groundwater week
Nashville · Dec. 5-7, 2017

INSTRUMENTAL TO YOUR SUCCESS

NWGA GROUND WATER WEEK 2017

Excavation Safety

Osha definition of our trade

Industry code # 1781 Water Well Drilling

- Special trade contractors primarily engaged in water well drilling. *(Establishments primarily engaged in drilling oil or gas field water intake wells on a contract or fee basis are classified in Mining, Industry 1381.)*
- Drilling water wells-contractors
- Geothermal drilling-contractors
- Servicing water wells-contractors
- Well drilling, water: *except oil or gas field water intake-contractors*

Not All of Our Work is Drilling

What osha standards apply?

29 CFR 1926 Construction

1926.651 Subpart P

EXCAVATION

Statistically the most dangerous type of work in the U.S.

Approximately 60 persons are killed and 600 hurt from cave-ins

Fatality rate for trenching work is 112% higher than construction work in general

This backhoe operator is having second thoughts about the days events which resulted in the death of the company owner!

Death and Injuries

Suffocating

Crushing

Loss of Circulation

Struck by falling object

Moves/Falls at 17 mph

History

Since OSHA's inception there has been a need for more comprehensive regulations which employers can comply with to protect their workers.

The new excavation regulations which became effective March 5, 1990 were designed to do just that.

Three Major Changes

1. The requirement that the employer assign a "Competent Person" to every excavation!
2. Every "Protective System" is required to have a certification.
3. The soil at every excavation must be analyzed.

The Competent Person

Knows the soil

Knows the Standards

Knows the Protective System

Has the Appropriate Authority

Competent person Should Make inspections

- Daily Prior to Work
- Of the Excavation
- Protective System
- Surrounding Area
- After a Rain
- Possible Cave-ins
- Hazardous Atmospheres are Possible
- After other Hazards Occur or Increase in Frequency

Soil Classifications

Sand, silt, and clay are the basic types of soil. Most soils are made up of a combination of the three. The texture of the soil, how it looks and feels, depends upon the amount of each one in that particular soil.

Stable Rock	(The most stable material)
Type A	(The most stable "soil")
Type B	(The most common "soil")
Type C	(The most unstable "soil")

EXCAVATION Slopes

Soil Type	Slope Ratio	Slope angle
Stable Rock	Vertical	90°
Type A	¾:1	53°
Type B	1:1	45°
Type C	1½:1	34°
Type A (ST)	½:1	63°

Soil Analysis

What does it weigh?

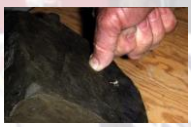
Weights of Materials for 1 cu. foot

- Dry Sand=80-90 lbs.
- Dry Clay=85-90 lbs.
- Wet Clay=110-125 lbs.
- Wet Mud=120-125 lbs.
- Limestone=160 lbs.
- Granite=165 lbs.

Soils Testing

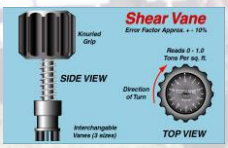
Instruments

Review soil testing



Thumb Penetration Test

Plasticity Test



Shear Strength

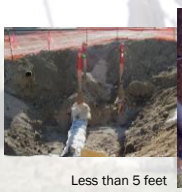
Unconfined Compressive Strength

Protective System

When needed?

Less than 5 feet if a Competent person determines that a cave-in could occur

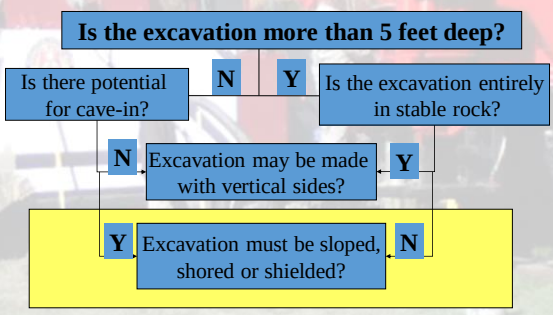
When a trench is 5 feet or more in depth



Less than 5 feet

More than 5 feet

Excavation Depth



Excavation options

Sloping

Benching

Shoring

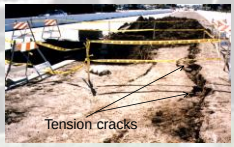
Trench Box

Sloping Options

When sloping a trench you must know

Type of Soil
Depth of Excavation
Time Excavation will be open
Changing conditions

Checking soil



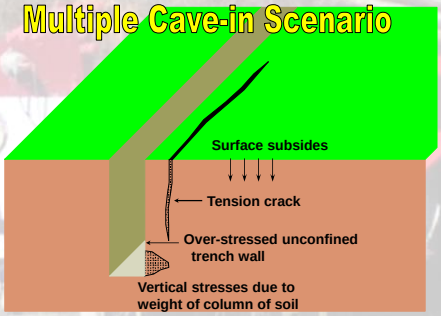
Placement of spoils

Spoil piles must be placed 2 feet away from the excavation

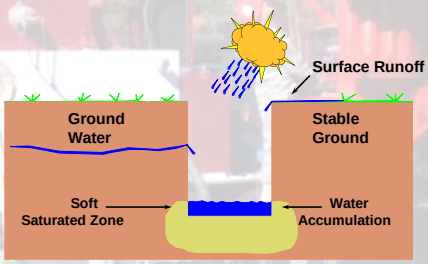
Factors of cave-ins

Soil Composition
Water in soil
Depth of Excavation
Climatic Conditions
Time Excavation will be open
Locations of Utilities
Traffic and near-by Structures

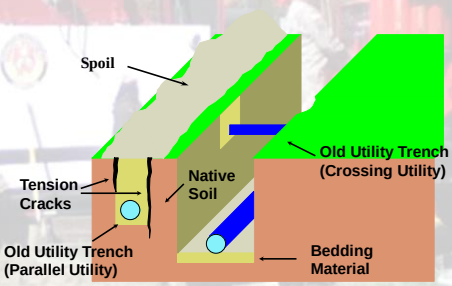
Multiple Cave-in Scenario



Effects of Water



Previously Disturbed Areas



After a cave-in

After the fact inspections are the most difficult for a contractor to defend against because:
"A highly predictable, preventable event has occurred."

- **PREDICTABLE:** There are no permanently vertical soil or rock walls found in nature!
- **PREVENTABLE:** There are MEANS (equipment) or METHODS (work processes) available which will prevent worker exposure.

CONCLUSION: Cave-ins are not accidents!

Shield and shoring

Uprights
Wales
Cross Braces
Close Sheeting




Shoring is a structure such as a metal hydraulic, mechanical, or timber bracing system that supports the sides of an excavation.

Trench boxes

A trench shield or box is a heavy metal box designed to be placed in a trench; it prevents the sides of the trench from caving in.

Installed Properly
Provide end Protection
No Employees Outside Of Trench Box
Move Only When No One Is In The Trench
Use Manufactures Tabulated Data Sheets
Rated for The Depth Of The Trench

Trench box

Rated for The Depth Of The Trench

No Employees Outside Of Trench Box

Move Only When No One Is In The Trench

Trench box

Evaluating Shields Condition

The contractor was only asking $900.00 because it had some "minor" damage!

Many components necessary for the safe use of this shield are missing:
- Spreaders
- Stacking pins
- End plates

Trench box

Assemble correctly

Installed Properly

Use Manufactures Tabulated Data Sheets

Personal Safety

Fall Protection – Physical protection shall be provided

Each employee at the edge of an excavation 6 feet (1.8m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of plant growth or other visual barrier

Hazardous Atmospheres – Low oxygen, flammable atmosphere, Toxic environment.

Hazardous Atmospheres

To prevent exposure to harmful atmospheres the following guidelines should be used:

Entry into excavations deeper than 4' where it is reasonable to expect that hazardous atmospheres might exist shall be tested before entry is allowed.

Entry into areas where the O^2 (oxygen) level is less than 19.5% is prohibited.

Entry is prohibited when flammable gases are present in concentrations greater than 20% of the lower flammable limit of the gas.

Common Effects of Gas

Carbon Monoxide	Hydrogen Sulfide
• Headache	• Coughing
• Nausea	• Eye irritation
• Loss of Consciousness	• Loss of Consciousness
• Brain Damage	
• Death	PEL –10 (smell of rotten eggs)
PEL- 35 (No order)	

Testing Requirement

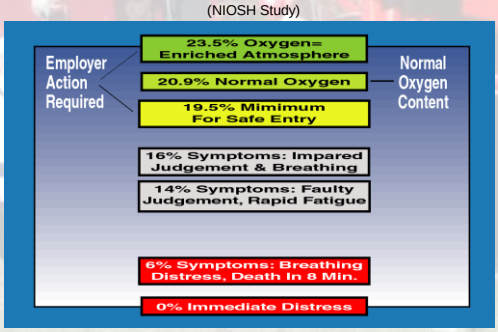
It is reasonable to expect hazardous atmospheres in:

- ❑Landfill areas (dump grounds, landfills, etc.)
- ❑Next to fuel and chemical storage areas
- ❑When doing removal of contaminated soils
- ❑When digging in soils with high organic content

NOTE: Testing should always be performed in these areas

Oxygen Deficiency

(NIOSH Study)



Support Protect or Remove Utilities

An "I" beam and chains were used to support the concrete "duct-bank" crossing this excavation from left-to-right.

Contractor supported these communication lines by placing timbers across the trench then using strapping.

Locating Utilities by HYDRO EXCAVATION

professional engineer

Any system not found within the guidelines set forth in the standard, or within the tabulated data tables in the standard requires use of a Professional Engineer.

*No where in the standard or tabulated data does it allow for excavations deeper than 20 feet

Access & Egress

All excavations four feet or more in depth must have a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel for employees.

Exposure to falling loads

Employees must be protected from falling loads or objects falling from lifting or digging equipment

Employees are not permitted to work under raised loads

Employees are required to stand away from equipment that is being loaded or unloaded

Trucks will either have cab protection or the driver will exit the vehicle during loading

Exposure To vehicles

Protect employees from being injured or killed by vehicle traffic: Provide employees with and **require them to wear warning vest**. Require a designated, trained flagger along with signs, signals, and barricades when necessary.

No Vest

No Shoring

Surface crossing

Surface crossing of trenches should be discouraged; Vehicle crossing must be designed by and installed under the supervision of a registered professional engineer.

Each employee within six feet of the edge of an excavation six feet or more in depth must be protected from falling by guardrail systems, fences, personal fall arrest systems, or barricades.

No mid-rail

Review questions

1. Protect workers from excavated materials that could pose a hazard by falling inside the excavation by placing and keeping such materials at least ___2___ feet from the edge of the excavation
2. The depth of a trench is greater than its width, but the width of a trench is not greater than ___15___feet.
3. Short term exposure means a period of time less than or equal to ___24___hours that an excavation is open
4. A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are ___4___ feet
5. Trenches deeper than __5__ feet deep must be sloped, shored or shielded.

Review questions

6. Hazardous atmospheres can occur in __Any Depth__of an excavation.
7. Safe egress from an trench can require no more than __25__ feet of lateral travel for employees.
8. Ladders must be secured and extend at least __3__feet above the landing
9. Workers are prohibited from entering a excavation with less than __19.5__ percent oxygen.
10. Inspection of the excavation and surrounding area has to be completed by a competent person at least __1__ times daily.
11. Entry is prohibited when flammable gases are present in concentrations greater than __20__% of the lower flammable limit of the gas.

Review questions

12. Each employee within __6__ feet of the edge of an excavation six feet or more in depth must be protected from falling by guardrail systems, fences, personal fall arrest systems, or barricades.
13. An excavation deeper than ___20___feet has to be approved by a registered professional Engineer from that state.
14. An oxygen enriched atmosphere is any space with above __23.5__ percent oxygen.
15. A trench shield set below grade should extend ___18___ inches above the bottom of the sloped part of the excavation.
16. A trench shield can be no more than __2__ feet above the bottom of the excavation.
17. Entry into excavations deeper than ___4___ feet where it is reasonable to expect that hazardous atmospheres might exist shall be tested before entry is allowed.

Review questions

18. Equipment must be kept at least ___2___feet away from an excavation.
19. Fatality rate for trenching work is __112__ % higher than construction work in general.
20. Approximately __60__ persons are killed in cave ins each year.