

**The Occupational Safety and Health Administration (OSHA) categorizes soil and rock deposits into four classes: Stable Rock, Type A Soils, Type B Soils, and Type C Soils.**

**1. STABLE ROCK** is considered the “mother” of all soil. It’s a natural, solid mineral matter which isn’t fissured or loose. It can be excavated with vertical sides and remain intact while exposed. This is the most infrequently used classification. Thus, typically no protective systems are required for trenches in stable rock.

**2. TYPE A SOILS** are cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. They often contain high amounts of clay as in cohesive soils: silty clay, sandy clay, or clay loam. No soil is Type A if:

- It’s fissured.
- It’s subject to vibration of any type.
- It has previously been disturbed.
- It’s 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.
- It has seeping water.
- It’s deemed unstable by a **competent person**.

**3. TYPE B SOILS** are cohesive soils with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. These soil mixtures have less clay and more sand and/or loam. This includes:

- 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.
- 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).



**Spoil Pile - Type B Soil**

**4. TYPE C SOILS** are cohesive soils with an unconfined compressive strength of 0.5 tsf or less and therefore, require the highest degree of protective measures. Type C soils tend to be saturated and/or submerged. Type C soils include:

- Granular soils such as gravel, sand, and loamy sand
- Submerged soil
- Soil from which water is freely seeping
- Submerged unstable rock
- Material in a sloped, layered system where the layers dip into the excavation or have a slope of four horizontal to one vertical (4H:1V) or greater.



**Layered soil - Type A over Type C**

## Test Equipment and Methods for Evaluating Soil Type

OSHA requires the **competent person** be responsible for visually and manually testing the soil. Soil testing of at least one sample is required. The sample may be taken from the trench face or fresh clumps in the soil pile. ***No entry into the trench is allowed until proper safety procedures and devices are in place.*** Many kinds of equipment and methods are used to determine the type of soil prevalent in an area, as described below.

**1. Pocket Penetrometer:** Penetrometers are direct-reading 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 tons per square foot (tsf). However, penetrometers have error rates in the range of  $\pm 20$ -40 percent.



**2. Shearvane (Tovane):** 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 two to provide results in tons per square foot (tsf).

**3. 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's probably Type B soil, and if the thumb penetrates the full length of the thumb, it's Type C soil. The thumb test is subjective and therefore is the least accurate of the three methods.

**4. 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 don't break into smaller clumps (and the soil can be broken only with difficulty), the soil is considered un-fissured unless there's visual indication of fissuring.

**5. 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 one-eighth inch (3 mm) in diameter by two inches (50 mm) in length. Then, the soil sample is held by one end. If the sample doesn't break or tear, the soil is considered cohesive.



**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, soil forming the sides of the trench, and the soil being excavated. If the soil remains in clumps, it's cohesive; if it appears to be coarse-grained sand or gravel, it's considered granular. The **competent person** should also check for any signs of vibration such as cracks or fissures.

During a visual test, the **competent person** 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.
- Observe the open side of the excavation for indications of layered geologic structuring.
- Watch 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.
- Evaluate the area adjacent to the excavation and the area within the excavation for signs of vibration that may affect the stability of the excavation face.

After completing these manual and visual tests, the **competent person** should be able to accurately determine the soil type. Once the type of soil is known, the protective systems can be determined and designed.