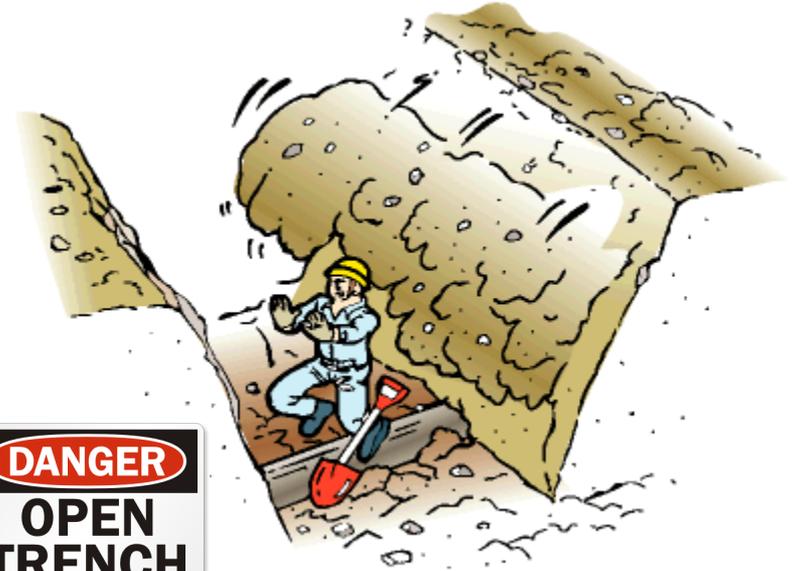


# Excavations



OSHA Construction Standard:  
1926 Subpart P  
1926.650 - 652 with Appendices A - F



# Definitions

Excavation – a man-made cut, cavity, trench, or depression formed by earth removal



Trench – a narrow excavation where the depth is greater than the width; bottom not wider than 15 feet

# Excavation Hazards

- **Cave-ins**
- **Asphyxiation from lack of oxygen**
- **Inhale toxic materials**
- **Fire**
- **Collapse caused by moving machinery near the excavation**
- **Accidentally cut underground utility lines**

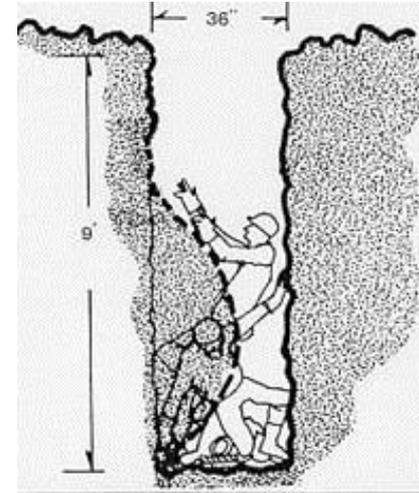


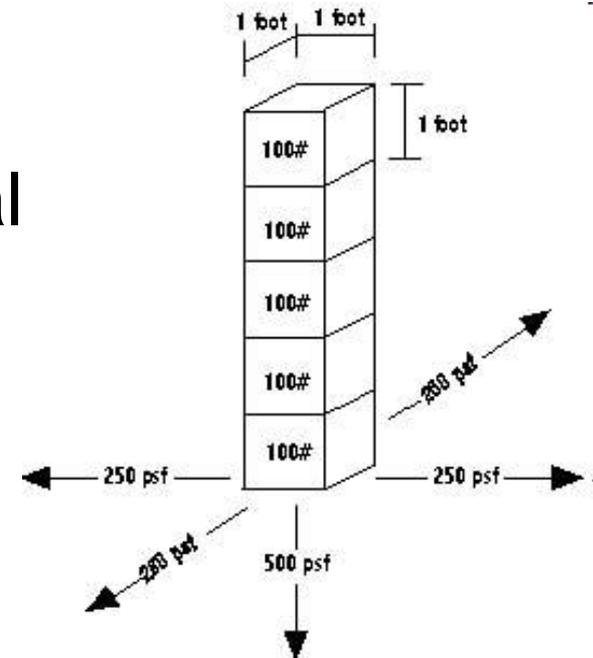
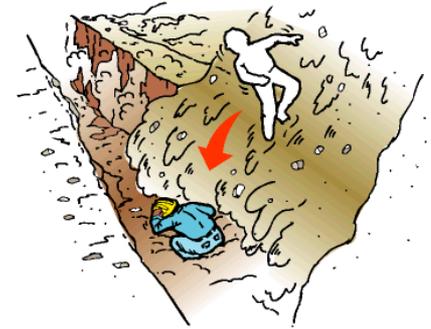
Photo courtesy of OSHA. This picture shows actual disaster site work conditions and may not illustrate proper safety and health procedures.

**Any Excavation is Dangerous**

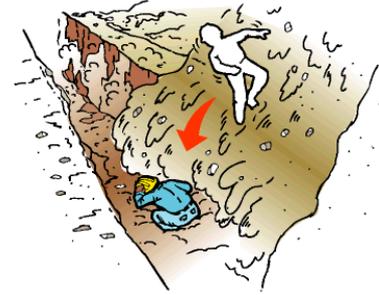
# Excavation Hazards

## Is It Really That **Dangerous**?

- Every trench will fail
- One cubic yard of soil  
= 500 pounds per square foot
- Even partial burial can be fatal
  - Crush / Blunt Force Trauma
  - Suffocation



# Excavation Hazards



Crane: Weight & Vibrations  
= Danger for Trench Collapse

No Sloping, Shoring or Shield  
= No Protection from Cave-In

No Ladder or Ramp  
= No Emergency Escape

Workers should not be in this trench

# Excavation Hazards

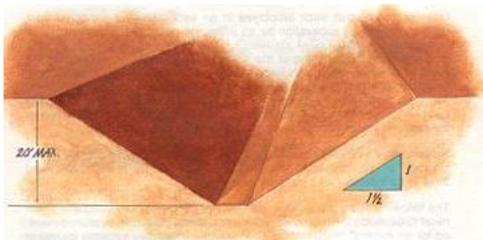
## Cave-In Protection

Shield / Shoring - a structure or box that supports the sides of an excavation

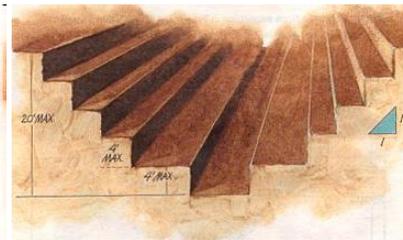
Sloping / Benching - angling the sides of an excavation according to factors such as soil type



Trench Box Shield



Sloping



Benching



Timber Shoring



Hydraulic Aluminum Shoring

See 29 CFR Subpart P  
App B: Sloping and Benching  
App C: Timber Shoring for Trenches  
App D: Aluminum Shoring for Trenches

# Excavation Hazards

## Cave-In Protection =

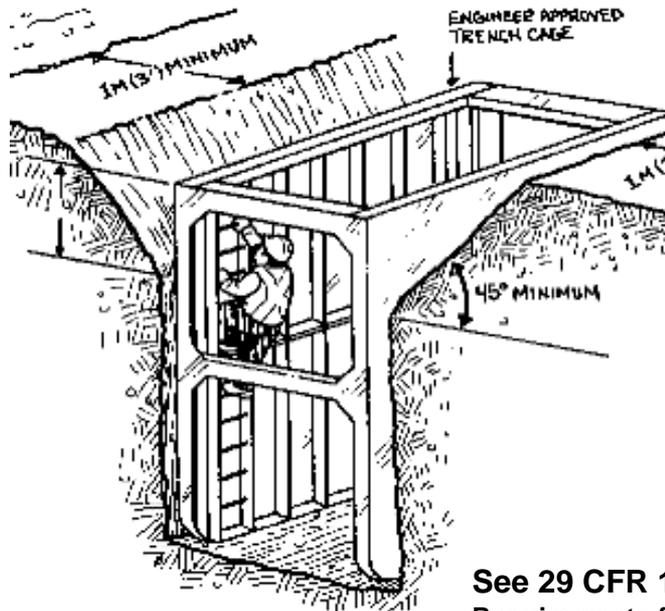
A well-designed protective system

+

correct installation / removal

+

Appropriate materials handling



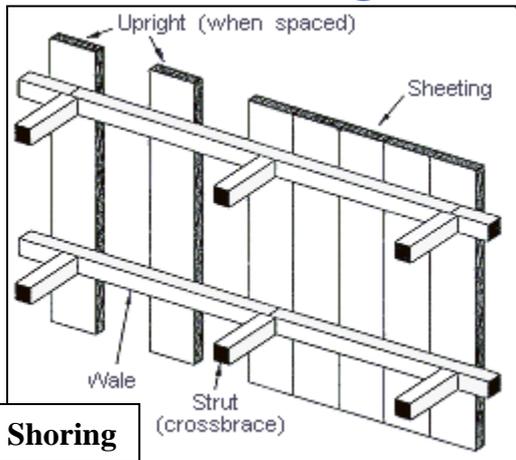
See 29 CFR 1926.652  
Requirements for Protective Systems



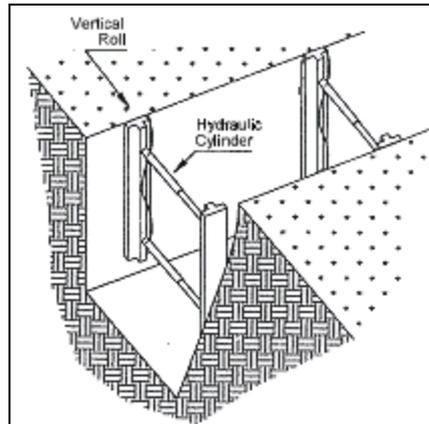
# Excavation Hazards

## Cave-In Protection

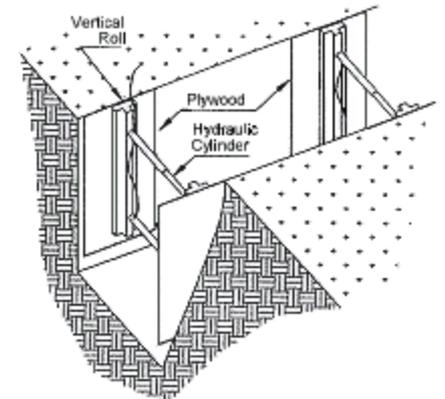
### Shoring



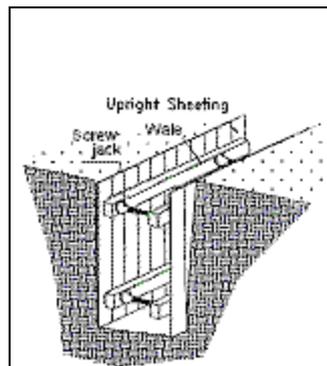
**Timber Shoring**



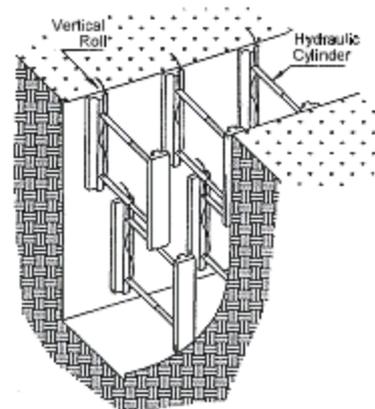
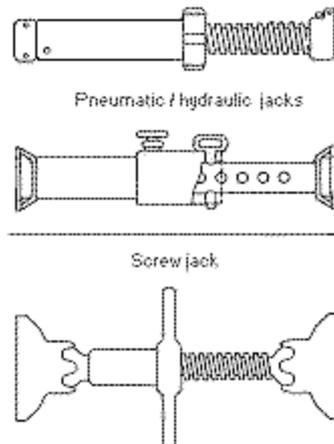
**Vertical Aluminum Hydraulic Shoring (Spot Bracing)**



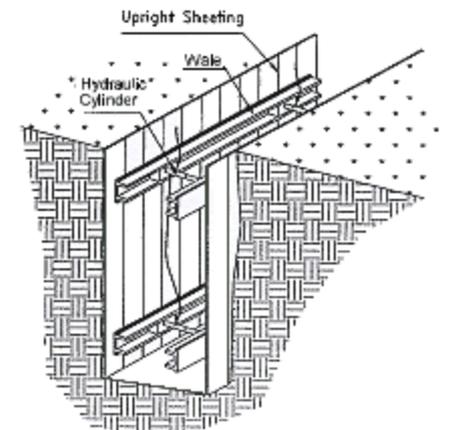
**Vertical Aluminum Hydraulic Shoring (With Plywood)**



**Pneumatic Shoring**



**Vertical Aluminum Hydraulic Shoring (Stacked)**

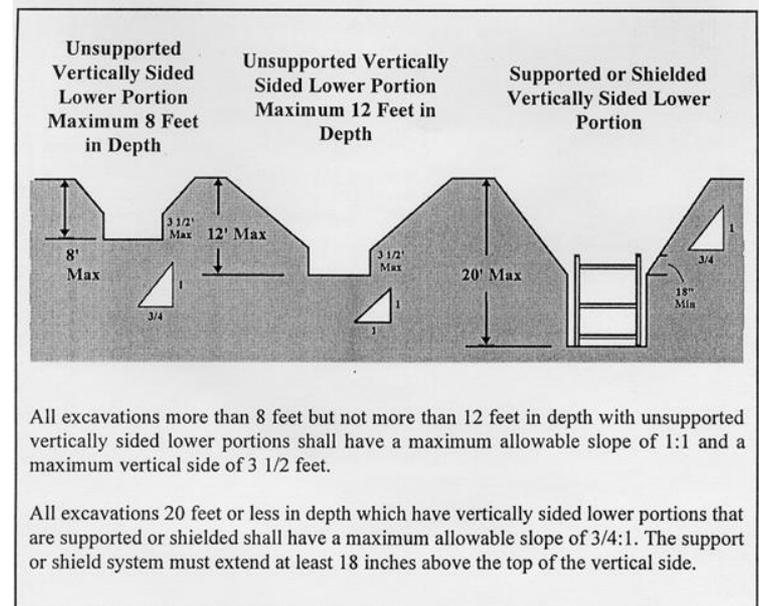
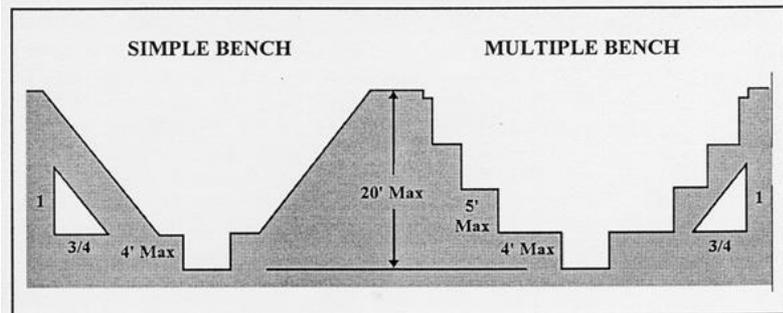
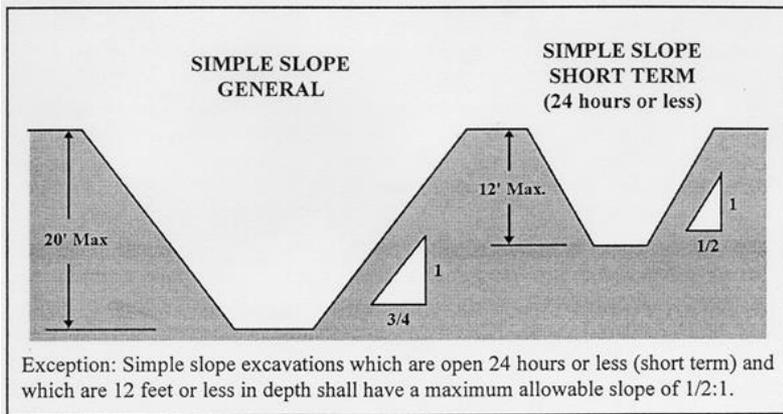


**Aluminum Hydraulic Shoring Waler System (Typical)**

# Excavation Hazards

## Cave-In Protection

### Sloping / Benching



Slope Angle & Depth Depends on Soil Type

# Excavation Hazards

## Factors In Designing a **Protective System**

- Soil classification
- Depth of cut
- Water content of soil
- Changes due to weather and climate
- Other operations in the vicinity



# Excavation Hazards

## Factors In Designing a Protective System

Equipment / Vehicle Operator Must Have Direct View of Excavation and/or:

- Barricades
- Hand/mechanical signals
- Stop logs
- Grade soil away

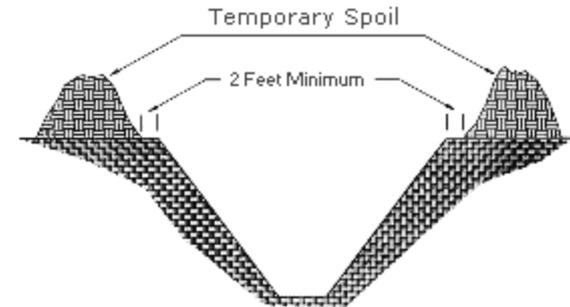


Trench collapsed when vehicle got too close to edge

# Excavation Hazards

## Spoil Piles

- Excavated materials placed more than 2 feet from excavation edge
- Grade spoil pile so rainwater runs away from the excavation



# Excavation Hazards



**WATER =**

- Unstable Soil / Cave-In
- Drowning Hazard
- Hampers Egress

Never work in a trench during a rainstorm

# Excavation Hazards



## Atmosphere

Treat an excavation more than 4 feet as a

## Confined Space

Test for:

- Oxygen deficiency
- Combustible gas
- Toxic & other hazardous substances

# Excavation Hazards

## Emergency Egress

4' or More Deep  
Requires:

Stairway, Ladder or  
Ramp

within 25' of Entrants

Top of straight  
ladder to be 3'  
above  
excavation



Improper use of step  
ladders; use straight  
ladder instead



# Excavation Hazards

## Falls, Falling Loads and Mobile Equipment

- Wear PPE – Hard Hat & Safety Footwear
- Use Barricades or Fencing & Signs to keep People / Vehicles away from Edge, especially Overnight
- Vehicles
  - Have Spotter use Hand / Mechanical Signals
  - Use a Flagger (when signs, signals, barricades are not enough protection)
- Stack supplies away from excavation

# Competent Person for Excavations

Has specific training in and is knowledgeable about:

- Soils classification
- Protective systems
- OSHA standard

Plans Excavation Work

Inspects Excavation Site

Identifies Hazards

Authorized to immediately eliminate hazards



# Competent Person Inspecting Excavations

Daily (Before Work Starts):

- Excavations
- Protective systems
- Surrounding Areas
  - Spoil Pile
  - Stored Equipment & Supplies
  - Vehicles
- Continuously Test for:
  - Low Oxygen
  - Hazardous Fumes
  - Toxic Gases



# Competent Person Inspecting Excavations

As Needed, such as After:

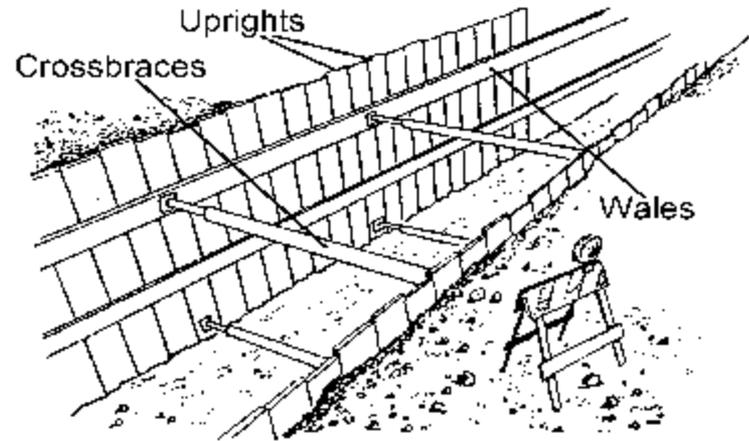
- Rainstorms
- High Winds
- Other occurrence which may increase hazards
- When exposure to hazards is reasonably expected



# Competent Person Inspecting Excavations

## Site Evaluation & Planning:

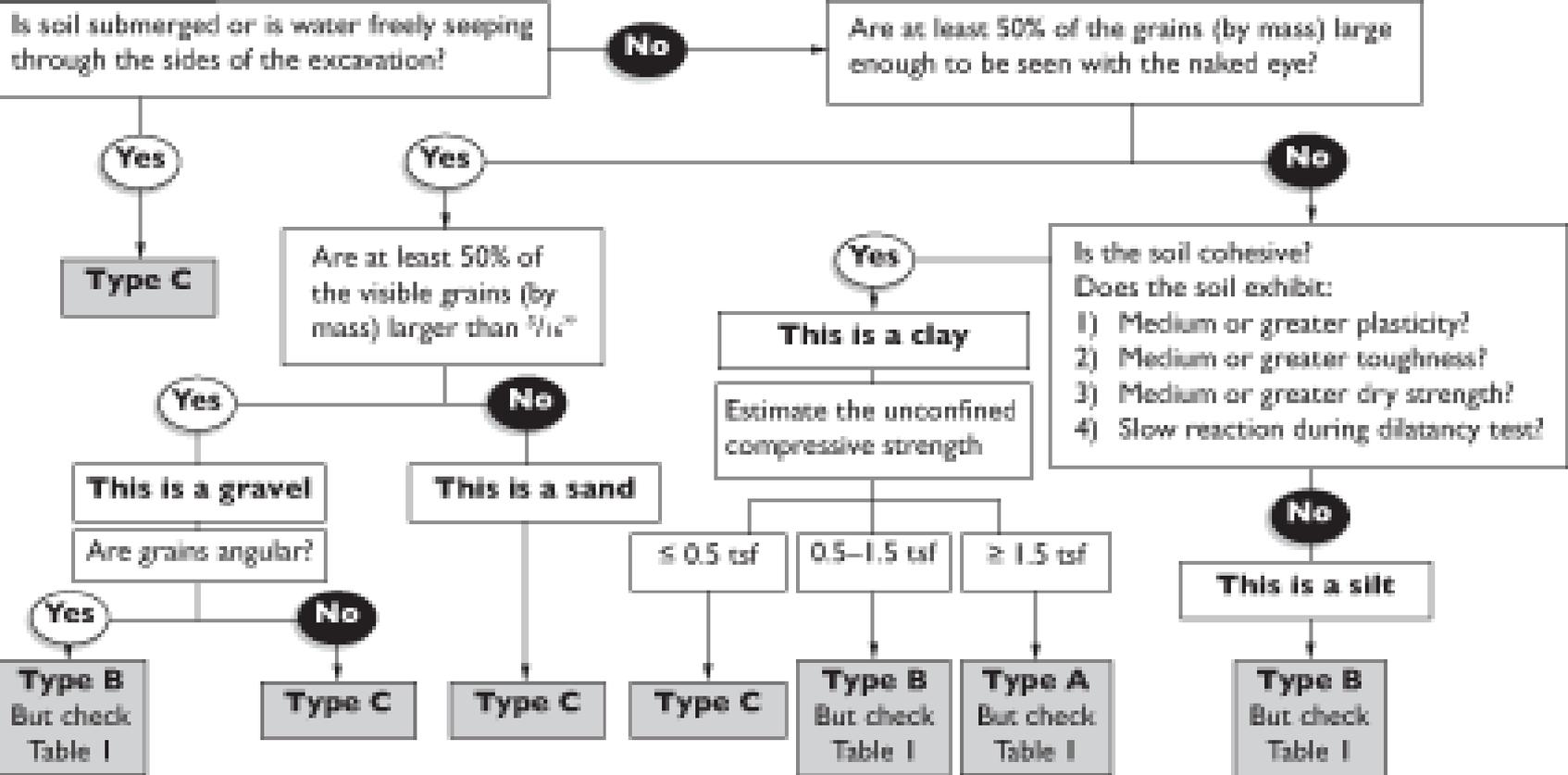
- Evaluate Soil Conditions
- Construct Protective Systems
- Provide Safe Access & Emergency Egress
- Locate Underground Utilities
- Determine Needed Safety Equipment



# Competent Person Inspecting Excavations

## Soil Classification

**Start here**



# Competent Person Inspecting Excavations

**Table I**

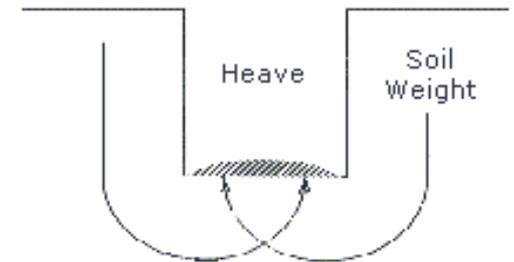
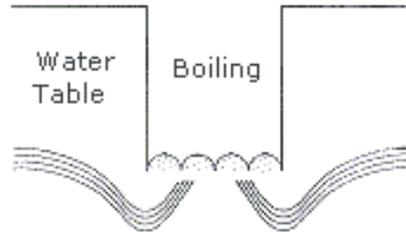
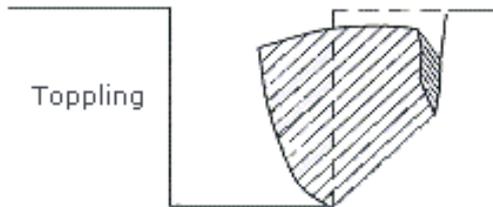
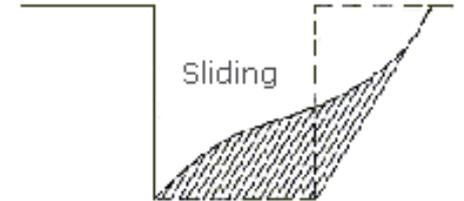
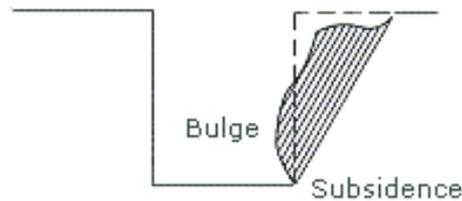
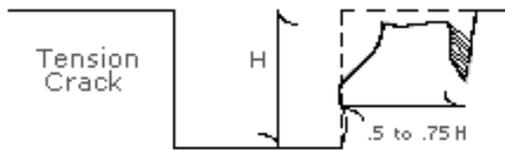
**Site Conditions That Affect Rock/Soil  
Slope Stability**

| Condition   | Requirement  |
|---|--|
| Soil is fractured/unstable dry rock.  | Downgrade to Type B.   |
| Soil is fractured/unstable submerged rock.  | Downgrade to Type C.   |
| Soil is cemented (caliche, hardpan, etc.).  | Classify as Type A.  |
| Soil is fissured.   | Downgrade from Type A to Type B.                                     |
| Soil is subject to vibration.   | Downgrade from Type A to Type B.                                     |
| Soil has been previously disturbed.   | Downgrade from Type A to Type B.                                     |
| Soil is submerged or water is freely seeping through the sides of the excavation.   | Downgrade from Type A to Type C.<br>Downgrade from Type B to Type C. |
| Soil profile is layered with the layers dipping into the excavation on a slope of four horizontal to one vertical or steeper. | Downgrade from Type A to Type C.<br>Downgrade from Type B to Type C. |

- Soil can destabilize quickly
- Stay alert for
  - Cracks, bulging or heaving
  - Sinking along the edges
  - Seeping or running water
  - Trickling gravel or pebbles

# Competent Person Inspecting Excavations

## Signs of Destabilized Soil



# Competent Person Inspecting Excavations

If the competent person finds:

- Evidence of a possible cave-in
- Indications of failed Protective Systems
- Hazardous Atmosphere
- Other hazardous conditions

Exposed employees:

- Must Evacuate the Excavation
- May not return until the necessary precautions have been taken

**Fissure**



# Summary

- **The greatest risk in an excavation is a cave-in**
- **Other excavation hazards include water accumulation, oxygen deficiency, toxic fumes, falls and mobile equipment**
- **Employees can be protected through sloping, shielding and/or shoring the excavation**
- **A Competent Person is responsible to inspect the excavation and keep workers safe**

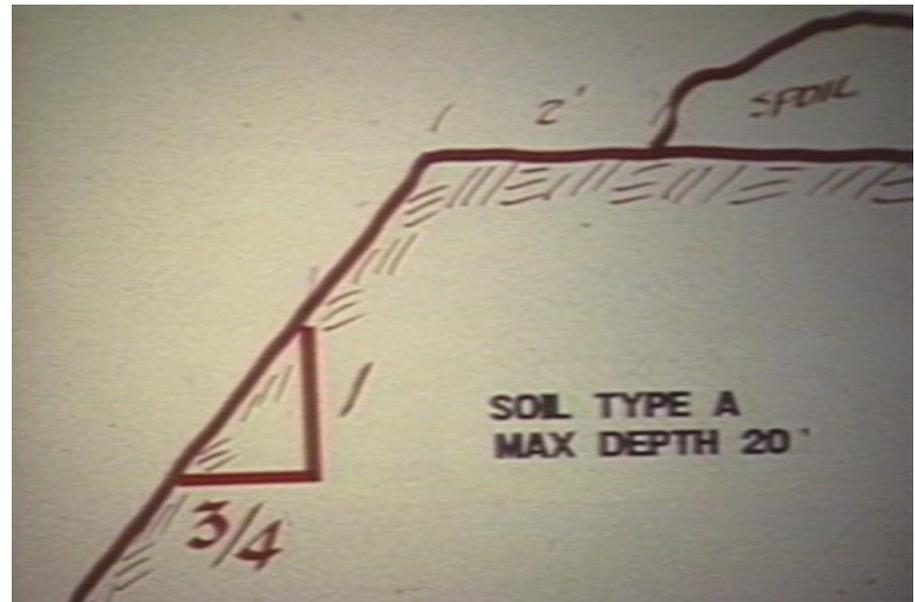
# Trenching Safety

# Hazardous Atmospheres

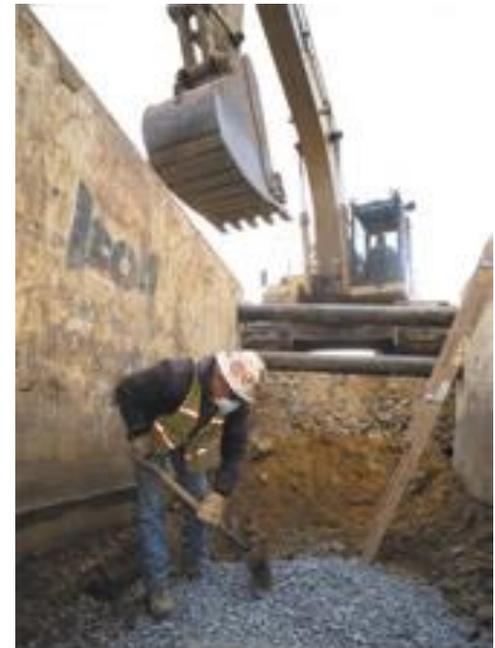
- The air inside an excavation may become hazardous in some cases
- Lack of oxygen can be fatal
- Report:
  - Shortness of breath or increased heart rate
  - Dizziness or nausea
  - Feeling faint
- Work with a buddy
- Protective gear may be required

# How to Protect Yourself: Sloping and Benching

- More than 4 feet, protective systems required
- Sloping
- Benching
- Type of soil determines angle
- Never work above other people



- Used when space is too limited for sloping or benching
- Used to prevent cave-ins
- Shoring consists of:
  - Uprights or sheeting
  - Wales
  - Crossbraces
- Can be made of wood or aluminum hydraulic
- Stay alert for signs of distress



OSHA's excavation standard requires employers to provide sloping, benching, shoring, or shielding to protect workers in excavations five feet or deeper.

# How to Protect Yourself: Shielding

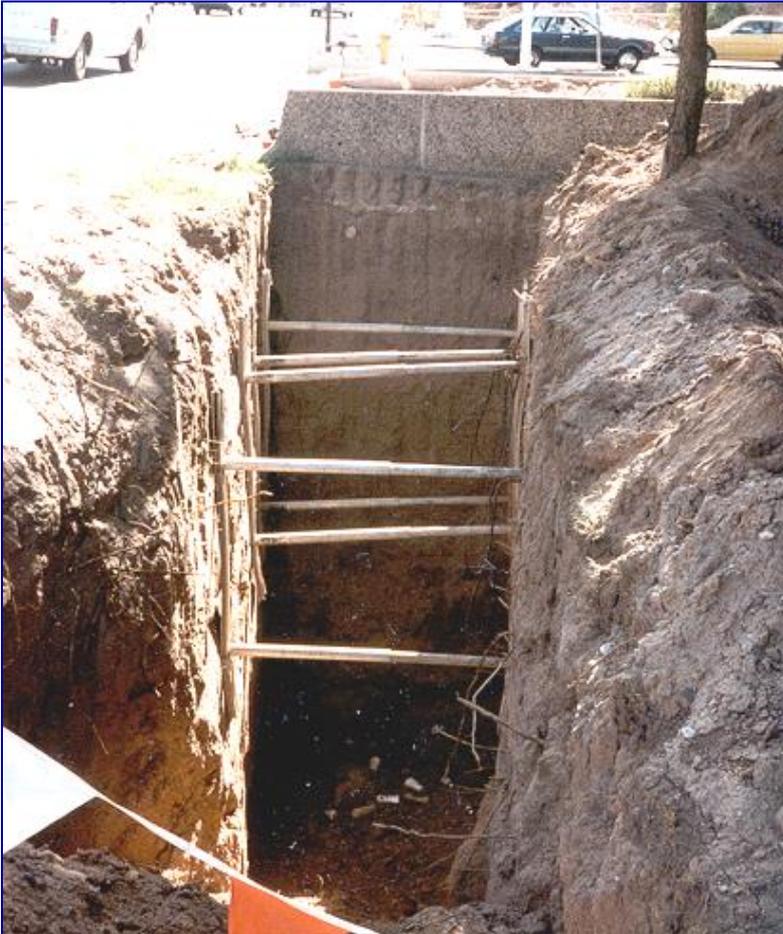
- Protects workers from cave-ins, but doesn't prevent them
- 18 inches above materials
- Don't extend with sheeting
- Fill in gaps
- Use care when stacking
- Evacuate before moving



# General Rules in the Work Zone

- Wear your hard hat
- Never stand or work under heavy loads
- Steer clear of vehicles loading or unloading
- Exit immediately if you're told to
- Stay clear of the edges of an excavation unless you're wearing fall protection

# Cave-in Hazard



**This excavation has inadequate support posts and egress access**

**Inadequate protective system**

# Inadequate Protective System

**This worker is in a trench with no protective system, that is not sloped or benched and has no means of egress**



# Shoring

- General
  - Provides a framework to work in
  - Uses wales, cross braces and uprights
  - Supports excavation walls
- OSHA tables provide shoring data
  - Must know soil type
  - Must know depth and width of excavation
  - Must be familiar with the OSHA Tables

# Trench Shield



A trench shield was built around this work area

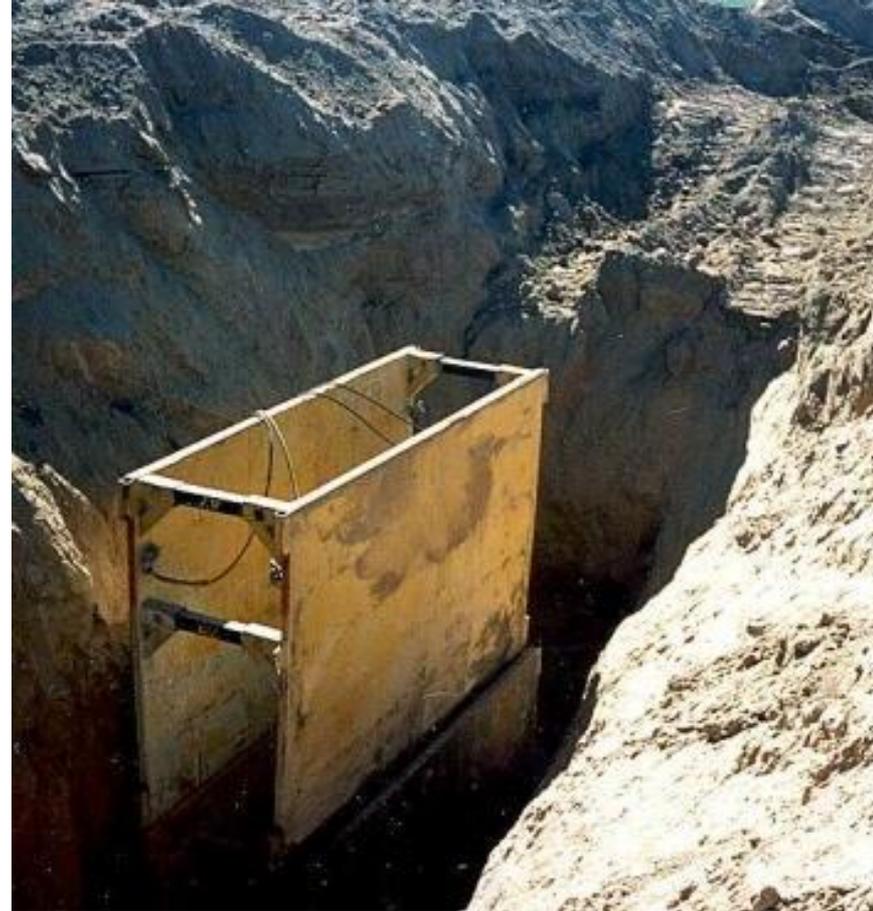
# Hydraulic Trench Support

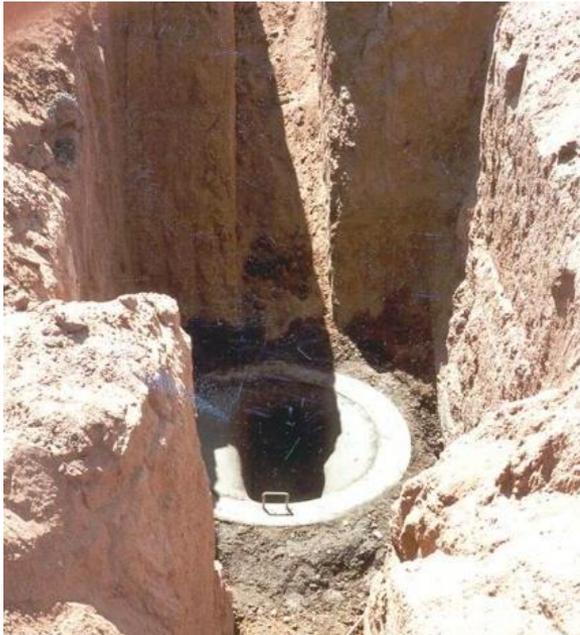
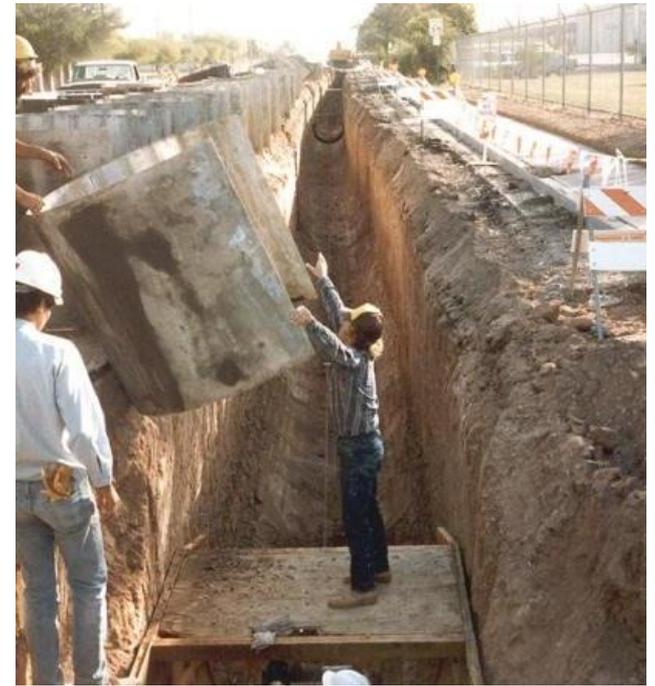


- Using hydraulic jacks the operator can easily drop the system into the hole
- Once in place, hydraulic pressure is increased to keep the forms in place
- Trench pins are installed in case of hydraulic failure

# Materials and Equipment

- Equipment used for protective systems must not have damage or defects that impair function.
- If equipment is damaged, the competent person must examine it to see if it is suitable for continued use.
- If not suitable, remove it from service until a professional engineer approves it for use.





[http://www.osha.gov/dts/osta/otm/otm\\_v/otm\\_v\\_2.html](http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html) ★

