An **excavation** is defined as any man-made cut, cavity, trench, or depression in the earth’s surface formed by earth removal.

**Trenches** are narrow, underground excavations that are deeper than they are wide and are no wider than 15 ft.
Excavation is one of the most hazardous activities you can do on the job. Excavation hazards include:
- Underground utilities
- Cave-ins
- Hazardous atmospheres
- Water accumulation
Underground utilities, such as pipelines and electrical cables, are a potential hazard during excavations.

Before any excavation can begin, you must call 811. Utility operators will mark underground utilities to verify their location before you begin to excavate the worksite to prevent accidental damage.
Many excavation fatalities are because of cave-ins.

Cave-ins pose the greatest risk and are much more likely to result in worker fatalities than other excavation-related accidents.
Workers die when they cannot breathe because the weight of collapsed materials prevents their chest from expanding.

Chest constriction prevents your body from taking in oxygen and releasing carbon dioxide.
Other possible *injuries* caused by cave-ins include:
- Fractures
- Broken or shattered bones
- Trauma
- Internal injuries
<table>
<thead>
<tr>
<th>Excavation depth</th>
<th>Protection required by the Occupational Safety and Health Administration (OSHA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ft. or less</td>
<td>Must have a competent person determine if protective systems are required</td>
</tr>
<tr>
<td>5 ft. or greater</td>
<td>Must have cave-in prevention unless:</td>
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<tr>
<td></td>
<td>• The excavation is made entirely in stable rock</td>
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<tr>
<td></td>
<td>• A competent person provides no indication of a potential cave-in</td>
</tr>
<tr>
<td>20 ft. or greater</td>
<td>Require protective systems designed or approved by a registered professional engineer</td>
</tr>
</tbody>
</table>
Methods developed to prevent cave-ins include:
- Shielding and shoring
- Sloping and benching
Shielding and shoring use mechanical structures to support the sides of an excavation.

Sloping and benching rely on angling the sides of an excavation so the walls can safely support themselves.
When sloping and benching are used, the angle of the excavation is determined by the type of soil being excavated.

During excavation and trenching activities, it is important to know the type of soil you are working with.
OSHA divides soil into **four categories**:

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Description</th>
<th>Maximum Allowable Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable Rock</td>
<td>Solid mineral material</td>
<td>90°</td>
</tr>
<tr>
<td>Type A</td>
<td>Clay, sandy clay, and clay loam</td>
<td>53°</td>
</tr>
<tr>
<td>Type B</td>
<td>Angular gravel, silt, sandy loam, and disturbed soil</td>
<td>45°</td>
</tr>
<tr>
<td>Type C</td>
<td>Gravel, sand, loamy sand, and soil freely seeping water</td>
<td>34°</td>
</tr>
</tbody>
</table>
For safety purposes, assume that soil is *Type C* unless a competent person tells you otherwise.

Always handle *unknown* soil in the safest possible way.
Soil may be saturated, or drenched, with hazardous liquids. **Hazardous gases** or vapors from outside the excavation that are heavier than air may enter and settle in the excavation.

Excavations with hazardous atmospheres may require similar precautions to those used in **confined spaces**.
When oxygen deficiency or a hazardous atmosphere exists or could exist in an excavation greater that 4 ft. in depth, the atmosphere must be tested before workers enter.

Oxygen deficient atmospheres are atmospheres that contain less than 19.5% oxygen.
If flammable gases are greater than 20% of the lower explosive limit (LEL), then your exposure must be prevented and the excavation must be ventilated and retested before entry.

Check your company policy because it may be stricter.
When controls are used to reduce the level of atmospheric contaminants to acceptable levels, testing must be conducted as often as necessary to make sure the atmosphere remains safe.

Always take precautionary measures and make sure adequate ventilation and appropriate respiratory equipment is used.
Take precautions to prevent water from collecting in an excavation. This is done by designing:

- Diversion ditches
- Dikes
- Pumps
- Other ways to stop water from building up within an excavation
OSHA says a competent person must inspect excavations, nearby areas, and protective systems every day or if conditions change. Inspections must also be done after every rainstorm.

The inspection should be done before work begins and as needed throughout a shift.
Personal protective equipment (PPE) that may be required depending on the type of work includes:

- Hard hats
- Protective footwear
- Gloves
- Safety glasses with sideshields
- Hearing protection
- Fall protection
Workers in an excavation near a roadway must be provided with and wear high-visibility vests or other PPE so drivers can see them.

When working in deep or confined footing excavations, you must wear a full body harness with a securely attached lifeline.
Excavations have many potential hazards for workers. Using proper procedures when conducting excavation work can help keep you safe.

Always follow your company policies when working in or around excavations and trenches.
Safety Meeting Quiz: Excavation and Trenching

Sign and date this quiz sheet. Circle the letter representing the correct answer to each quiz question below.

1. ______________ are defined as any man-made cut, cavity, trench, or depression in the earth’s surface formed by debris removal.
   A. Excavations
   B. Confined spaces
   C. Walking working surfaces
   D. Atmospheric hazards

2. Trenches are narrow, underground excavations that are deeper than they are wide and are no wider than ______________.
   A. 15 ft.
   B. 20 ft.
   C. 25 ft.
   D. 30 ft.

3. Before an excavation can begin, you must call ____________.
   A. 411
   B. 611
   C. 811
   D. 911

4. Excavations with a depth of ______________ must have a competent person determine if protective systems are required.
   A. 5 ft. or less
   B. 5 ft. or greater
   C. 10 ft. or greater
   D. 20 ft. or greater

5. ______________ use mechanical structures to support the sides of an excavation.
   A. Sloping and benching
   B. Shielding and shoring
   C. Locking and tagging out
   D. Sorting and grading

6. ______________ rely on angling the sides of an excavation so the walls can safely support themselves.
   A. Shielding and shoring
   B. Locking and tagging out
   C. Sloping and benching
   D. Sorting and grading

7. For safety purposes, assume that soil is ______________ unless a competent person tells you otherwise.
   A. Type A
   B. Type B
   C. Type C
   D. Type D

8. Excavations with hazardous atmospheres may require similar precautions to those used ______________.
   A. When operating a forklift
   B. On walking working surfaces
   C. During a group lockout
   D. In confined spaces

9. Oxygen deficient atmospheres are atmospheres that contain less than ______________ oxygen.
   A. 19.5%
   B. 20.5%
   C. 21.5%
   D. 22.5%

10. OSHA says a competent person must inspect excavations, nearby areas, and protective systems ______________.
    A. Before the excavation is started
    B. Every day or if conditions change
    C. After the workshift ends
    D. Once a month
Instructors: The following key shows the answers for the Excavation and Trenching safety meeting quiz.

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<table>
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<tbody>
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<td>8.</td>
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<td>9.</td>
<td>A</td>
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<td>10.</td>
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