3. Dry Strength Test. Dry soil that crumbles freely or with moderate pressure into individual grains is granular. Dry soil that falls into clumps that subsequently break into smaller clumps (and the smaller clumps can be broken only with difficulty) is probably clay in combination with gravel, sand, or silt. If the soil breaks into clumps that do not break into smaller clumps (and the soil can be broken only with difficulty), the soil is considered unfissured unless there is visual indication of fissuring. Plasticity or Wet Thread Test.

**B. Plasticity or Wet Thread Test**

This test is conducted by molding a moist sample of the soil into a ball and attempting to roll it into a thin thread approximately 1/8 inch (3 mm) in diameter (thick) by 2 inches (50 mm) in length. The soil sample is held by one end. If the sample does not break or tear, the soil is considered cohesive.

**C. Visual Test**

A visual test is a qualitative evaluation of conditions around the site. In a visual test, the entire excavation site is observed, including the soil adjacent to the site and the soil being excavated. If the soil remains in clumps, it is cohesive; if it appears to be coarse-grained sand or gravel, it is considered granular. The evaluator also checks for any signs of vibration. During a visual test, the evaluator should check for crack-line openings along the failure zone that would indicate tension cracks, look for existing utilities that

indicate that the soil has previously been disturbed, and observe the open side of the excavation for indications of layered geologic structuring.

The evaluator should also look for signs of bulging, boiling, or sluffing, as well as for signs of surface water seeping from the sides of the excavation or from the water table. If there is standing water in the cut, the evaluator should check for "quick" conditions. In addition, the area adjacent to the excavation should be checked for signs of foundations or other intrusions into the failure zone, and the evaluator should check for surcharging and the spoil distance from the edge of the excavation.

# Appendix E: Excavation and Trenching Checklist

| Item | Response |
|---|---|
| Is the cut, cavity, or depression a trench or an excavation? | |
| Is the cut, cavity, or depression more than 4 ft. (1.2 m) in depth? | |
| Is there water in the cut, cavity, or depression? | |
| Nearby surface or groundwater sources? Depth of water table? | |
| Are there adequate means of access and egress from the cut, cavity, or depression (e.g. proper height, quantity, and quality of ladders/stairs/ramps, and no more than 25 ft. from the work)? | |
| Are there any surface encumbrances? | |
| Are there overhead/underground utilities? Located and marked? | |
| Is there exposure to vehicular traffic? | |
| Are adjacent structures stabilized? Are they in good condition? | |
| Have weather conditions or natural events affected excavation? | |
| Does mobile equipment have a warning system? | |
| Is a competent person in charge of the operation? | |
| Is equipment operating in or around the cut, cavity, or depression? | |
| Are procedures required to monitor, test, and control hazardous atmospheres? | |
| Does a competent person determine the soil type? | |
| Was a soil testing device used to determine soil type? Soil type? | |
| Is the spoil placed 2 ft. or more from the edge of the cut, cavity, or depression? | |
| Is the depth 20 ft. or more for the cut, cavity, or depression? | |
| Has a registered professional engineer approved the procedure if the depth is more than 20 ft.? | |
| Does the procedure require benching or multiple benching? Shoring? Shielding? | |
| If provided, do shields extend at least 18 in above the surrounding area if it is sloped toward the excavation? | |
| If shields are used, is the depth of the cut more than 2 ft. below the bottom of the shield? | |
| Are any required surface crossings of the cut, cavity, or depression the proper width and fitted with handrails? | |
| Has proper PPE and fall protection been provided to workers? | |
| Is emergency rescue equipment required? | |
| Is there documentation of the minimum daily excavation inspection? | |

TU may gather the information needed through worksite studies, observations, test borings for soil type or conditions, and consultations with local officials and utility companies. This information will help determine the amount, kind, and cost of safety equipment they will need to perform the work safely.

# Appendix F: Individual Trenching & Shoring Plan Elements

A trenching and shoring plan will typically include the following: excavation site layout, soil classification, appropriate protection method and specific protection system components, installation procedures, inspection procedures, emergency equipment and procedures, safety equipment, protective gear, and tools used. In this, all engineering controls, administrative controls, and personal protective equipment will be accounted for and will be based on specific site conditions. Always consult a qualified professional engineer to design a site-specific trenching and shoring plan.

The key elements of a trenching and shoring plan are as follows:

**Project Information**

- Project name, location, date, site contact details (Facilities Management-Work Control, Designated Supervisor, Utility Company)

**Site Assessment**

- Soil classification, groundwater level, land/water features and geological conditions, existing utilities and structures, weather, other hazard sources

**Excavation Details**

- Trench dimensions (width, depth); trench layout; access points (ladders, stairs)

**Protective System Selection**

- Sloping requirements based on soil type; benching design (if applicable); shoring system details such as type of shoring (hydraulic, timber, etc.); component specifications (size, capacity of struts, wales, posts); installation procedures

**Emergency and Safety Information:**

- Designated competent person responsible for trench safety, daily inspections before work begins, warning signage and barricades, emergency response plan, and personal protective equipment (PPE) requirements

Other Considerations:

**Weather Conditions:**

- Monitor weather conditions and take necessary precautions for potential water infiltration

**Inspections:**

- Regularly inspect the shoring system for stability and damage prior to worker entry; inspect after heavy rains or storms, and damage to the trench