## WHAT YOU NEED TO KNOW

*1. The four soil classifications and their general properties .*
*2. How to identify structural hazards by being aware of soil mechanics.*

# Soil Classification

For the purpose of excavation planning and safety, soil is classified as one of the following:

- Stable Rock (strongest)
- Type A
- Type B
- Type C (weakest)

To assure maximum safety, many contractors plan trenching operations under the assumption that all soil is type C.

# Classification Criteria

**Unconfined compressive strength -** A soil's type is determined by its unconfined compressive strength, or the load per unit area that would cause the compressed soil to collapse.

**Angle of repose:**

- A soil's maximum angle of repose is the steepest angle at which it remains stable.
- The maximum angle of repose will vary depending on the soil classifications being excavated.
- No trench slope should exceed a soil's maximum angle of repose.

**Stable Rock** - Rather than granular materials and clay, this soil classification is comprised of solid rock, making it the strongest. Maximum safe angle of repose: 90° (0:1, meaning 0 horizontal to 1 vertical). Stable rock deposits are usually referred to by their primary mineral, e.g. granite or sandstone. In stable rock, excavation walls can be vertical and unsupported. It is sometimes difficult to determine if a deposit is stable rock prior to excavating. Surface cracks may be an indication that the soil is not stable rock.

**Type A** - Type A soil has high cohesion and plasticity. Unconfined compressive strength: 1.5 tons per square foot (tsf) or greater. Maximum safe angle of repose: 53° (3/4:1). Examples of type A soil include; clay, silty clay, sandy clay and clay loam. Soil cannot be classified as type A if it is fissure, seeping water, or was previously disturbed.

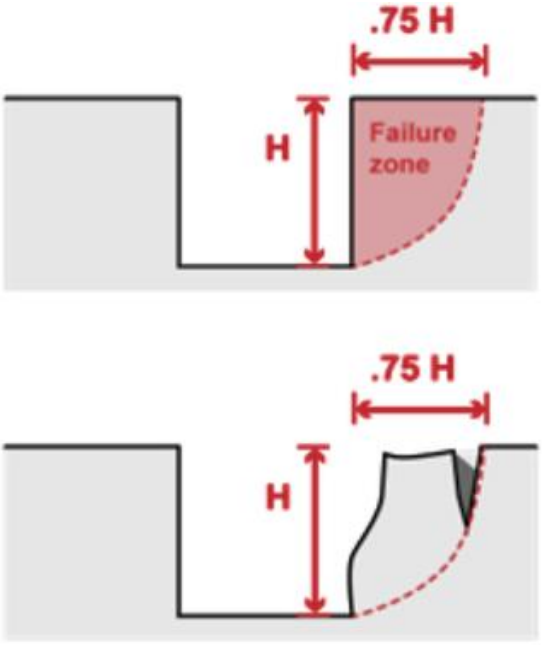
**Type B** – It is granular and lacks cohesion. Unconfined compressive strength: Between 0.5 and 1.5 tsf. Maximum safe angle of repose: 45° (1:1). Examples include; angular gravel, silt, silt loam, and sandy loam. Silty clay loam and sandy clay loam can be either Type A or Type B.

**Type C** – It is the least cohesive soil type. Unconfined compressive strength: 0.5 tsf or less. Maximum safe angle of repose: 34° (1-1/2:1). Examples include gravel, sand, loamy sand, submerged soil, soil from which water is freely seeping, and submerged unstable rock.

**Understanding Soil Mechanics -** Excavation walls can withstand a certain amount of stress or deformation that affect their stability (e.g., moisture content or surface pressure) before they will collapse. For this reason, it is essential to minimize stress within the failure zone.

**Failure zone:** The failure zone is a distance around the trench which is 0.5 – 0.75 of the trench's depth. Signs of soil stress, such as tension cracks, found in this area indicate a risk of cave-in.

**Tension cracks:** Tension cracks run parallel to the trench. If found in the failure zone, chances of a cave-in significantly increase.




## Danger Signs of Soil Mechanics

- Sliding, or sloughing, can occur when the soil is weakened by tension cracks.
- Toppling is another potential consequence of tension cracks. The trench's wall splits along the tension crack line and falls into the trench.
- Insufficiently supported excavations can lead to uneven stress in the soil. Subsidence, or sinking, in the surface and bulges in the trench's walls may result.
- Bottom heaving or squeezing occurs when downward pressure from the weight of the adjacent soil causes a bulge in the bottom of the trench. These conditions can be dangerous if your trench is not properly shored.
- Boiling refers to water flowing up into the bottom of the trench, usually due to a high-water table. Boiling can create quick conditions in the trench.

**Both heaving and boiling can occur even with appropriate protective systems in place.*

Topic:
Soil Classification

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TOOLBOX TALK
Safety Briefing

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