OSHA Subpart P
Trenching and Excavation
Behold, the trench. Defined as No Wider Than 15 feet.

Otherwise, it is an excavation.
Trench Cave-Ins

• A Major Killer in Construction
• At least 50 fatalities per year, probably closer to 100
• The leader in prosecutions of contractors for criminally negligent homicides and involuntary manslaughter.
• Significant OSHA fines associated with trench cave-ins
  Average Fine = $5,124?? $25,000
Figure 3. Frequency of accidents at different trench depths
Competent Person

- Must be able to identify hazards (the potential for a cave-in)
- Must have the authority to take appropriate corrective actions
Responsibilities of the Competent Person

- Recognizes confined space hazards
- Specifies any safety controls needed
- Oversees all tasks being performed
- Removes any workers not protected
- Remains present during excavation
- Observes protection being installed
- Remains present when workers in trench
Duties of Competent Person

• Pre-inspects site and develop safety plan
• Designs access for employees & equipment
• Determines soil conditions
• Selects protection system
• Monitors environmental conditions
• Communicates and inspects for worker safety
Be Vigilant with Inspections

• Prior to beginning work each day
• During work - as needed
• After a rainstorm or other natural change
• When conditions exist that might contribute to trench cave-ins
Confined Space Concerns

A means of egress shall be provided so the horizontal distance does not exceed 25 feet.

The atmosphere is oxygen deficient when the air contains less than 19.5% oxygen.
No protection is needed in a trench when

1. Material is solid rock

2. Trench is less than 5 feet deep
   and
   a competent person determines that there is no indication of a potential cave-in.
Things to Consider

- Surface Encumbrances
- Underground Installations
- Access and egress
- Hazardous atmospheres
- Water accumulation
- Stability of adjacent structures
- Fall protection
- Protection from falling objects
- Inspections
Factors That Make Trench Walls Unstable

- Water
- Surcharge Loads and Other Loads
- Vibrations
- Previously Disturbed (Existing Utilities)
- Clay Seams
- Frozen Soil
- Lack of Soil Support
- Excavations under Structures
What is the weight of soil?

It will vary with the type of material and the amount of water being contained, but it is in the general vicinity of about 100 pounds per cubic foot.

Most soils are 2,000 to 3,000 pounds per cubic yard

1 Cubic Yard ~
Section 15
1926 Subparts P

Cleveland State University
Work Zone Safety and Efficiency Transportation Center

Conditions that Contribute to Cave-Ins

- Clay
- Seam

2 ft Minimum

Clay Seam
Signs of Potential Trench Wall Collapse

- Layered Soil
- Spalling
- Tension cracks

Existing Utility
1926.652(b) Design of Sloping and Benching System

(b)(1) *Option (1)* – Allowable configuration and slopes. Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(b)(2) *Option (2)* – Determination of slopes and configurations using Appendices A and B.

(b)(3) *Option (3)* – Designs using other tabulated data. Designs of sloping or benching systems shall be selected from and be in accordance with the tabulated data, such as tables and charts.
Means of Protection in Trenches

1. Sloping the trench walls
2. Trench Boxes
3. Shoring System
Adequate Slope?
"Type A" means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or
(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
(iii) The soil has been previously disturbed; or
(iv) The soil is 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; or
(v) The material is subject to other factors that would require it to be classified as a less stable material.
Reclassification of Soil

- Recognize that soil types can change quickly.
- Evaluate soil conditions periodically
- If soil appears to be different, evaluate it
- Reclassify the soil if appropriate
Figure B-1.1 Excavations made in Type A soil

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of $\frac{3}{4}:1$. 

SIMPLE SLOPE -- GENERAL
Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of $\frac{1}{2}:1$.

SIMPLE SLOPE -- SHORT TERM
2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 3/4 to 1 and maximum bench dimensions as follows:

SIMPLE BENCH

MULTIPLE BENCH
3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.

UNSUPPORTED VERTICALLY SIDED LOWER PORTION -- MAXIMUM 8 FEET IN DEPTH
All excavations more than 8 feet but not more than 12 feet in depth with unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet.

UNSUPPORTED VERTICALLY SIDED LOWER PORTION -- MAXIMUM 12 FEET IN DEPTH
All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of \( \frac{3}{4} : 1 \). The support or shield system must extend at least 18 inches above the top of the vertical side.
Type B Soil

"Type B" means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as a Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.
2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

**SINGLE BENCH**

- 20' Max
- 4' Max

**MULTIPLE BENCH**

- 20' Max
- 4' Max
3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.
Type C Soil

"Type C" means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
(ii) Granular soils including gravel, sand, and loamy sand; or
(iii) Submerged soil or soil from which water is freely seeping; or
(iv) Submerged rock that is not stable; or
(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.
B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of $1\frac{1}{2}:1$. 

SIMPLE SLOPE
2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.
Summary – Simple Slopes

Soil Type A - 3/4H:1V
Soil Type B - 1H:1V
Soil Type C - 1.5H:1V

20 ft maximum
B-1.4 Excavations Made in Layered Soils

1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.

Soil Type B OVER Soil Type A
Soil Type C OVER Soil Type A

Soil Type C OVER Soil Type B
Soil Type A OVER Soil Type B

Soil Type A OVER Soil Type C

Soil Type B OVER Soil Type C
When must a Professional Engineer be Consulted?

- Trenches over 20 feet deep
- Specially designed support systems
- When excavating near other structures
- Standard protection methods will not work
Workers exposed to vehicular traffic

Flaggers shall be provided and they shall wear warning vests or other garments made of reflectorized or high visibility material.
Figure 4. Trench Shields
Figure 1. Aluminum Hydraulic Shoring
Is the excavation more than 5 feet in depth?

Is there potential for cave-in?

Is the excavation entirely in stable rock?

Excavation may be made with vertical sides.

Excavation must be sloped, shored, or shielded.

Sloping selected.

Shoring or shielding selected.

Go to Figure 2

Go to Figure 3

FIGURE 1 - PRELIMINARY DECISIONS
Figure 1. Root Causes of Trench Shield (TS) Accidents
Figure 2. Types of accidents involving trench shields

- Cave-in: 62%
- Struck by: 29%
- Fall: 3%
- Electric shock: 3%
- Drowned: 1%
- Caught in-between: 1%
- Explosion: 1%
Figure 6. Frequency of trench accidents by age
Trench Box Available But Not Used!!!!
Workers Injured When a Trench Box was Available But Not Used - 9%

This is Stupid
Trench Box Too High Above the Trench Bottom
Workers Injured Because the Trench Box Was Set Too High Above the Trench Bottom - 7%

2 feet (max)
Trench Box Set Too Low!!!!
Workers Injured Because Trench Box Was Set Too Low - 13%
Venturing Out of the Protection of Trench Box
Workers Injured Venturing Out of the Protection of the Trench Box - 25%
Safe Inside the Trench Box?
Workers Struck by Excavator Bucket - 10%
Safe Inside the Trench Box?
Workers Struck by Materials Falling into Trench Box - 7%
Standing Too Close to the Trench Box?
Workers Injured by Standing Too Close to the Trench Box – 4%
**Trench Shoring**

- There is little evidence that shoring practices are inadequate.
- Some companies don’t shore when they should.
- Sometimes there is a lack of recognition of when shoring is needed and there is a problem.
The following three overheads are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with 1926.652(b) and (c).
There is little evidence that shoring practices are inadequate. Some companies don't shore when they should. Sometimes there is a lack of recognition of when shoring is needed and there is a problem.

**FIGURE 2 - SLOPING OPTIONS**

- Shoring or shielding selected as the method of protection.

Will soil classification be made in accordance with Sec. 1926.652(b)?

<table>
<thead>
<tr>
<th>YES</th>
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Excavation must comply with one of the following three options:

- Option 1:
  Sec. 1926.652(b)(3) which requires Appendices A and B to be followed

- Option 2:
  Sec. 1926.652(b)(3) which requires other tabulated data (see definition to be followed).

- Option 3:
  Sec. 1926.652(b)(4) which requires the excavation to be designed by a registered professional engineer.

Excavations must comply with Sec. 1926.652(b)(1) which requires a slope of 1 1/2 H:1V (34 deg.).

**FIGURE 3 - SHORING AND SHIELDING OPTIONS**

- Soil Classification is required when shoring or shielding is used. The excavation must comply with one of the following four options:

  - Option 1
    Sec. 1926.652(c)(1) which requires Appendices A and C to be followed (e.g. timber shoring).

  - Option 2
    Sec. 1926.652(c)(2) which requires manufacturers data to be followed (e.g. hydraulic shoring, trench jacks, air shores, shields).

  - Option 3
    Sec. 1926.652(c)(3) which requires tabulated data (see definition) to be followed (e.g. any system as per the tabulated data).

  - Option 4
    Sec. 1926.652(c)(4) which requires the excavation to be designed by a registered professional engineer (e.g. any designed system).