Trenching and Excavation - Trainer Handbook

Trench and Excavation Safety for Wastewater Workers and Plumbing Contractors

Safety and Health Investment Project (SHIP)

Written by The Washington On-Site Sewage Association, Funding and Support Provided by the Washington State Department of Labor and Industries

Acknowledgements

Acknowledgement

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For more information about this grant, or the WA. Department of Labor and Industries Safety & Health Investment Projects (SHIP) visit their website at: SafetyProjects.LNI.wa.gov

Introduction

Instructor's Guideline

This pre-amble will provide guidance to the instructional use of this training resource for the Onsite Wastewater Industry.

Introduction

Washington State Labor and Industry requires employers to provide a safe and health workplace for their workers. Washington requirements for Excavation and Trench safety are well defined under Chapter WAC 296-45-195 and the provisions of Part N, chapter 296-155 WAC requirements. Rules in Washington State have their basis in specific regulations for excavation and trenching work found in the Code of Federal Regulations at section 1926 Subpart P.

Risk identification and management is the employer's responsibility, but it also requires awareness, recognition and compliance to company policy and procedures by employees in the identified risk based work activities.

Understanding the requirements of the Part N, chapter 296-155 WAC requirements rule for employers' raises awareness to the administrative requirements of Chapter WAC 296-45-195 and the provisions of Part N, chapter 296-155 WAC requirements. The best way to approach this in the learning environment for employers is to use the course materials as a gap analysis as they develop their company specific Part N, chapter 296-155 WAC requirements program.

This training resource is designed to be used and presented to employers and employee's working in trenching and excavations in the decentralized wastewater industry. These work environments would include, but are not limited to:

- On-Site Wastewater Systems (small flows less than 3,500 gpd)
- Light commercial applications (strip malls, combined wastewater/grease)
- Side sewer and jetting operations connected to sewer infrastructure
- Public works projects and associated activities involving utility infrastructure

How to use these Training Materials

Suggested Instructor qualifications:
The instructor should have a minimum of 3-5 years' experience in the On-Site industry working with OSS Pumpers, Inspectors, Installers or Regulatory infrastructure and have at least 1 year presentation/education experience to the OSS industry for qualified CEU approved training.

Have direct experience trenching and excavation procedures. Familiarity with tank installation and maintenance exposures specific to the industry are important to an instructor's ability to communicate with learners. Having a working knowledge of OSHA and State Labor Industrial Health and Safety Regulations and how they are applied is critical to the successful delivery of the program.
Practical experience in Safety Management applications and program implementation for small business and risk management would add a depth of understanding for the instructor's transfer of information regarding application of rule to the various work tasks this program is designed for.

Using the Resource
Presenters of the training resource should anticipate approximately 8-10 hours of preparation time to familiarize themselves to the learning objectives and content of this program before presenting it. The material and content is designed to be interactive and encourage a learning environment for discussion and Q/A on the subject matter. The companion documents are structured so the presentation will build the framework of developing the knowledge and skills for effective individual company programs.

1. Power Point presentation:
    a. This should be printed in the format included, 3 slides to a page with "note" lines for participants. Speaker's notes are inclusive for each slide and should be reviewed for content and intent to learning objectives.
2. Companion documents:
    a. Spanish translation of the PowerPoint handout is available and inclusive to this training resource.
    b. Chapter WAC 296-45-195 and the provisions of Part N, chapter 296-155 WAC requirements are inclusive to the training resources but should be verified to current code available online at: http://apps.leg.wa.gov/WAC/default.aspx?cite=296-155 to ensure they are current.

Note: With minor modifications, this resource could be used in other similar industry needing confined space program development and training for Part N, chapter 296-155 WAC requirements.

Excavation and Trenching for OSS industry

Pre/Post-course Quiz

Name: _____

1. What is the greatest exposure for workers in an excavation or trenching project?
    a. Slips
    b. Falls
    c. Caught-in
    d. Trips

2. What is the principle cause of death in an excavation accident?
    a. Crushing weight of soils
    b. Inability to breathe
    c. No Rescue Plan in place
    d. All of the above

3. If you are a worker you have the right to request an inspection for workplace hazards.
    a. True
    b. False

4. What best describes an excavation exposure where you work?
    a. _____

5. If you are a worker you have the right to refuse to work in an imminent danger situation, under certain conditions.
    a. True
    b. False

6. Generally, Table N Excavation rules don't apply to Septic Tank installations.
    a. True
    b. False

7. The Competent Person on the job is responsible to do daily site/soil inspections or as conditions change.
    a. True
    b. False

8. Excavation or trench safety protection includes: Engineered Boxes, Speed Shoring, but not structures built in place.
    a. True
    b. False

9. A type A soil must be downgraded to type B if the following is observed:
    a. Water flowing in
    b. Fissures in the type A soil profile
    c. Operating equipment adjacent to the excavation due to vibrations
    d. All of the Above

10. Under the Table N requirements, employers have a responsibility to provide a workplace free from serious recognized hazards and comply with standards, rules and regulations.
    a. True
    b. False

11. Atmospheric testing may be required in addition to excavation protection
    a. True
    b. False
12. In 12' excavation 150' long, ladders for egress from the excavation must be provided at this minimum interval:
    a. 10'
    b. 15'
    c. 20'
    d. Not needed if the excavation is benched on the end
13. In an excavation, the ladder must extend how far out of the excavation?
    a. to the top of the excavation
    b. to the top of the trench box
    c. 1-2 rungs above the trench box
    d. 3' above the trench box
14. What is the minimum inspection frequency of a trench by the competent person?
    a. Daily
    b. When conditions change
    c. Both
15. Type A, Type B and Type C soil are classifications of soils that must be determined by the competent person on the project.
    a. True
    b. False – the project owner is responsible for determining this
16. Field tests for unconfined compressive strength include: (Choose all that apply)
    a. laboratory testing
    b. pocket penetrometer
    c. "Thumb" test
    d. Other methods
17. Classification of soils by the competent person shall be made based on the results of at least one visual and at least one manual analysis.
    a. True
    b. False
18. A simple slope in Type B soil that is less than 20' shall have an allowable slope of:
    a. ¾ to 1
    b. 1:1
    c. 1.5 to 1
    d. None of the above
19. In layered slopes 20' and under (i.e. B over A), there may be a mixed slope configuration based on the determination of the Competent Person.
    a. True
    b. False
20. Based on what I learned in the Excavation and Trenching for OSS class, I plan to change how I approach my workplace and personal safety decisions.
    a. Yes
    b. No

WOSSA Trenching and Excavation for OSS – *DATE*

Name of Attendee: _____

Company: _____

Address: _____

Tel: _____

Location of Training: *Location* Instructor(s): *Instructor*
(Circle the appropriate number)

Trenching & Excavation for OSS: Content	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.) The objectives were clearly stated.	5	4	3	2	1
2.) The material learned was what I needed.	5	4	3	2	1
3.) The training helped me understand important hazards I may encounter in my job.	5	4	3	2	1
4.) Based on what I learned, I will make changes to improve my personal safety for Trenching and Excavation in my job.	5	4	3	2	1
5.) The content was clear and easy to understand.	5	4	3	2	1
STRUCTURE					
6.) The presentation methods were effective.	5	4	3	2	1
7.) The visual aids, handouts or notes were effective.	5	4	3	2	1
8.) The length of training and each session was about right.	5	4	3	2	1
9.) The training encourages participation.	5	4	3	2	1
10.) I will recommend the training to others	5	4	3	2	1

Overall Evaluation	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(If made available, otherwise no ranking here)					
OVERALL EVALUATION					
The training met my need.	5	4	3	2	1
I learned what I needed	5	4	3	2	1
I will recommend the training to others	5	4	3	2	1

COMMENTS
Please comment on any other aspects of the training

Washington On-Site Sewage Association

NWOTC

This is to certify that

First & Last Name

Completed: LNI SHIP Grant – "Trench and Excavation Safety for Wastewater Workers"

Sponsored by the Washington On-Site Sewage Association

Month Day, Year

This is a full day Course: 8.0 Contact hours awarded

City, State

John Thomas
Executive Director

TRENCH/EXCAVATION
Competent Person
Quick Reference Guide

DEFINITIONS

Competent Person: One who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Intent: In order to be a "competent person" for the purpose of this standard one must have had specific training in, and be knowledgeable about, soils analysis, the use of protective systems , and the requirements of this standard and must be designated by the employer

Inspections : Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rain storm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

GENERAL REQUIREMENTS

- Protecting **SURFACE ENCUMBRANCES** that may create a hazard to employees.
- Locating **UNDERGROUND INSTALLATIONS** prior to opening an excavation.
- Providing appropriate **ACCESS AND EGRESS. (4 feet)**
- Reducing employees **EXPOSURE TO VEHICULAR TRAFFIC** with the use of warning vests.
- Employee **EXPOSURE TO FALLING LOADS** shall be eliminated.
- Providing a **WARNING SYSTEM FOR MOBILE EQUIPMENT** operating adjacent to or near an excavation.
- Testing the air in excavations to identify potentially **HAZARDOUS ATMOSPHERES. (4 feet)**
- **PROTECTION FROM HAZARDS ASSOCIATED WITH WATER ACCUMULATION.**
- Ensuring the **STABILITY OF ADJACENT STRUCTURES.**
- Adequate **PROTECTION OF EMPLOYEES FROM LOOSE ROCK OR SOIL** that may fall or roll into an excavation.
- Daily **INSPECTIONS** by a competent person (see above definition)
- Appropriate **FALL PROTECTION** near excavations. **(4 feet)**

REQUIREMENTS FOR PROTECTIVE SYSTEMS

Each employee in an excavation shall be protected from cave-ins by an adequate protective system except when excavations are less than **(4 feet)** in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

Disclaimer: For use by the trained and knowledgeable "competent person" only. Refer to appropriate requirements of your local city, county, state, federal regulations or manufacturer's tabulated engineering for further clarification.

SOIL CLASSIFICATION

Type A Soil:

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:

(1) The soil is fissured; or
(2) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
(3) The soil has been previously disturbed; or
(4) 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
(5) The material is subject to other factors that would require it to be classified as a less stable material.

Type B Soil:

(1) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf; or
(2) 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.
(3) Previously disturbed soils except those which would otherwise be classed as Type C soil.
(4) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
(5) Dry rock that is not stable; or
(6) 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.

Type C

(1) Cohesive soil with an unconfined compressive strength or 0.5 tsf or less; or
(2) Granular soils including gravel, sand, and loamy sand; or
(3) Submerged soil or soil from which water is freely seeping; or
(4) Submerged rock that is not stable; or
(5) 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.

SOIL TESTING

(Minimum: One visual and one manual test are required.)

Visual Tests: Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples form excavated material.

A. Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material.
B. Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.
C. Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall *off* a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.
D. Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.
E. Observe the opened side of the excavation to identify layered systems. Examine to see if layers slope toward the excavation. Estimate the degree of slope of the layers.
F. Observe the area adjacent to the excavation and the sides of the open excavation for evidence of surface water, water seeping from the sides of the excavation, or location of the level of the water table.
G. Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may *affect* the stability of the excavation face.

Manual Tests: Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

A. Plasticity. Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8-inchin diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch length of 1/8-inch thread can be held on one end without tearing, the soil is cohesive.
B. Thumb Penetration. The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 1.5 !sf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great *effort.* Type C soils with an unconfined compressive strength of 0.5 !sf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure.
C. Dry Strength. If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

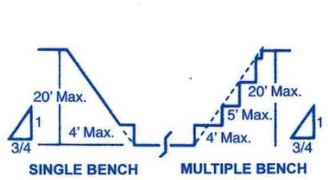
Other available options using SOIL REPORTS

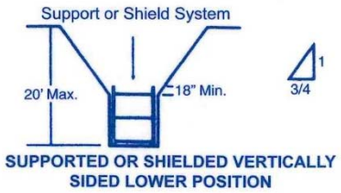
Blows Per Foot	Cohesive Soil	Granular Soil
0-4	C-Soft	C - Very Loose
4-8	B- Medium	C - Loose
8-15	B or A-Stiff	C - Medium Loose
15-30	A-Very Stiff	C- Medium
>30	A- Hard	* B - Dense

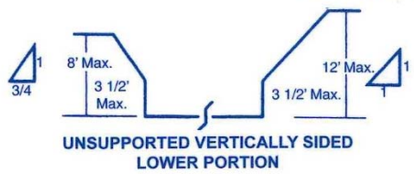
* Could be Type A if hardpan or cementation exists

SLOPING & BENCHING

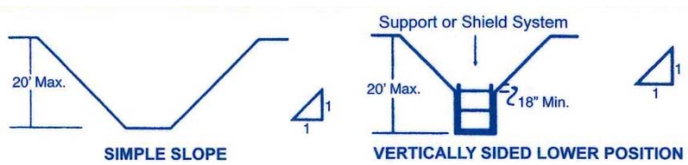
TYPE "A" SOIL

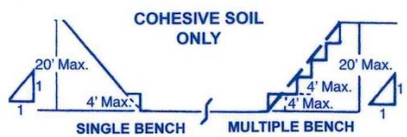




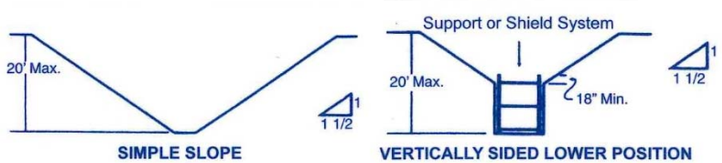


TYPE "B" SOIL





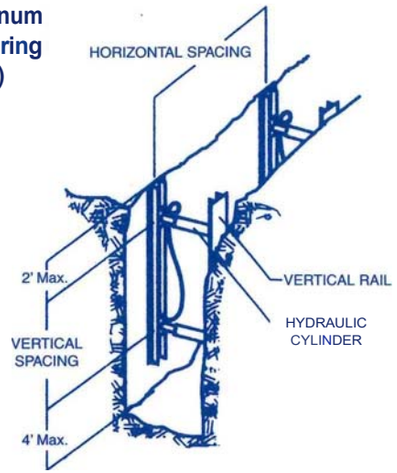
TYPE "C" SOIL



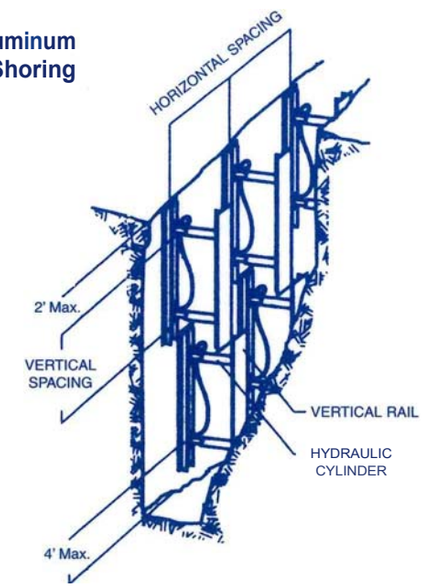
SPEED SHORE ALUMINUM HYDRAULIC SHORING

Typical Installations

Vertical Aluminum Hydraulic Shoring (Spot Bracing)



Vertical Aluminum Hydraulic Shoring (Stacked)



Note: Always install shoring from the top down and remove from the bottom up.

Table VS-1 Type "A" Soil **SPEED SHORE**

Depth of Excavation FEET	HYDRAULIC CYLINDERS					Sheeting (Note 3)
	Maximum Horizontal Spacing *(FEET)*	Maximum Vertical Spacing (Note 6) *(FEET)*	Width of Excavation *FEET*			
			O to 8	8 to 12	12 to 15	
O to 15	8	4	2" dia.	2" dia.	2" dia. (1)	(Note2)
O to 25	8	4	2" dia.	2" dia. (1)	2" dia. (1)	(Note2)

Table VS-2 Type "B" Soil

Depth of Excavation FEET	HYDRAULIC CYLINDERS					Sheeting (Note3)
	Maximum Horizontal Spacing *(FEET)*	Maximum Vertical Spacing (Note 6) *(FEET)*	Width of Excavation *FEET*			
			O to 8	8 to 12	12 to 15	
O to 10	8	4	2"dia.	2" dia.	2" dia. (1)	(Note2)
O to 20	6	4	2" dia.	2"dia. (1)	2" dia. (1)	(Note2)
O to 25	5	4	2"dia.	2" dia.(1)	2" dia. (1)	(Note7)

Table VS-3 Type "C" Soil

Depth of Excavation FEET	HYDRAULIC CYLINDERS					Sheeting (Note4)
	Maximum Horizontal Spacing *(FEET)*	Maximum Vertical Spacing (Note 6) */FEET)*	Width of Excavation *FEET*			
			O to 8	8 to 12	12 to 15	
O to 10	6 (Note 5)	4	2" dia.	2" dia.	2"dia. (1)	(Note2)
O to 20	4	4	2" dia.	2" dia.	2"dia. (1)	(Note7)
O to 25	4	4	2" dia.	2" dia.	**N/A**	(Note7)

Notes to Tables VS-1 , VS-2 , VS-3

(1) Two inch diameter cylinders shall have a structural steel tube oversleeve 3.5 **x** 3.5 **x** 0.1875inches extension (installed over the aluminum oversleeve extension) or a steel tube oversleeve3 x 3 x 0.1875 inch extension (installed without the aluminum oversleeve) that extends the full retracted length of the cylinder.

(2) The bottom of the sheeting shall extend within 2 feet of the bottom of the excavation. If there is an indication of a possible loss of soil from behind the support system, sheeting must extend to the bottom of the excavation.

(3) Four feet wide sheeting is required at each Vertical Shore if raveling or sloughing of the excavation face appears likely to occur.

(4) Four feet wide sheeting shall be used.

(5) When 4 feet horizontal spacing is exceeded, the open spaces between the sheeting must be monitored for sloughing and raveling of the excavation face.

(6) The bottom hydraulic cylinder shall be a maximum of 4 feet above the bottom of the excavation.

(7) Sheeting shall extend to the bottom of the excavation.

Washington On-Site Sewage Association WOSSA

Excavation and Trenching Onsite Wastewater Systems

Developed by the Washington Onsite Sewage Association Under an LNI SHIP Grant # 2016 ZA 00329

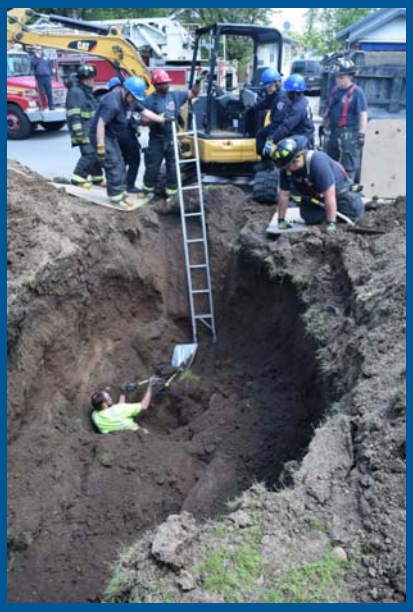
SHIP Grant Program — Safety and Health Investment Projects — SafetyGrants.Lni.wa.gov — Funded by the Department of Labor & Industries

Funding and support for this project has been provided by the State of Washington, Department of Labor & Industries, Safety & Health Investment Projects

Excavation and Trenching Operations For Contractors in On-Site.

Course objective:

To raise awareness of the excavation, trenching and shoring regulations and requirements in Part N, Chapter 296-155 of the Washington Administrative Code.



Instructors notes are inclusive on each slide and assumes that the instructor has both knowledge and experience in construction/excavation and a working knowledge of the referenced administrative code. Instructors should review the code prior to teaching this program for updates and changes.

Insert Video From Keith Pelzel OSS Designer in this slide position.

https://www.bing.com/videos/search?q=wossa+safety&&view=detail&mid=291817032441F3556B03291817032441F3556B03&FORM=VRDGAR

Topics covered

- Introduction to Trench Safety & Review of the WAC Part N Rules
- Definitions
- Competent Person Responsibilities
- Soil classification
- Trench protective systems:
  - Shoring & sloping
  - Shielding Guidelines
  - Protective Systems Options
- Common OSS Scenario's

This slide identifies the learning objectives for the training session.

What are the rules?

Chapter 296-155 WAC SAFETY STANDARDS FOR CONSTRUCTION WORK

- 22 Sections:
  - Parts A - V Cover a wide scope of activities from working on Roofs to Crane and more.
- Part N and appendixes are Excavation and Trenching rules.

This slide references the excavation and trenching regulatory WAC and narrows the training topic to the Part N requirements

Chapter 296-155 WAC
Safety Standards for Construction Work

Part N consists of 3 Primary Sections

PART N
EXCAVATION, TRENCHING, AND SHORING

296-155-650	Scope, application, and definitions applicable to this part.
296-155-655	General protection requirements.
296-155-657	Requirements for protective systems.

This slide references the excavation and trenching regulatory focus of Part N in the WAC and provides references for participants to cite for additional information.

Chapter 296-155 WAC
Safety Standards for Construction Work

Part N also has 6 additional appendices for Guidance

296-155-66401	Appendix A—Soil classification.
296-155-66403	Appendix B—Sloping and benching.
296-155-66405	Appendix C—Timber shoring for trenches.
296-155-66407	Appendix D—Aluminum hydraulic shoring for trenches.
296-155-66409	Appendix E—Alternatives to timber shoring.
296-155-66411	Appendix F—Selection of protective systems

This slide references the excavation and trenching regulatory focus of Part N in the WAC. The instructor should point out these as reference/guidance documents that provide specific information to help companies understand and implement programs that are compliant.

Part N Excavation, Trenching and Shoring: 296-155-650

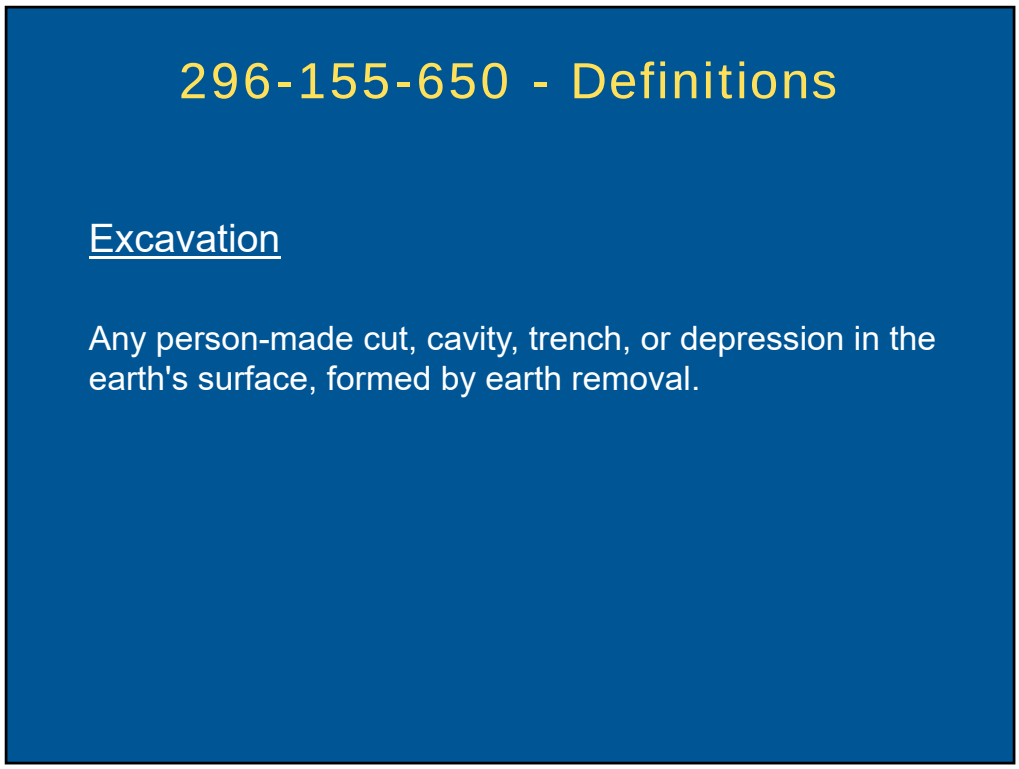
Scope, Application and Definitions

- “This part applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.”

Most common field exposures that the on-site industry are involved with include:

- Tank Excavations
- Side Sewer
- Soil Test Pits
- Other – Utility work, Sewer Mains

This slide defines “Scope and Application” and the general definition of excavations and examples of OSS industry specific applications that follow in the subsequent slides.



This slide provides the definition of an excavation under code.

296-155-650 - Definitions

Trench (trench excavation)

A narrow excavation in relation to its length made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6m).

If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

Relative to the OSS industry this would include side sewer work, utility work, and in some cases OSS trench excavations. In particular, an area often not considered for both the OSS Design community and the regulatory community are soil log test pits. This is a generally weak area of compliance and poses significant risk. Most local health jurisdictions along with state code have specifics embedded in their local rule for construction and dimension that do not take into consideration the table N excavation requirements.

296-155-650 - Definitions

Cave-in

The separation of a mass of soil or rock material from the side of an excavation, or loss of soil from under a trench shield or support system, and its sudden movement into the excavation in quantity that it could entrap, bury, injure, or immobilize a person.

This slide defines the term Cave-in – Instructor can reference for later discussion, that soil type affects the failure mode, and it is always changing. Duration of trench exposure, introduction of water, snow, vibration, equipment loading, and excavation spoils can all contribute to cave-ins.

296-155-650 - Definitions

Protective system

A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures.

Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

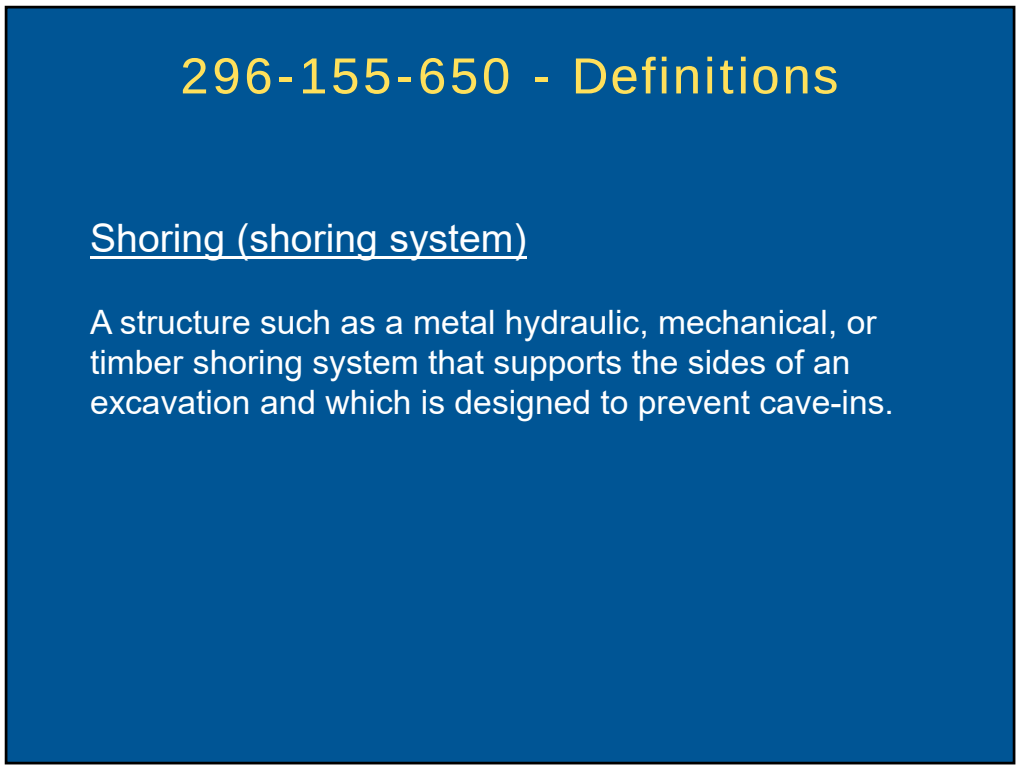
This slide defines the term: protective system.

296-155-650 - Definitions

Ramp

An inclined walking or working surface that is used to gain access to one point to another, and is constructed from earth or from structural materials such as steel or wood

This slide defines the term: ramp.



This slide defines the term: Shoring. Instructor should highlight there are different methods and different ways to meet the standard that will be discussed later.

296-155-650 - Definitions

Sloping (sloping system)

A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

This slide defines the term: sloping.

296-155-650 - Definitions

Sheeting

The members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

This slide defines the term: sheeting.

296-155-650 - Definitions

Aluminum Hydraulic Shoring

A pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross-braces) used in conjunction with vertical rails (uprights) or horizontal rails (walers).

Such system is designed, specifically to support the sidewalls of an excavation and prevent cave-ins.

This slide defines: aluminum hydraulic shoring.

296-155-650 - Definitions

Cross braces

The horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

This slide defines the term: cross braces.

296-155-650 - Definitions

Shield (shield system)

A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses.

Additionally, shields can be either pre-manufactured or job-built in accordance with WAC 296-155-657 (3)(c) or (d). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

This slide defines the term: shield.

296-155-650 - Definitions

Tabulated data

Tables and charts approved by a registered professional engineer and used to design and construct a protective system.

This slide defines the term: tabulated data.

296-155-650 - Definitions

Benching (benching system)

A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

This slide defines the term: benching.

296-155-650 - Definitions

Competent person

One who can identify existing or predictable hazards in the surroundings that are unsanitary, hazardous, or dangerous to employees.
Has authorization or authority by the nature of their position to take prompt corrective measures to eliminate them.
The person must be knowledgeable in the requirements of this position.

This slide defines the term: competent person.

296-155-650 - Definitions

A Complete list of definitions can be found at:

http://apps.leg.wa.gov/WAC/default.aspx?cite=296-155-650

The instructor should direct participants to make note of this link for review.

296-155-655 – General Protection Requirements

This Section has Twelve (12) Parts

Part N – Page 3-6

This is a transition slide to the overview of the general protection requirements

296-155-655 – General Protection Requirements

(1) Surface encumbrances

You must remove or support surface encumbrances that are located so as to create a hazard to employees, as necessary, to safeguard employees.

This includes excavation spoils, equipment, rolling stock, crossover structures and basically anything that could fall into the excavation onto the entrant(s) in the excavation.

296-155-655 – General Protection Requirements

(2) Underground installations

(a) You must locate utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, prior to opening an excavation.

(b) You must contact utility companies or owners within established or customary local response times, advised of the proposed work, and asked to locate the underground utility installation prior to the start of actual excavation.

Call 811 before you dig. The instructor can either poll the participants or reference informal polling that the creators of this resource have conducted that demonstrate the accuracy of "locates" can vary widely.

The instructor should point out that in addition to the locates done by 811, private property locates are the responsibility of the project owner to identify and protect their employees. Handheld locate equipment is available for companies to accomplish this.

296-155-655 – General Protection Requirements

(2) Underground installations

(c) When excavation operations approach the location of underground installations, you must determine the exact location of the installations by safe and acceptable means.

(d) While the excavation is open, you must protect underground installations, supported, or removed as necessary to safeguard employees.

In the following case studies, the instructor will highlight a “gas line” that was identified and accidently hit and scarred (not broken) by the excavator bucket teeth. The gas company was called and sent out an inspector/technician to cut and replace the damaged section of line.

296-155-655 – General Protection Requirements

(3) Access and egress (a) Structural ramps.

(i) Structural ramps that are used solely by employees as a means of access or egress from excavations must be designed by a competent person. Structural ramps used for access or egress of equipment must be designed by a competent person qualified in structural design, and must be constructed in accordance with the design.

(ii) Ramps and runways constructed of two or more structural members must have the structural members connected together to prevent displacement.

The instructor should highlight the requirements of this section and emphasize the qualification and knowledge of a “competent person”. Often, this is understood to be the job supervisor or most senior person, but may not be adequate to the requirements of the standard.

296-155-655 – General Protection Requirements

(3) Access and egress (a) Structural ramps.

(iii) Structural members used for ramps and runways must be of uniform thickness.

(iv) Cleats or other appropriate means used to connect runway structural members must be attached to the bottom of the runway or must be attached in a manner to prevent tripping.

(v) Structural ramps used in lieu of steps must be provided with cleats or other surface treatments on the top surface to prevent slipping.

The instructor should discuss the need to do this properly. If the project owner is unprepared to protect excavations and/or does not have a program in place, employees will use whatever material is at their disposal and could worsen the exposure with materials and bits that are cobbled together.

296-155-655 – General Protection Requirements

(3) Access and egress

(b) Means of egress from trench excavations.

A stairway, ladder, ramp or other safe means of egress must be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

The instructor should highlight the 4’ rule and relate it principally to OSS applications of septic tank excavations and soil log excavations. These types of excavations are the most unmanaged exposures to the workers in our industry.

This picture represents an example of an improperly constructed walkway and detail.

296-155-655 – General Protection Requirements

(4) Exposure to vehicular traffic

You must provide employees exposed to vehicular traffic with, and they must wear, high-visibility garments meeting the requirements of WAC 296-155-200, General requirements for personal protective equipment (PPE).

The instructor should speak to this protection requirement in relationship to companies that do utility work in the right of way and side sewer projects that may need protection under this standard.

High Visibility clothing comes in several colors…is it enough? See the next slide!

High visibility clothing is a requirement, but ensure that it works under the conditions you need to make it functional.

296-155-655 – General Protection Requirements

(5) Exposure to falling loads

You must not permit any employee underneath loads handled by lifting or digging equipment. You must require employees to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.

Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with WAC 296-155-610 (2)(g), to provide adequate protection for the operator during loading and unloading operations.

The instructor can point out in the Case Studies examples of this exposure with backfilling trenches and dump trucks in the normal course of the project workflow. Consideration of the working space for both equipment (digging) and employees in protected areas (trench boxes) should be evaluated by the competent person during the workflow.

296-155-655 – General Protection Requirements

(6) Warning system for mobile equipment

When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, you must utilize a warning system such as barricades, hand or mechanical signals, or stop logs.

If possible, the grade should be away from the excavation.

The instructor should review these critical points.

296-155-655 – General Protection Requirements

(7) Hazardous atmospheres

(a) Testing and controls. In addition to the requirements set forth in parts B-1, C, and C-1 of this chapter (296-155 WAC) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements apply:

296-155 WAC

B-1 – Occupational Health and Environmental Control

C - Personal Protective & Life Saving Equipment

C-1 - Fall Protection Requirements for Construction

The instructor should review these critical points. Consideration of the operation of generators and exhaust flow require placement at a point on the site where it will not accumulate in the excavation.

296-155-655 – General Protection Requirements

(7) Hazardous atmospheres (cont'd)

(a) Testing and controls. In addition to the requirements set forth in parts B-1, C, and C-1 of this chapter (296-155 WAC) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements apply:

(i) Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, you must test the atmospheres in the excavation before employees enter excavations greater than 4 feet (1.22 m) in depth.

The instructor should refer to situations similar to needs of confined space entry programs and requirements.


CO
CO
0 ppm
CO-03
POWER MODE
O2
O2
20.9%
OX-03
POWER MODE
LEL
CH4
0 %LEL
RKI
GP-03
AIR
POWER MODE
H2S
H2S
0.0 ppm
RKI
HS-03
AIR
POWER MODE

296-155-655 – General Protection Requirements

(7) Hazardous atmospheres (cont'd)

(a) Testing and controls. In addition to the requirements set forth in parts B-1, C, and C-1 of this chapter (296-155 WAC) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements apply:

(ii) You must take adequate precautions to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with chapter 296-842 WAC.

.

The instructor should refer to situations similar to needs of confined space entry programs and requirements: Septic Tanks, Pump Trucks, Sewer structures that maintenance is performed, pump chambers, lift stations, but also mention potential situation in excavations that could be impacted by running equipment adjacent to the excavation.

296-155-655 – General Protection Requirements

(7) Hazardous atmospheres (cont'd)

(b) Emergency rescue equipment.

(i) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, must be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment must be attended when in use.

The instructor should refer to situations similar to the needs of confined space entry programs and requirements. Explain the difference between self rescue capability and having an actual rescue plan in place. Highlight that 911 as a "rescue plan" is generally unacceptable unless specific steps with the 911 responder (interview for capability and availability) must be documented to the employer's plan.


ARE YOU
PREPARED?
Every second counts
during a rescue
SALA
SALA

296-155-655 – General Protection Requirements

(7) Hazardous atmospheres (cont'd)

(a) Testing and controls. In addition to the requirements set forth in parts B-1, C, and C-1 of this chapter (296-155 WAC) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements apply:

(iii) You must take adequate precaution such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 10 percent of the lower flammable limit of the gas.
(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, you must conduct testing as often as necessary to ensure that the atmosphere remains safe.

The instructor to refer to situations similar to the needs of confined space entry programs and requirements….including (iii) supplied air.


ECKO
ECKO
ECKO

296-155-655 – General Protection Requirements

(8) Protection from hazards associated with water accumulation.

(a) Employees must not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation.

The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

The instructor should emphasize the involvement of decision making with the competent person on site.

296-155-655 – General Protection Requirements

(8) Protection from hazards associated with water accumulation – cont'd

(b) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations must be monitored by a competent person to ensure proper operation.

(c) If excavation work interrupts the natural drainage of surface water (such as streams), you must use diversion ditches, dikes, or other suitable means to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with subdivisions (a) and (b) of this subsection.

The instructor should emphasize the involvement of decision making with the competent person on site.

296-155-655 – General Protection Requirements

(9) Stability of adjacent structures

(a) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, you must provide support systems such as shoring, bracing, or underpinning to ensure the stability of such structures for the protection of employees.

The instructor should emphasize the involvement of decision making with the competent person on site. Focus would principally be on side sewer scope of work projects.

296-155-655 – General Protection Requirements

(9) Stability of adjacent structures – cont'd

(b) You must not permit excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees except when:

(i) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or
(ii) The excavation is in stable rock; or
(iii) A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or
(iv) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

The instructor should emphasize the involvement of decision making with the competent person on site.

296-155-655 – General Protection Requirements

(9) Stability of adjacent structures – cont'd

(c) Sidewalks, pavements, and appurtenant structure must not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

The instructor should emphasize the involvement of decision making with the competent person on site.

296-155-655 – General Protection Requirements

(10) Protection of employees from loose rock or soil.

(a) You must provide adequate protection to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face.

Such protection must consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

The instructor should emphasize the involvement of decision making with the competent person on site.

296-155-655 – General Protection Requirements

(10) Protection of employees from loose rock or soil.

(b) You must protect employees from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations.

Protection must be provided by placing and keeping such materials or equipment at least two feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

The instructor should emphasize the responsibility of the competent person monitoring the excavation and that the 2' setback is a "minimum", and refer to solutions provided in the Case Studies.

296-155-655 – General Protection Requirements

(11) Inspections

(a) Daily inspections of excavations, the adjacent areas, and protective systems must be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.

An inspection must be conducted by the competent person prior to the start of work and as needed throughout the shift.

Inspections must also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

The instructor should emphasize the involvement of decision making with the competent person on site.

296-155-655 – General Protection Requirements

(11) Inspections - cont'd

(b) Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, you must remove exposed employees from the hazardous area until the necessary precautions have been taken to ensure their safety.

The instructor should emphasize the involvement of decision making with the competent person on site and the need to take action when information of an increasing hazard presents itself or is identified.

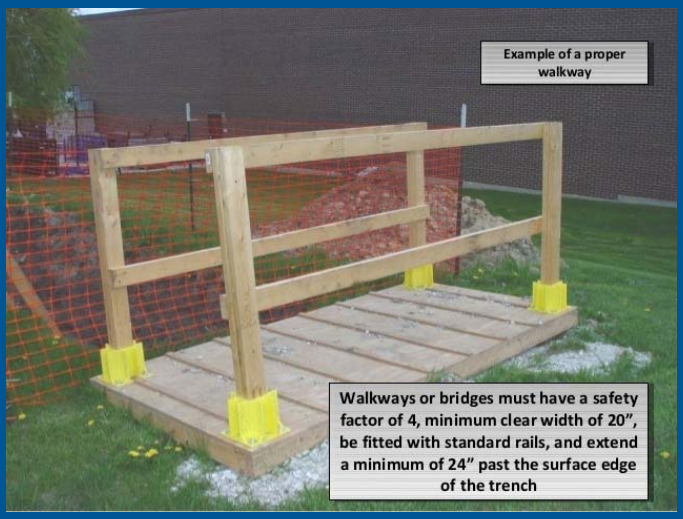
296-155-655 – General Protection Requirements

(12) Fall protection

(a) You must provide walkways where employees or equipment are required or permitted to cross over excavations. You must provide guardrails which comply with chapter WAC 296-155, Part C-1 where walkways are 4 feet or more above lower levels.

You must provide adequate barrier physical protection at all remotely located excavations. You must barricade or cover all wells, pits, shafts, etc. Upon completion of exploration and similar operations, you must backfill temporary wells, pits, shafts, etc.

The instructor should review/comment on to raise awareness to the requirement, but note that this scenario would be uncommon in the OSS industry.


Example of a proper walkway
Walkways or bridges must have a safety factor of 4, minimum clear width of 20”, be fitted with standard rails, and extend a minimum of 24” past the surface edge of the trench

296-155-657 – Requirements for Protective Systems

This Section has Seven (7) Parts

Part N - Pages 6-9

Transition slide: This would be a good time to afford a break to the participants.

296-155-657 – Requirements for Protective Systems

(1) Protection of employees in excavations.

(a) You must protect each employee in an excavation from cave-ins by an adequate protective system designed in accordance with subsections (2) or (3) of this section except when:

(i) Excavations are made entirely in stable rock; or

(ii) Excavations are less than 4 feet (1.22m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(b) Protective systems must have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

This slide identifies the exceptions under rule (a) (i) is unlikely a consideration for OSS due to design requirements, but could be a potential factor when doing side sewer or utility work.

296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

The slopes and configurations of sloping and benching systems must be selected and constructed by the employer or employer's designee and must be in accordance with the requirements of subdivision (a); or, in the alternative, subdivision (b); or, in the alternative, subdivision (c); or, in the alternative, subdivision (d), as follows:

The instructor will principally focus on the fact that 95% or greater of the work done with OSS or side sewer work is typically 20’ or less.

296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

3 options:

(a) Option 1—Allowable configurations and slopes.

(i) Excavations must be sloped at an angle not steeper than 1 1/2 horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(ii) Slopes specified in item (i) of this subdivision, must be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this part.

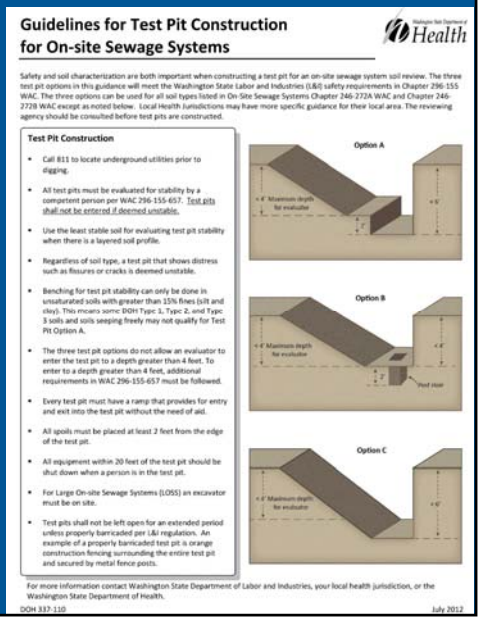
The instructor will principally focus on the fact that 95% or greater of the work done with OSS or side sewer work is typically 20’ or less.

Washington Soil Test Pit Configurations

All test pits must be evaluated for stability by a competent person per WAC 296-155-657. Test pits shall not be entered if deemed unstable.

Use the least stable soil for evaluating test pit stability when there is a layered soil profile.

Regardless of soil type, a test pit that shows distress such as fissures or cracks is deemed unstable.



Guidelines for Test Pit Construction for On-site Sewage Systems

Health

Safety and soil characterization are both important when constructing a test pit for an on-site sewage system soil review. The three test pit options in this guidance will meet the Washington State Labor and Industries (L&I) safety requirements in Chapter 296-155 WAC. The three options can be used for all soil types listed in On-Site Sewage Systems Chapter 246-272A WAC and Chapter 246-272B WAC except as noted below. Local Health Jurisdictions may have more specific guidance for their local area. The reviewing agency should be consulted before test pits are constructed.

Test Pit Construction

- Call 811 to locate underground utilities prior to digging.
- All test pits must be evaluated for stability by a competent person per WAC 296-155-657. Test pits shall not be entered if deemed unstable.
- Use the least stable soil for evaluating test pit stability when there is a layered soil profile.
- Regardless of soil type, a test pit that shows distress such as fissures or cracks is deemed unstable.
- Benching for test pit stability can only be done in unsaturated soils with greater than 15% fines (silt and clay). This means some DOH Type 1, Type 2, and Type 3 soils and soils seeping freely may not qualify for Test Pit Option A.
- The three test pit options do not allow an evaluator to enter the test pit to a depth greater than 4 feet. To enter to a depth greater than 4 feet, additional requirements in WAC 296-155-657 must be followed.
- Every test pit must have a ramp that provides for entry and exit into the test pit without the need of aid.
- All spoils must be placed at least 2 feet from the edge of the test pit.
- All equipment within 20 feet of the test pit should be shut down when a person is in the test pit.
- For Large On-site Sewage Systems (LOSS) an excavator must be on site.
- Test pits shall not be left open for an extended period unless properly barricaded per L&I regulation. An example of a properly barricaded test pit is orange construction fencing surrounding the entire test pit and secured by metal fence posts.

Option A

Option B

Option C

For more information contact Washington State Department of Labor and Industries, your local health jurisdiction, or the Washington State Department of Health.

DOH 337-110 July 2012

The instructor should review the following with participants: Key questions and push back from industry is resistance to construction standards in Table N and the negative impact of an excavation this large in the OSS design component for the drainfield. Site limiting conditions (small lots and repair scenario's) would also raise debate on an inability to construct a soil test pit to the standard.

Responses would be to seek alternatives to identifying soil characteristics with other means.

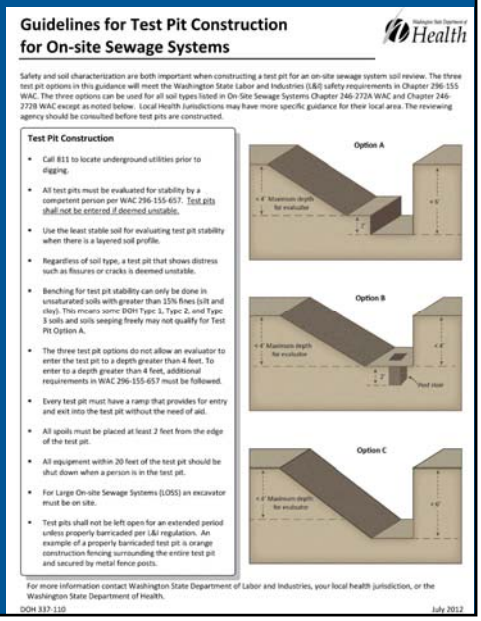
Washington Soil Test Pit Configurations

Every test pit must have a ramp that:

Provides for entry and exit into the test pit without the need of aid.

All spoils must be placed at least 2 feet from the edge of the test pit.

All equipment within 20 feet of the test pit should be shut down when a person is in the test pit.



Guidelines for Test Pit Construction for On-site Sewage Systems

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Safety and soil characterization are both important when constructing a test pit for an on-site sewage system soil review. The three test pit options in this guidance will meet the Washington State Labor and Industries (L&I) safety requirements in Chapter 296-155 WAC. The three options can be used for all soil types listed in On-Site Sewage Systems Chapter 246-272A WAC and Chapter 246-272B WAC except as noted below. Local Health Jurisdictions may have more specific guidance for their local area. The reviewing agency should be consulted before test pits are constructed.

Test Pit Construction

- Call 811 to locate underground utilities prior to digging.
- All test pits must be evaluated for stability by a competent person per WAC 296-155-657. Test pits shall not be entered if deemed unstable.
- Use the least stable soil for evaluating test pit stability when there is a layered soil profile.
- Regardless of soil type, a test pit that shows distress such as fissures or cracks is deemed unstable.
- Benching for test pit stability can only be done in unsaturated soils with greater than 15% fines (silt and clay). This means some DOH Type 1, Type 2, and Type 3 soils and soils seeping freely may not qualify for Test Pit Option A.
- The three test pit options do not allow an evaluator to enter the test pit to a depth greater than 4 feet. To enter to a depth greater than 4 feet, additional requirements in WAC 296-155-657 must be followed.
- Every test pit must have a ramp that provides for entry and exit into the test pit without the need of aid.
- All spoils must be placed at least 2 feet from the edge of the test pit.
- All equipment within 20 feet of the test pit should be shut down when a person is in the test pit.
- For Large On-site Sewage Systems (LOSS) an excavator must be on site.
- Test pits shall not be left open for an extended period unless properly barricaded per L&I regulation. An example of a properly barricaded test pit is orange construction fencing surrounding the entire test pit and secured by metal fence posts.

Option A

Option B

Option C

For more information contact Washington State Department of Labor and Industries, your local health jurisdiction, or the Washington State Department of Health.

DOH 337-110 July 2012

The instructor should review the following with participants: Key questions and push back from industry is resistance to construction standards in Table N and the negative impact of an excavation this large in the OSS design component for the drainfield. Site limiting conditions (small lots and repair scenario's) would also raise debate on an inability to construct a soil test pit to the standard.

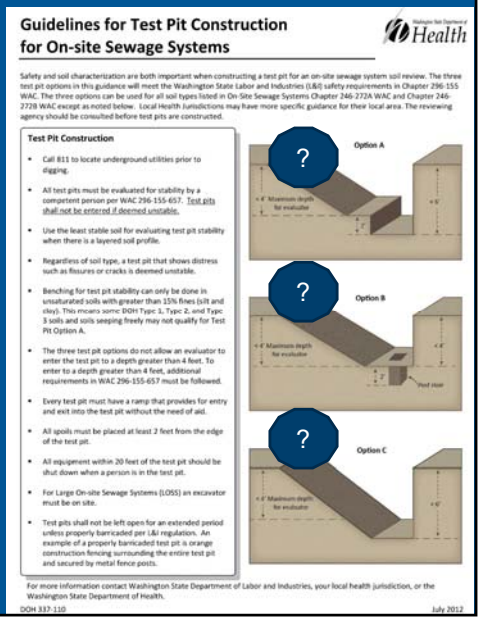
Responses would be to seek alternatives to identifying soil characteristics with other means.

Washington Soil Test Pit Configurations

Benching for test pit stability can only be done in unsaturated soils with greater than 15% fines (silt and clay)

This means some DOH Type 1, Type 2, and Type 3 soils and soils seeping freely may not qualify for Test Pit Option A.

Test pit options do not allow an evaluator to enter the test pit to a depth greater than 4 feet. To enter to a depth greater than 4 feet, additional requirements in WAC 296-155-657 must be followed



Guidelines for Test Pit Construction for On-site Sewage Systems

Health

Safety and soil characterization are both important when constructing a test pit for an on-site sewage system soil review. The three test pit options in this guidance will meet the Washington State Labor and Industries (L&I) safety requirements in Chapter 296-155 WAC. The three options can be used for all soil types listed in On-Site Sewage Systems Chapter 246-272A WAC and Chapter 246-272B WAC except as noted below. Local Health Jurisdictions may have more specific guidance for their local area. The reviewing agency should be consulted before test pits are constructed.

Test Pit Construction

- Call 811 to locate underground utilities prior to digging.
- All test pits must be evaluated for stability by a competent person per WAC 296-155-657. Test pits shall not be entered if deemed unstable.
- Use the least stable soil for evaluating test pit stability when there is a layered soil profile.
- Regardless of soil type, a test pit that shows distress such as fissures or cracks is deemed unstable.
- Benching for test pit stability can only be done in unsaturated soils with greater than 15% fines (silt and clay). This means some DOH Type 1, Type 2, and Type 3 soils and soils seeping freely may not qualify for Test Pit Option A.
- The three test pit options do not allow an evaluator to enter the test pit to a depth greater than 4 feet. To enter to a depth greater than 4 feet, additional requirements in WAC 296-155-657 must be followed.
- Every test pit must have a ramp that provides for entry and exit into the test pit without the need of aid.
- All spoils must be placed at least 2 feet from the edge of the test pit.
- All equipment within 20 feet of the test pit should be shut down when a person is in the test pit.
- For Large On-site Sewage Systems (LOSS) an excavator must be on site.
- Test pits shall not be left open for an extended period unless properly barricaded per L&I regulation. An example of a properly barricaded test pit is orange construction fencing surrounding the entire test pit and secured by metal fence posts.

?

Option A

?

Option B

?

Option C

For more information contact Washington State Department of Labor and Industries, your local health jurisdiction, or the Washington State Department of Health.

DOH 337-110 July 2012

The instructor should review the following with participants: Key questions and push back from industry is resistance to construction standards in Table N and the negative impact of an excavation this large in the OSS design component for the drainfield. Site limiting conditions (small lots and repair scenario's) would also raise debate on an inability to construct a soil test pit to the standard. Key points on this slide is that for Option A – the evaluator must restrict access and not step into the bottom of the trench off of the bench at 4" into the bottom of the 2' trench. Option B is allowable because it is 4 feet or less and doesn't require the excavation as pictured for the horizontal length of the trench – a ramp from the end is acceptable per LNI provided no entry in the "post hole" area of the excavation is done. Option C is unacceptable to the Table N requirements in all circumstances.

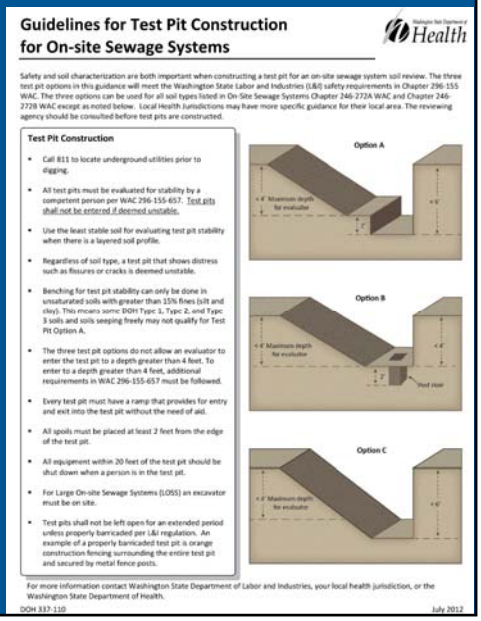
Responses would be to seek alternatives to identifying soil characteristics with other means.

Washington Soil Test Pit Configurations

CAUTION!

Test pits shall not be left open for an extended period unless properly barricaded per L&I regulation.

An example of a properly barricaded test pit is:
Orange construction fencing surrounding the entire test pit and secured by metal fence posts.



Guidelines for Test Pit Construction for On-site Sewage Systems

Health

Safety and soil characterization are both important when constructing a test pit for an on-site sewage system soil review. The three test pit options in this guidance will meet the Washington State Labor and Industries (L&I) safety requirements in Chapter 296-155 WAC. The three options can be used for all soil types listed in On-Site Sewage Systems Chapter 246-272A WAC and Chapter 246-272B WAC except as noted below. Local Health Jurisdictions may have more specific guidance for their local area. The reviewing agency should be consulted before test pits are constructed.

Test Pit Construction

- Call 811 to locate underground utilities prior to digging.
- All test pits must be evaluated for stability by a competent person per WAC 296-155-657. Test pits shall not be entered if deemed unstable.
- Use the least stable soil for evaluating test pit stability when there is a layered soil profile.
- Regardless of soil type, a test pit that shows distress such as fissures or cracks is deemed unstable.
- Benching for test pit stability can only be done in unsaturated soils with greater than 15% fines (silt and clay). This means some DOH Type 1, Type 2, and Type 3 soils and soils seeping freely may not qualify for Test Pit Option A.
- The three test pit options do not allow an evaluator to enter the test pit to a depth greater than 4 feet. To enter to a depth greater than 4 feet, additional requirements in WAC 296-155-657 must be followed.
- Every test pit must have a ramp that provides for entry and exit into the test pit without the need of aid.
- All spoils must be placed at least 2 feet from the edge of the test pit.
- All equipment within 20 feet of the test pit should be shut down when a person is in the test pit.
- For Large On-site Sewage Systems (LOSS) an excavator must be on site.
- Test pits shall not be left open for an extended period unless properly barricaded per L&I regulation. An example of a properly barricaded test pit is orange construction fencing surrounding the entire test pit and secured by metal fence posts.

Option A

Option B

Option C

For more information contact Washington State Department of Labor and Industries, your local health jurisdiction, or the Washington State Department of Health.

DOH 337-110 July 2012

The instructor should review the following with participants: Key questions and push back from industry is resistance to construction standards in Table N and the negative impact of an excavation this large in the OSS design component for the drainfield. Site limiting conditions (small lots and repair scenario's) would also raise debate on an inability to construct a soil test pit to the standard.

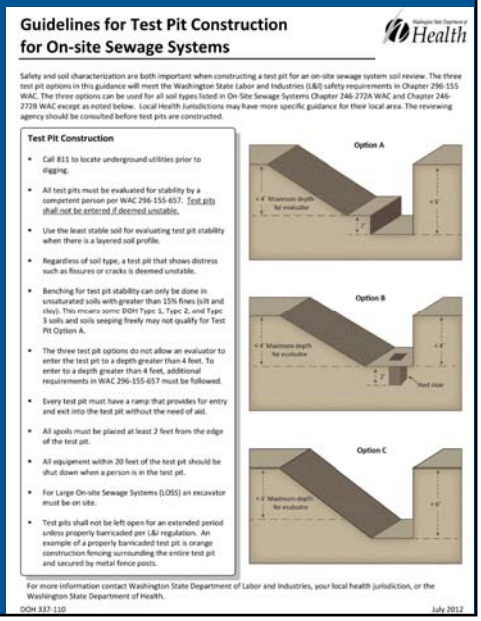
Responses would be to seek alternatives to identifying soil characteristics with other means.

Washington Soil Test Pit Configurations

Discussion?

What is local practice?

Does it comply?



Guidelines for Test Pit Construction for On-site Sewage Systems

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Safety and soil characterization are both important when constructing a test pit for an on-site sewage system soil review. The three test pit options in this guidance will meet the Washington State Labor and Industries (L&I) safety requirements in Chapter 296-155 WAC. The three options can be used for all soil types listed in On-Site Sewage Systems Chapter 246-272A WAC and Chapter 246-272B WAC except as noted below. Local Health Jurisdictions may have more specific guidance for their local area. The reviewing agency should be consulted before test pits are constructed.

Test Pit Construction

- Call 811 to locate underground utilities prior to digging.
- All test pits must be evaluated for stability by a competent person per WAC 296-155-657. Test pits shall not be entered if deemed unstable.
- Use the least stable soil for evaluating test pit stability when there is a layered soil profile.
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- Benching for test pit stability can only be done in unsaturated soils with greater than 15% fines (silt and clay). This means some DOH Type 1, Type 2, and Type 3 soils and soils seeping freely may not qualify for Test Pit Option A.
- The three test pit options do not allow an evaluator to enter the test pit to a depth greater than 4 feet. To enter to a depth greater than 4 feet, additional requirements in WAC 296-155-657 must be followed.
- Every test pit must have a ramp that provides for entry and exit into the test pit without the need of aid.
- All spoils must be placed at least 2 feet from the edge of the test pit.
- All equipment within 20 feet of the test pit should be shut down when a person is in the test pit.
- For Large On-site Sewage Systems (LOSS) an excavator must be on site.
- Test pits shall not be left open for an extended period unless properly barricaded per L&I regulation. An example of a properly barricaded test pit is orange construction fencing surrounding the entire test pit and secured by metal fence posts.

Option A

Option B

Option C

For more information contact Washington State Department of Labor and Industries, your local health jurisdiction, or the Washington State Department of Health.

DOH 337-110 July 2012

The instructor should review with participants: Key questions and push back from industry is resistance to construction standards in Table N and the negative impact of an excavation this large in the OSS design component for the drainfield. Site limiting conditions (small lots and repair scenario's) would also raise debate on an inability to construct a soil test pit to the standard.

Responses would be to seek alternatives to identifying soil characteristics with other means.

296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

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

Maximum allowable slopes, and allowable configurations for sloping and benching systems, must be determined in accordance with the conditions and requirements set forth in appendices A and B to this part.

Part N – Pages 15 -25

The instructor will principally focus on the fact that 95% or greater of the work done with OSS or side sewer work is typically 20’ or less.

Figure N-1
Slope Configurations for Type A Soil

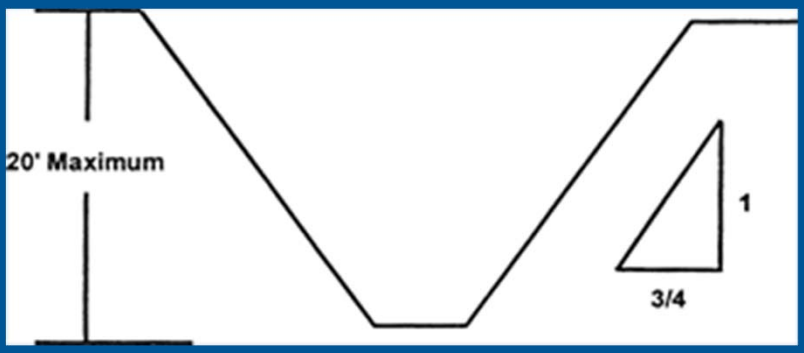
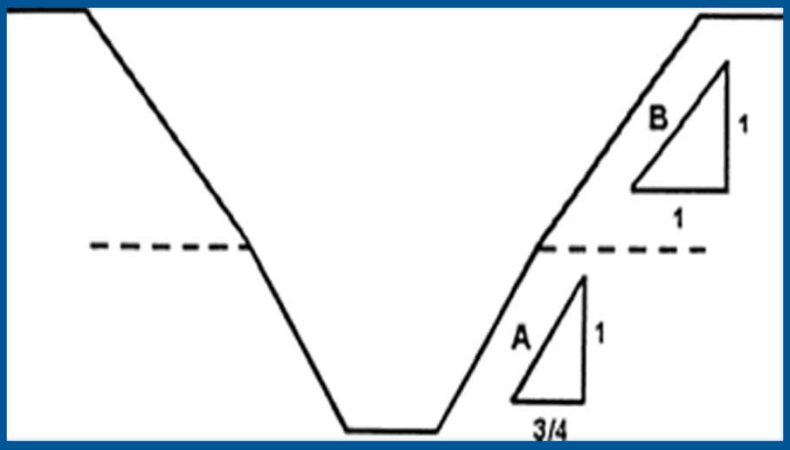


Figure N-14 Two distinct layers



296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

(c) Option 3—Designs using other tabulated data.
(i) Designs of sloping or benching systems must be selected from and be in accordance with tabulated data, such as tables and charts.
(ii) The tabulated data must be in written form and must include all of the following:
(A) Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;
(B) Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

Part N – Pages 26- 45

Review key points on slide including the program administrative requirements listed in the content of the slide.

296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) You must maintain at least one copy of the tabulated data which identifies the registered professional engineer who approved the data at the job site during construction of the protective system.

After that time the data may be stored off the job site, but you must make a copy of the data available to the director upon request.

Review key points on slide.

296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

(d) Option 4—Design by a registered professional engineer.

(i) Sloping and benching systems not utilizing Option 1 or Option 2 or Option 3 under subsection (2) of this section must be approved by a registered professional engineer.

(ii) Designs must be in written form and must include at least the following:

(A) The magnitude of the slopes that were determined to be safe for the particular project;

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(2) **Design of sloping and benching systems.**

(d) Option 4—Design by a registered professional engineer.

(ii) Designs must be in written form and must include at least the following:

(C) The identity of the registered professional engineer approving the design.

(iii) You must maintain at least one copy of the design at the job site while the slope is being constructed. After that time the design need not be at the job site, but you must maintain a copy available to the director upon request.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

Designs of support systems, shield systems, and other protective systems must be selected and constructed by the employer or employer's designee and must be in accordance with the requirements of subdivision (a); or, in the alternative, subdivision (b); or, in the alternative, subdivision (c); or, in the alternative, subdivision (d) as follows:

The instructor will principally focus on the fact that 95% or greater of the work done with OSS or side sewer work is typically 20’ or less.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

(a) Option 1—Designs using appendices A, C, and D. Designs for timber shoring in trenches must be determined in accordance with the conditions and requirements set forth in appendices A and C to this part.

Designs for aluminum hydraulic shoring must be in accordance with subdivision (b) of this subsection, but if manufacturer's tabulated data cannot be utilized, designs must be in accordance with appendix D.

Review key points on slide, the instructor should either reference availability of these appendices or have them available as a handout.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

(b) Option 2—Designs using manufacturer's tabulated data.

(i) Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data must be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

(ii) Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer must only be allowed after the manufacturer issues specific written approval.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

(b) Option 2—Designs using manufacturer's tabulated data.

(iii) Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations must be in written form at the job site during construction of the protective system.

After that time this data may be stored off the job site, but you must make a copy available to the director upon request.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

(c) Option 3—Designs using other tabulated data.

(i) Designs of support systems, shield systems, or other protective systems must be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data must be in written form and include all of the following:

(A) Identification of the parameters that affect the selection of a protective system drawn from such data;

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**
(c) Option 3—Designs using other tabulated data.

(B) Identification of the limits of use of the data;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) You must maintain at least one copy of the tabulated data, which identifies the registered professional engineer who approved the data at the job site during construction of the protective system. After that time the data may be stored off the job site, but you must make a copy of the data available to the director upon request.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

(d) Option 4—Design by a registered professional engineer.

(i) Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, must be approved by a registered professional engineer.

(ii) Designs must be in written form and must include the following:

(A) A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(3) **Design of support systems, shield systems, and other protective systems.**

(d) Option 4—Design by a registered professional engineer.

(B) The identity of the registered professional engineer approving the design.

(iii) You must maintain at least one copy of the design at the job site during construction of the protective system.

After that time, the design may be stored off the job site, but you must maintain a copy of the design available to the director upon request.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(4) **Materials and equipment.**

(a) Materials and equipment used for protective systems must be free from damage or defects that might impair their proper function.

(b) You must use and maintain manufactured materials and equipment used for protective systems in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(4) **Materials and equipment.**

(c) When material or equipment that is used for protective systems is damaged, a competent person must examine the material or equipment and evaluate its suitability for continued use.

If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then you must remove such material or equipment from service, and it must be evaluated and approved by a registered professional engineer before being returned to service.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(5) **Installation and removal of support.**

(a) General.

(i) Members of support systems must be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

(ii) You must install and remove support systems in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(5) **Installation and removal of support.**
(a) General.

(iii) You must not subject individual members of support systems to loads exceeding those which those members were designed to withstand.

(iv) Before temporary removal of individual members begins, you must take additional precautions to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(5) **Installation and removal of support.**
(a) General.

(v) Removal must begin at, and progress from, the bottom of the excavation. You must release members slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

(vi) Backfilling must progress together with the removal of support systems from excavations.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(6) **Sloping and benching systems.**

You must not permit employees to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(7) **Shield systems.**

(a) General.

(i) You must not subject shield systems to loads exceeding those which the system was designed to withstand.

(ii) You must install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) You must protect employees from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) You must not allow employees in shields when shields are being installed, removed, or moved vertically.

Review key points on the slide.

296-155-657 – Requirements for Protective Systems

(7) **Shield systems.**

(b) Additional requirement for shield systems used in trench excavations. Excavations of earth material to a level not greater than two feet (.61 m) below the bottom of a shield is permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

Review key points on the slide.

Competent Person Responsibilities

Responsibilities include:

- Understand the standards and rule
- Conduct tests for Soil Classification
- Determine proper protective system
- Recognize and reclassify soil when conditions change
- Monitor and inspect protective systems for damage and take it out of use if it becomes inadequate for protection

Review key points on the slide.

Competent Person Responsibilities

Responsibilities include:

- Evaluate site conditions and conduct air tests for hazardous atmosphere if needed
- Design of structural ramps within the scope of rule
- Locate underground installations and utilities
- Monitor water removal equipment and operation if used and when in use
- Perform and document daily inspections

Review key points on the slide. This area of responsibility is often not well defined, documented or enforced by small business employers.

Competent Person

Employer Requirements: Every excavation must have a "Competent Person"

Competent person. *"One who can identify existing or predictable hazards in the surroundings that are unsanitary, hazardous, or dangerous to employees. Also has authorization or authority by the nature of their position to take prompt corrective measures to eliminate them. The person must be knowledgeable in the requirements of this part."*

Review key points on the slide.

Classifying Soils

It is important to correctly classify soil type before selecting and using a protective system.

In order to classify soil, at least one visual test and one manual test are required to determine if the soil is Type A, Type B, or Type C.

Most engineers agree that less than 5% of the soil in Washington can be classified as Type A, and as soon as the Type A soil is disturbed, it must be down graded to a Type B.

NOTE: If you designate the soil as Type C, no testing is required.

Review key points on the slide. The instructor should highlight the differences between soil classification under the LNI Excavation and Trench Safety standards are a different scheme than that of OSS design soil classification methods for application loading rates. While the two overlap, they are inherently different. The competent person onsite should be trained to understand the variation in standards of application and how they relate to each other.

Soil characteristics

Type A: Good cohesive soil with a high compressive strength such as: clay, silty clay, sandy clay, clay loam and cemented soils such as caliche, duricrust and hardpan

Type B: Cohesive soil with a moderate compressive strength such as: silt, silty clay, sandy clay, clay loam, silt loam, sandy loam, angular gravel (similar to crushed rock), any previously disturbed fissured or soil or subject to vibration

Type C: Cohesive soil with a low compressive strength such as: granular soils including gravel, sand, and loamy sand or submerged soil or rock that is not stable or soil from which water is freely seeping

Review key points on the slide, if possible the instructor should provide some basic examples of soils for a more hands on approach to soil texturing.

Soil classification

- Type A
  - Fine grained
  - Doesn't crumble
  - Hard to break up when dry
  - Examples:
    - Clay
    - Hardpan
    - Silty or sandy clay, clay loam

Clay Loam

Clay

As more organic matter, silt and sand (together known as loam) gets mixed in and as the grains get larger, the classification will be degraded to type B. As the mix has less and less clay and organic matter in it becoming closer to pure sand or gravel it is further degraded to Type C.

Review key points on the slide, if possible the instructor should provide some basic examples of soils for a more hands on approach to soil texturing.

Soil Classification

Type A

Even if soil has high clay content and is plastic when moist, it cannot be classified as "Type A" if it is:

- fissured,
- has been previously disturbed, or
- subject to vibration from heavy traffic, etc.

This soil is fissured changing the classification from A to B

Clues for previously disturbed soil: soil discoloration, lack of vegetation, you dig and discover pipes or something else. If the work orders are specific to replacing existing pipes---this is a heads up that you are dealing with previously disturbed soil.

Review key points on the slide, if possible the instructor should provide some basic examples of soils for a more hands on approach to soil texturing.

Soil classification

Type B

- Granular: coarse grains
- Little or no clay content
- Crumbles easily when dry
- Examples:
  - **Silt**-fine mineral particles in size between clay and sand
  - **Loam**-from fragments of rock deposits in water
  - **Angular gravel**-crushed rock-the angular nature of the individual rocks provides some resistance to movement

Silty loam

Loam

Angular gravel

Review key points on the slide, if possible the instructor should provide some basic examples of soils for a more hands on approach to soil texturing.

Soil Classification

Type C *

- Granular soil: very coarse
- Minimal cohesion
- Examples:
  - Sand
  - Gravel
  - Loamy sand
  - Submerged soil or soil with freely seeping water
  - Submerged rock that is not stable.

Sand

Gravel

Loamy sand

* Type C is the most common soil classification in Washington.

Review key points on the slide, if possible the instructor should provide some basic examples of soils for a more hands on approach to soil texturing.

Types of Protection Systems

Your Choices are:

- Sloping and Benching
- Shoring System
  - Timber, Aluminum-Hydraulic
- Shield System
  - Steel Shield Box, Aluminum Box

The instructor should outline the choices and differences.

What are the protective system requirements?

Use protective systems when there is potential for cave-in for Class A, B, and C soils:

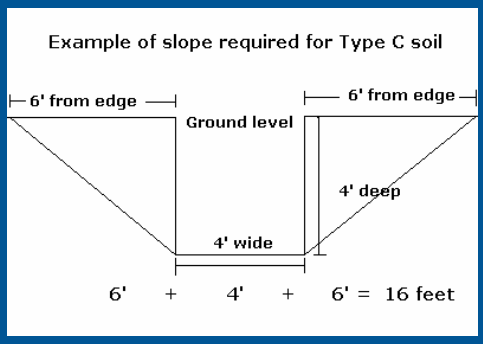
- **Under 4'** deep if a potential for a cave-in exists
- **4' to 20'** deep
  - Sloping or Benching (benching is not an option in C soil)
  - Shield or Shoring
- **Over 20'** deep - protective system must be designed by Registered Professional Engineer or approved in manufacturer's tabulated data
- Protective system is not required for stable rock

The instructor should review key points on slide.

Sloping

Sloping is the process of removing soil to eliminate the chance of a cave in.

The required maximum allowable slope is determined by the class of soil.



The requirements are as follows:

- For each foot of trench depth, the ratio of slope measured from the trench edge at ground height must be:

Soil Type A – ¾ to 1 (53°)

Soil Type B – 1 to 1 (45°)

Soil Type C – 1 ½ to 1 (34°)

The instructor should review key points on slide.

Shoring

Shoring is one of the most common used methods of worker protection. It is light-weight, portable and easy to install.

The manufacturer provides tabulated data with the shoring that provides the limitations, precautions, required spacing and proper use.

This photo shows an example of aluminum hydraulic shoring.

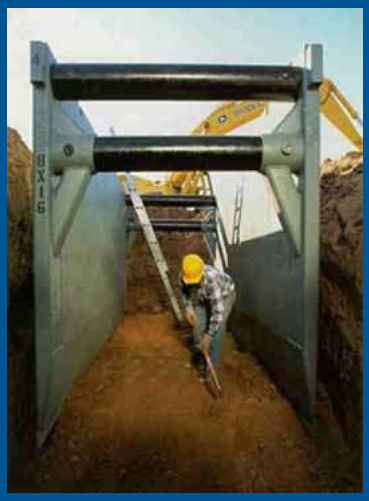
The instructor should review key points on slide.

Shields

Shields are manufactured by a number of companies and are designed to protect workers working within the confines of the shield.

Check tabulated data for the maximum allowable depth it can be used. The tabulated data must accompany the shield when it is being used.

Additionally, the shield must be designed by a Registered Professional Engineer, be in good condition, and used properly.



The instructor should review key points on slide. The instructor should also note that while many small business rely on the company they rent this equipment from, it is critical to provide the company renting the equipment with as much information as possible. It is also the employer's responsibility to ensure that the calculations or selections of protective equipment should be reviewed by the business owner to ensure its suitability for the work.

RPE-Designed Protective System

A Registered Professional Engineer can design a protection system for use on a specific project.

The RPE will consider the soil type and conditions as well as other concerns that might exist at the excavation site.

The system must be used as designed by the RPE.

Even with an RPE, the Competent Person must still perform daily inspections checking site conditions and any change.

Explain the elements and responsibilities of the RPE.

Other Shoring Method Examples

Must be designed by a registered professional engineer regardless of depth





The instructor should provide examples.

What is an Excavation?

- An excavation is any person-made cut, cavity, trench, or depression in the earth's surface.
- A trench is an excavation
- Employees must be protected from cave-in when the excavation is 4 feet or more in depth.
- Cave-in protection is not required when:
  - Excavations are made entirely in stable rock; or
  - They are less than 4 feet in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

This slide serves to revisit definitions and exceptions.

15 Fatalities Related to Excavation Activities in Washington State
1998 – 2008

Types of Incidents

Soil collapse (cave-in) = 7

Struck by machinery = 4

Struck by motor vehicle = 1

Struck by falling object = 1

Electrocution = 1

Fall = 1

This slide serves to review statistical references.

What makes trenches hazardous?

The factors shown in this illustration can create deadly conditions for workers.

The spoils pile and the equipment being too close to the vertical walls of the trench are called “surcharge loads” which increase the likelihood of collapse.

Additionally, equipment vibration, adverse weather conditions and ground water can change the condition and classification of the soil.

A “Competent Person” must take all of these factors into consideration and re-evaluate the jobsite periodically.

In a work setting, discuss how both an individual event can increase risk but coupling combined impacts (vibration and three days of rain)…can exacerbate the risk potential.

Example of a Hazardous Trench

This trench is well over 4’ deep, cut into loose sand (class C soil), that is sloughing off the trench walls. The spoils pile is a surcharged load. The shear weight of the spoils not being set at least 2 feet back from the vertical face increases the likelihood of a cave-in and it adds to the depth of the trench. If the trench is 8’ deep and the spoils pile is 8’ high directly at the edge, the trench is now 16’ deep! A trench that is 3’ deep could easily become 5-6’ deep if the spoils pile is on the edge.

Situational awareness is very low. The lack of perceived risk by the workers can be worse than the actual risk.

Hazardous Trench Example (con't.)

- The weight & vibration of the track-hoe also increases the probability of a collapse.
- The employees working in the trench are exposed to:
  - overhead hazards (no hard hats), and
  - trench collapse without a protective system
- It does not appear that safe access or egress has been provided.*

*A stairway, ramp, ladder or other safe means of egress must be located so workers don't have to travel more than 25 feet laterally in the trench.

Review the risk enhancements and discuss with the group potential remedies.

Another hazardous trench example

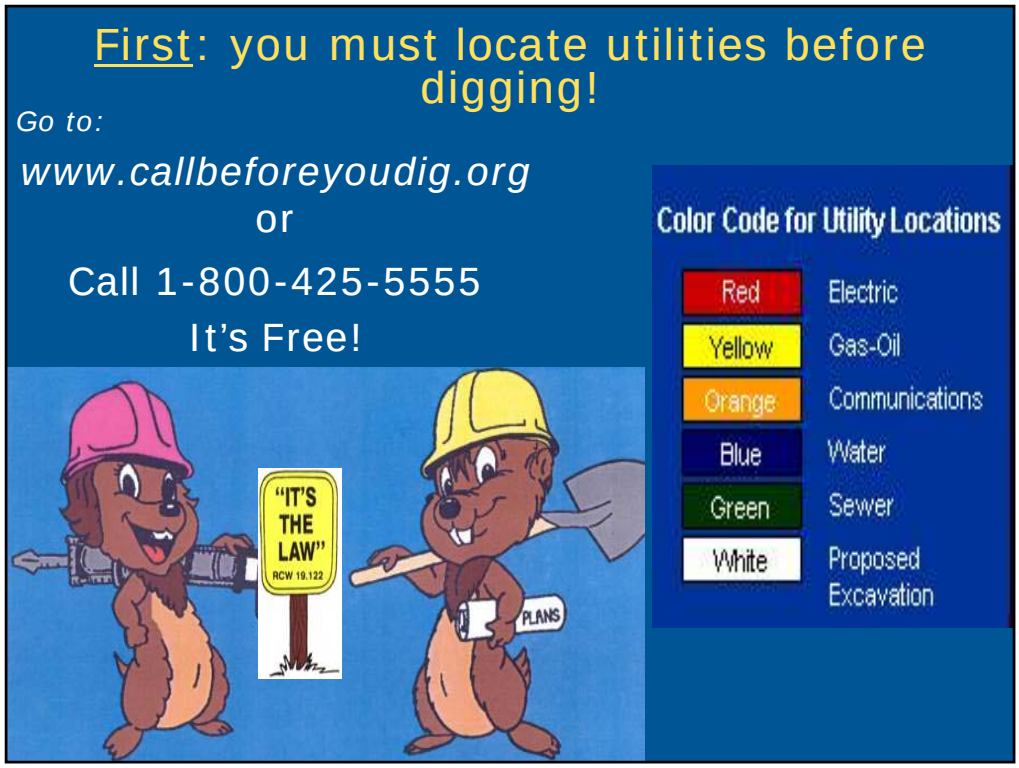
Nearby heavy equipment and the spoils pile directly on the right edge of the excavation both create a surcharge load. The protective system in this photo does not extend far enough up the trench to provide adequate protection for the two workers in the trench.

Review the risk enhancements and discuss with the group potential remedies.

Process for Safe Trench Work

- Identify knowledgeable competent person
- Check and verify above and below ground utility locations, any adjacent structures or surface encumbrances, and water table
- Determine soil classification through testing
- Choose the correct protective system for soil type
- Verify protective system installation and set-up
- Provide safe access
- Comply with requirements specified in the Excavation, Trenching, and Shoring regulations.
- Conduct daily inspections prior to the start of work, after any weather event, and as needed.

Review elements of the slide. The instructor can do Q&A with the group to anchor process controls as checklists so things are not forgotten.



The instructor should review the use of 811, but also to provide a context for the accuracy of the utility ID. It is commonly wrong or missed to a high unreliability. Beware!

Underground Installations (utilities)

You are required to to call for utility locates and once the locates have been identified onsite, the employer *must do an exact locate as specified by:*

WAC 296-155-655(2)(c)

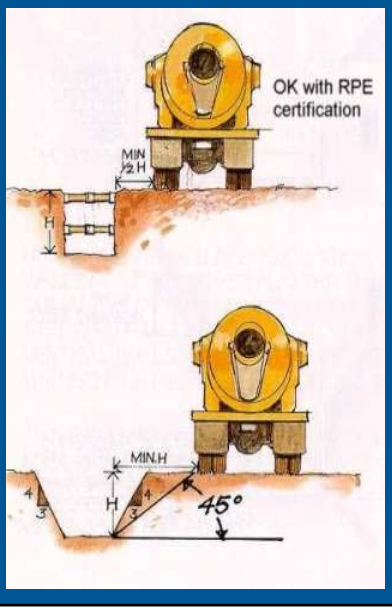
"When excavation operations approach the location of underground installations, the exact location of the installations shall be determined by safe and acceptable means."

Why do you need to do exact utility locates?

Because they are rarely spot-on, and older installations may not show up on current utility maps.

Discuss the learning points on the slide.

Controlling heavy vehicle surcharge loads



What does the 45-degree angle represent?

It represents the zone of influence or affected area. In other words, it represents the shear plane (weakest area), at which the excavation or trench wall will fail, and that is why it should always be kept clear of heavy equipment or machinery, and the spoils pile, *unless* the trench can be properly shored.

The instructor can provide relational discussions depending on the audience, but an easy visualization would be to replace the trucks with excavation equipment.

Controlling water accumulation

Water accumulation in a trench is hazardous because it erodes and changes soil; which means the stability of the soil is likely weakened.

Prevent water accumulation by using sump pumps, or create diversion ditches and dikes for natural drainage of streams interrupted by the excavation or in anticipation of heavy rainwater runoff, or consult with an RPE.

Special supports or shield systems may be needed if water accumulates on the trench floor.

This slide shows how water impact to an excavation can take you from a 6 to a 10 in very short order. Ask participants to share stories if they have them.

Water Accumulation Control System

Water accumulation hazards should be prevented by either using a special support or shield systems designed for water drainage issues, or water removal to control the level of accumulating water, or use of a safety harness and lifeline by workers inside excavation.

Water controlled through the use of pumps and other equipment setups must be monitored by a competent person to ensure proper operation.

Diversion ditches, dikes, or other suitable means should be used to prevent surface water or rainwater from entering and accumulating in the excavation.

A water control system that got out of hand!

There is the rule applied and real life. The instructor should engage the participants with their stories.

Provide safe entry and exit

A trench that is 4’ or more in depth must have a safe means for workers to get in and out of the trench.

A means of egress is required to be within 25’ of lateral travel.

The most common method for access is a straight ladder or an extension ladder. If a ladder is used, it must extend a minimum of 3’ above the landing. The use of step ladders is **not** permitted.

Other means could be a stairway or ramps or other means as designed by a RPE.

Locating the method of access/egress outside of the protective system is prohibited.

It is not uncommon for this element to be missed or ignored. Examples of this are highlighted in subsequent slides.

Provide safe entry and exit

Buckets of excavators, backhoes, etc.

are not to be used as a means of egress.

The instructor should point out that this is unsafe, but not uncommon.

Typical excavation for a replacement Septic Tank. Typical workflow of minimizing the potential for cracking the bottom of the tank when it is being set in place is to place and rake pea gravel into the excavation.

Solutions

Typical excavation for a replacement Septic Tank. Typical workflow of minimizing the potential for cracking the bottom of the tank when it is being set in place is to place and rake pea gravel into the excavation.

Deep installation of tanks can present a hazard when standard O&M work is being done.

The slide shows a deep installation of a septic tank. Shown are very dangerous conditions both from excavation collapse as well as unstable equipment potential. The follow on story here is that the project owners representative was onsite during this operation. The instructor should engage the class on responsibility and liability. Should the project owners representative have ordered a stop to the work?

Let the class work through this to see if they come up with the correct approach: which would be for the project owner to immediately advise the competent person of the unsafe condition, and report the situation to the general contractor's representative to the owner.

Deep installation of a septic tank, shown are very dangerous conditions both from excavation collapse as well as unstable equipment potential.

Deep installation (22’) of a sewer line 2.100 feet long. The instructor should ask participants to identify exposures that will need to be managed (power line, etc). The underlying soil in the excavation is pure sand and unstable due to recent rain activity as well as the basic nature of the soil.

Deep installation (22’) of a sewer line 2.100 feet long showing lots of equipment on site, ground is sand as deep as you can dig and impacted by water/rainfall due to the time of year. How would the class rate this soil profile based on what they see?

Deep installation (22’) of a sewer line 2.100 feet long showing lots of equipment on site, ground is sand as deep as you can dig and impacted slightly by water/rainfall due to time of year. Excavation collapse is severe and continuous. Spoils are not adequately set back from excavation and was caused by operating limits on equipment adjacent to the power lines.

Very tight working conditions: Single length, double stack with worker in the trench box. You can see he has placed a shovel at the back of the box to give him a physical warning of the limits. The competent person is monitoring, but the rule says egress must be provided. The instructor should point out in this slide: “Where is the ladder?” You can see it on the right hand side of the picture laying on the ground.

Intermittent rain and weather the previous several days contribute to worsening the ongoing and continual collapse of material into the excavation.

The ladder from the previous picture now is absent all together. The depth of the excavation and limit of the reach of the equipment make for very tight working conditions. The entrant in the bottom of the trench must communicate with the surface, who then communicates with the equipment operator.

Preparations are being made to move the boxes forward along the excavation progression.

Tight working conditions, point loading and vibration all are contributing to the continual collapse of the sidewalls of the excavation.

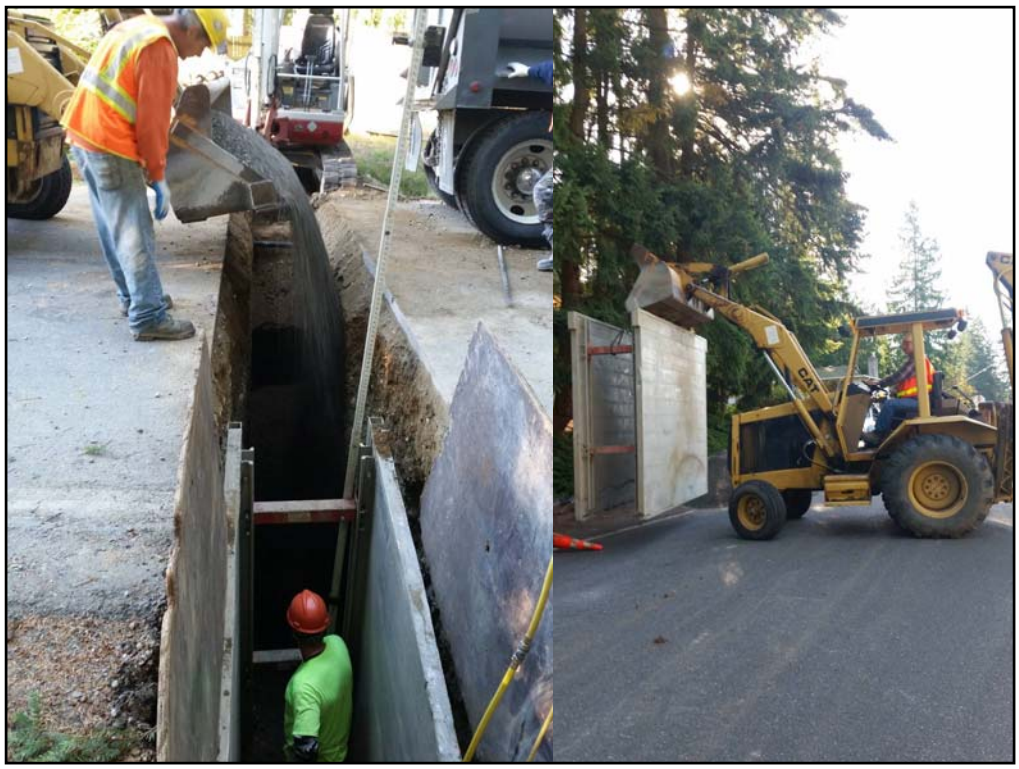
Spoils loading on the left of the picture cause caving due to point loading.

This slide is showing the ladder being made available to the worker, but the ladder was taken in and out of the excavation when the employee was working.

Collapsing material is being moved from the rear of the trench box as it collapses on a continuous basis.

This is not the same project in the previous case study picture, but an example of competent person site management with a third party delivery and dumping of material for backfill. The driver had delivered approximately 3 or 4 loads progressively along the excavation that was at the bottom of a slight slope and did not see that the slope angle had modestly changed, when the dump was raised, the trucks center of gravity shifted, spilling the load. Under other circumstances, the material had the potential to spill into the excavation where workers were.

This slide shows a residential side sewer job.



This slide is showing work on the site, trench box and equipment used for placement, backfilling, additional protection above the trench box to protect the worker.

The site is well organized (housekeeping).

A closer look at the sidewall of the trench excavation (8’ deep). Instructor can discuss soil type, change over time, if wet, if raining, etc.

Although the side walls of the excavation appear stable, once disturbed it is more like gravelly sand. The side walls of the trench once exposed to the air will begin to deteriorate

Because they did not set the choker chain correctly to pick and place the box, the worker climbed down to unhook chains, exposing himself to falls and struck-by exposures in the excavation that was not yet ready for workers, rescue etc.

Situational Awareness and Personal Safety

- Worker Close to Edge
- Working Equipment
- 8’ Fall

This slide shows a worker’s situation awareness when placing the box.

This slide shows a trench box placed and the height is too short. Under the rule, adjustments to protect the workers below must be made.

This and the next several slides show how to combine protection to make it effective.

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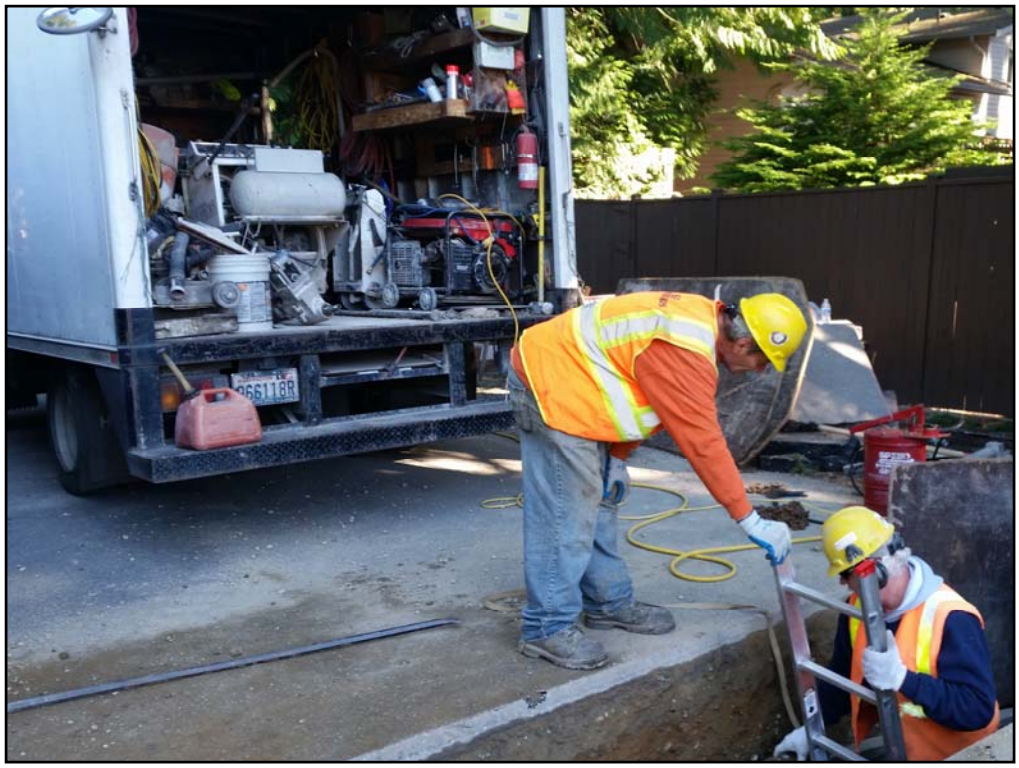
This and the next several slides show how to combine protection to make it effective.

This slide highlights that while most aspects of excavation safety are being addressed, not all are being met. The ladder needs to extend a minimum distance outside the excavation to specifically avoid these kind of entry and exit issues.

Workers are in the protection of the box but will be doing a principle task in tapping and connecting to the sewer main with no protection from the ends of the excavation.

Fairly tight working conditions require extra attention from the competent person. Should workers be pulled from the trench if they are just 15-20 feet away, on the right of the picture, or be allowed to continue working if they stay within their protection?



This is a third party contractor coming to cut the tap into the sewer main. With an electric saw, he backed up his truck to its location and fired up the gas generator. Exhaust fumes within a few feet of the excavation were excessive. The contractor plugged his hole saw into a 100’ extension cord. It would have been a simple matter for the competent person to request to the contractor when he set up, to park an additional 25-30 feet away from the trench and minimize the potential exposure of exhaust fumes in the trench and the requirements of CSE under the rule.

Workers in the protection of the trench boxes still have some exposure to material from the end of the trench face. The instructor should engage the class participants in what remedial action they would recommend to correct the exposure.

After the hole is cut, the worker has to extend outside of the protection to accomplish the next step in the project exposing himself. The instructor should emphasize that this is a rule violation.

This slide shows the depth of the trench and insufficient ladder length for the job. Should they stop work?

There is not enough protection for the job. Why didn’t they move the box? The slide shows the project supervisor outside the protection when the pipe is being laid and extended. The worker inside the trench box is safe, but has only been on the job for two months. What example is being set by the boss?

Most Common Trenching Violations

- No cave-in protective system being used when required by soil classification, depth, and code
- Excessive surcharge load (spoils piles too close to excavation wall or equipment or traffic too close to excavation operations)
- No access/egress for excavations 4 feet or more in depth
- No competent person/and requirements

The instructor should review the points on the slide.

An Employer only working in an unprotected excavation/trench can be cited by DOSH.

- If the employer is working in the trench alone (no employees in the trench) without using a protective system, the employer can be cited since, in the event of a cave-in, you are exposing every employee to cave-in hazards if they jump into the excavation to attempt rescue.
- See WRD 1.18 which describes DOSH policy

The instructor should review the points on the slide.

More information and training

Online Training course:
NIOSH -Trench Safety Awareness

OSHA e-Tool: OSHA Construction eTool: Trenching and Excavation

Oregon OSHA : “Excavations Safe Practices” publication:
http://www.cbs.state.or.us/osha/pdf/pubs/2174.pdf

DOSH excavation, Trenching and Shoring Rule:
http://www.lni.wa.gov/wisha/rules/construction/HTML/296-155N_1.htm

This slide provides additional reference material.

Questions?

If you have more questions on trenching and excavation:

- Call your local Labor and Industries office and ask to speak to a safety consultant.
- Click here to get local office locations and numbers:

lni.wa.gov/Main/ContactInfo/OfficeLocations

This slide shows a generic picture of an excavation collapse. There were decent conditions, dry, spoils well set back from edge, no equipment. Having an understanding of the soil profile changes when exposed to air over time is a critical tool for the competent person to understand.