

**GEORGIA INSTITUTE OF TECHNOLOGY**  
**ENVIRONMENTAL HEALTH AND SAFETY**  
**EXCAVATION AND TRENCHING PROCEDURE**

**PURPOSE**

The purpose of this procedure is to specify practices and guidelines for the safety of GEORGIA TECH employees while performing excavation and trenching.

**SCOPE**

This procedure applies to all GEORGIA TECH employees that perform any duties relating to open excavations made in the earth's surface, including trenches.

**DEFINITIONS**

**Excavation**

Any man-made cut, cavity, trench, or depression, in the earth's surface that is formed by the earth's removal.

**Trench**

A narrow underground excavation made below the surface of the ground. Trenches depth is larger than its width.

**Trench Box**

A trench box consists of two large plates, usually made of steel, which are parallel to the walls of the trench, and horizontal cross-members which hold the two plates apart. The lower edge of the box rests on the bottom of the trench, and the top edge extends above the top of the trench. The workers stay between the plates of the trench box, so that if the wall of the trench collapses, the dirt will be stopped by the trench box.

**Saturation**

Saturation refers to how much water is in the void between the grains. When voids fill with water, soil is saturated. When void fill with air, the soil is oven dry.

**Cohesion or Stability**

This refers to how well the grains hold together. It predicts how well the trench wall will hold together and whether or not trench protection is required.

**Unconfined Compressive Strength**

This refers to how soil reacts under pressure, as measured by the amount of weight per square foot required to collapse a sample.

**PROTECTIVE SYSTEMS**

Trench protection is required in any excavation 5 feet or more deep.

Once soil is classified, the right protective system is chosen. This choice is based on both soil classification and site restriction. There are two main types of systems:

- Sloping or benching

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- Shoring or Shielding

**Sloping or benching** is protective measures that cut the walls of an excavation back at an angle to its floor. (Sloped System has angled cuts; Bench System has one or more steps carved into the soil).

Danger Signs At Sloped or Benched Excavation Sites

Factors like weather, traffic vibrations and pressure from nearby loads, make the soil less stable. Excavation (sloped/benched) must be re-inspected for signs of distress after any disturbance. Evacuation may be required in the event of any of the following observed signs:

- Cracking excavation walls
- Bulging of material from trench sides
- Separation of small clumps from trench sides

**Shoring and shielding**

This is two protective measures that add support structure to an existing excavation (with or without sloped or benched soil). Installation and removal of the support system is safest when done from outside the trench.

Shoring

- System designed to prevent cave-ins by supporting walls with vertical shores called uprights or sheeting.
- Wales are horizontal members along the sides of a shoring structure.
- Cross braces are supports placed horizontally between trench walls.

Shielding

- System designed to give employees a safe work area by protecting them from collapsing material.
- Shields used in trenched are trench boxes or trench shields. They can be pre-manufactured or job-built under the specification of a registered professional engineer.
- Shields are usually portable steel structures placed in the trench by heavy equipment.
- For deep excavations, trench boxes are stacked and attached to each other with stacking lugs.

**CLASSIFYING SOIL**

- Soil testing may indicate the need for protection in excavation less than 5 feet deep.
- Soil classification must be tested by a competent person.
- Soil that has not been disturbed is kept in place by horizontal and vertical forces. In a trench or excavation, soil will naturally move downward and inward, causing a potential life threatening situation for any worker.

The competent person must have the following:

- Enough training to identify soil types and other exaction hazards
- Authority to take prompt corrective action.

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**Soil Types**

Soil Type A – Most stable: clay, silty clay, and hardpan (resist penetration)

Soil Type B – Medium stability: silt, sand loam, medium clay and unstable dry rock

Soil Type C – Least stable: gravel, loamy sand, soft clay, submerged soil or dense, heavy unstable rock

Stable Rock – Excavating makes this soil unstable.

**Grain Size**

Four (4) grain sizes:

- Gravel
- Sand
- Silt
- Clay

The bigger the grains, the less stable the soil.

**TESTING SOIL**

To classify soil, a competent person must conduct both visual and manual tests.

Visual Testing

- Look at the soil particle size and type, if the soil clump during digging, it could be clay or silt.
- Cracks in walls can mean soil types B or C.
- Layered systems with adjacent hazardous areas, buildings, roads and vibrating machinery, may require a professional engineer for classification.
- Standing water or water seeping through trench walls automatically means soil Type C.

Manual Testing

- Sedimentation Test – determines how much silt and clay are in sandy soil. Saturated sandy soil is placed in a straight-sided jar with about five inches of water. After the sample is thoroughly mixed and allowed to settle, the percentage of sand is visible. Note: A sample with 80 percent sand will be classified Type C.
- Wet Shaking Test – This test is to determine the amount of sand versus clay and silt in a soil sample. Shake a saturated sample to gauge soil permeability based on the following facts:
  - Shaken clay resists water movement through it
  - Water flows freely through sand and less freely through silt.

- Thread Test

Determines cohesion. A representative soil sample is rolled between the palms of the hands to 1/8" diameter and several inches in length. Place the rolled piece on a flat surface, then try to pick it up. If the sample holds together for two inches, it is considered cohesive.

- Ribbon Test

Determines cohesion and is used as a backup for the Thread Test. A soil sample is rolled out to a 3/4" diameter, and several inches in length. The sample is then squeezed between thumb and forefinger into a flat unbroken ribbon 1/8" to 1/4" thick, which is allowed to fall freely over the

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fingers. If the ribbon does not break off before several inches are squeezed out, the soil is considered cohesive.

#### **SAFETY PRECAUTION AT SHORED/SHIELDED EXCAVATION SITES**

- No one is allowed in the trench box while it is being raised or lowered into place.
- Using steel sheeting to extend the height of a trench box is unsafe because it over-stresses the box.
- Shielding or shoring used with a sloped trench must extend at least 18" above the bottom of the sloped part of the excavation.
- Individual shores are installed and released slowly to prevent failure of the remaining protection.
- Tabulated data on shores and shields provided by the manufacturer of a professional engineer must be followed regardless of soil classification. Note: Deviations must be approved in writing by the manufacturer.
- Excavation must be back-filled immediately after support systems are removed.

#### Dangers of trenching and excavation operations

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

#### **GENERAL SAFETY IN EXCAVATION**

- Trenches over 4 feet deep must have a safe exit such as a ramp or ladder within 25 feet of every worker.
- Underground utilities must be located and marked.
- Excavation material and other objects must be kept at least 2 feet from a trench opening.
- No one works on the sides of sloped or benched excavation above other employees unless the lower worker is protected from falling material.
- No one is allowed under loads handled by lifting or digging equipment.
- Station a "Top Person" outside the trench to detect moving ground and warn workers to leave a trench.
- Only the operator is allowed near a vehicle being loaded or unloaded.
- Barricade tape may draw attention to a work zone, but will not protect people or vehicles.
- Hard hats are required in every work zone, and vests are required when working in a street area.
- Any excavating under the base or footing of a foundation or wall requires a support system designed by a registered professional engineer.
- Soil can weigh 100-145 pounds per cubic foot. With the suction effect, pulling out one buried workers foot can take 750 pounds of force.