Safety and Health Policy and Procedure Manual

TRENCHING AND EXCAVATION PROGRAM
Section 0150

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SOIL TYPES

1. **Stable Rock**: This is natural solid mineral matter that can be excavated with vertical sides and remain intact.

2. **Type A**: These are cohesive soils in which its unconfined compressive strength yields a result of 1.5 tons per square foot or greater. Type A soils may include clay, silty clay, sandy clay, and clay loam.
No soil is Type A if it:

- Is fissured
- Is subject to vibration
- Has been previously disturbed
- Is part of a slope, layered system which dips into the excavation on a slope of 4 horizontal to 1 vertical [4H:1V] or greater
- Is subject to other factors requiring classification as less stable

3. **Type B**: These are cohesive soils with an unconfined compressive strength yield of less than 1.5 tons per square foot, but more than 0.5 tons per square foot and also particular angular granular soils. Type B soils may include angular gravel, crushed rock, silt, and silt loam.
Some characteristics of Type B soil are:

- Granular cohesionless soils, e.g. gravel, silt, silt loam, sandy loam
- Previously disturbed soils, except those otherwise classed as Type C
- Type A fissured or subject to vibration
- Unstable dry rock
- Part of a sloped, layered system which dips into the excavation on a slope less steep than 4H:1V, but only if the material would otherwise be classified as Type B

4. **Type C**: These are cohesive soils with an unconfined compressive strength of 0.5 tons per square foot or less and cohesion less or submerged soils. Type C soils may include gravel, sand, loam, and submerged rock that is not stable.
Some characteristics of Type C Soil are:

- Submerged soil or soil from which water is freely seeping
- Submerged rock that is not stable
- Sloped, layered system which slopes into an excavation at an angle of 4H:1V or steeper

Soil Testing

Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, B, C. Refer to Appendix F.

Basis of classification shall be made based on results of at least one visual and at least one manual analysis. These tests are described below:

Visual Tests

- Excavated soil: particle size and clumping
- Excavation sides: cracks, spills layered systems
- Adjacent areas: existing utility and other underground structures, previously disturbed soil, surface water, sources of vibration

Manual Tests

- Plasticity
- Dry Strength
- Thumb Penetration
- Other Strength Tests
- Drying Tests

Definitions

Cohesive Soil:

- Clay or soil with a high clay content which has cohesive strength.
- Does not crumble, can be excavated with vertical sides.
- Plastic when moist, hard to break up when dry.
- Clay, clayey silt, silty clay, organic clay, sandy clay

Unconfined Compressive Strength:

The load per unit area at which a soil will fail in compression. Estimated in the field by use of a pocket penetrometer, thumb penetration test, and other methods.

Granular Soil:

- Gravel, sand, or silt with little or no clay content.
- No cohesive strength.

Cannot be molded when moist and crumbles easily when dry

Layered Systems:

- Two or more distinctly different soil or rock arranged in layers
- Micaceous seams or weakened planes in rock and shale
- The system is classified according to its weaker layer, except where a more stable layer lies under a less stable layer

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THE UNIVERSITY OF NORTH CAROLINA at GREENSBORO
EXCAVATION PERMIT

Date:

Organization:	**Facility:**	**Location:**
Competent Person:	**Title:**	**Telephone:**

Date Excavation to Begin:	**Date Excavation to be Filled:**
Person In Charge:	**Title:**

DESCRIPTION OF EXCAVATION:

DESCRIPTION OF SPECIAL HAZARDS:

EVALUATION BY COMPETENT PERSON

No.	Description	Findings	Action Taken
	1926.651 GENERAL REQUIREMENTS		
1.	Surface Encumbrances.		
2.	Underground installations.		
3.	Access and egress (ramps).		
4.	Means of egress from trenches.		
5.	Exposure to vehicular traffic.		
6.	Exposure to falling loads.		
7.	Warning system for mobile equipment.		
8.	Hazardous atmosphere.		
9.	Emergency rescue equipment.		
10.	Protection from hazards associated with water accumulation.		
11.	Stability of adjacent structures.		
12.	Protection from loose rock or soil.		
13.	Inspections.		
	1926.652 PROTECTIVE SYSTEMS		
14.	Protection of employees.		
15.	Design of sloping and benching.		
16.	Design of support systems, shield system, and other protective system.		
17.	Materials and equipment.		

19.	Sloping and benching system.		
20.	Shield systems.		

SOIL CLASSIFICATION

Cemented	Moist	
Cohesive	Plastic	
Dry	Saturated	
Fissured	Stable Rock	
Granular	Submerged Soil	
Layered System		

SOIL TYPE (Complete) - BASIS OF CLASSIFICATION

Stable Rock _____

Type A Soil_____

Type B Soil_____

Type C Soil_____

OTHER COMMENTS:

COMPETENT PERSON
SIGNATURE:_____

TITLE: _____ DATE

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THE UNIVERSITY OF NORTH CAROLINA at GREENSBORO
EXCAVATION CHECKLIST

Date:
Organization: _____ Facility: _____
Location: _____

Excavation Description:

Excavation By (Name):
Title:
Telephone:

REQUIREMENTS FOR EXCAVATION

No.	Item	Yes	No	Comments
1.	**SURFACE** Surface encumbrances are removed or supported			
2.	**UNDERGROUND** Underground utility installations have been determined prior to opening the excavation			
3.	Exact location of underground installation has been determined			
4.	Underground installation is protected, supported or removed while excavation is open			
5.	Structural ramps are used solely be employees designed by a competent person			
6.	Means of egress from trench excavations such as stairway, ladder, ramp, or other means are provided for 4-foot deep or more trench excavations and requires no more than 25 feet lateral travel to reach			
7.	**TRAFFIC** Warning vests or similar high-visibility material are worn by employees exposed to vehicular traffic			
8.	**LOADS** Employees are not permitted underneath loads handled by lifting or diggin equipment			
9.	**WARNING SYSTEM FOR MOBILE EQUIPMENT** A warning system such as barricades, hand and mechanical signals, or stop logs is used when mobile equipment is operated adjacent to an excavation or required to approach the edge of the excavation and the operator does not have a clear and direct view of the edge of the excavation			
10.	**HAZARDOUS ATMOSPHERES**			

	Where hazardous atmosphere may exist such as oxygen deficiency and/or atmospheric contaminants or flammable gas, the atmosphere in the excavation is tested before employees enter			
11.	**EMERGENCY RESCUE EQUIPMENT** Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, is readily available where hazardous atmospheric conditions exist or may develop			
12.	Attendant is provided for emergency rescue equipment			
13.	Employee entering bell-bottom pier holes or other similar deep and confined footing excavations, are wearing a harness with life-line securely attached and reports from material handling lines			
14.	Each life-line is individually attended at all times			
15.	**PROTECTION FROM WATER ACCUMULATION HAZARDS** Employees do not work in excavations in which water is accumulating, unless adequate precaution taken to protect against water accumulation hazards			
16.	When water is controlled or prevented from accumulating, the water removal equipment and operations are monitored by a competent person			
17.	If excavation interrupts the natural drainage of surface water, diversion ditches, dikes, or other suitable means are used to prevent surface water from entering the excavations and provide drainage			
18.	Excavations subject to runoff from heavy rains are inspected by a competent person to ensure protection from water accumulation hazards			
19.	**STABILITY OF ADJACENT STRUCTURES** Support systems such as shoring, bracing, or underpinning are provided to ensure stability of adjoining buildings, walls or other structures and protection of employees			
20.	Excavations below the base or footing of any foundation such as a retaining wall is not permitted unless a support system is provided, or the excavation is in solid rock, or approved by a registered professional engineer			
21.	Sidewalks, pavements, and appurtenant structures are not undermined unless supported by other protective systems used			
22.	**LOOSE ROCK AND SOIL** Employees are protected from loose rock or soil that could fall or roll on them by scaling, barricades, or other means			
23.	Excavated and other materials or equipment that could fall or roll on employees kept at least 2 feet from the edge and/or retaining devices used			
24.	**INSPECTIONS** Daily inspections are conducted by competent person prior to			

	starting work and as needed throughout the shift, and often during rainstorms or other hazard increasing occurrences when employee's exposure is expected			
25.	Exposed employees are removed from the hazardous area when competent person finds hazardous situations and do not return until the necessary precautions have been taken			
26.	**FALL PROTECTION** Walkways or bridges with standard guardrails are provided where employees or equipment cross over excavations			
27.	Remotely located excavations have adequate barriers			
28.	All wells, pits, shafts, etc. are barricaded or covered			
29.	Temporary wells, pits, shafts, etc. are backfilled			
30.	**PROTECTIVE SYSTEMS Sloping and Benching** Protective systems, including sloping and benching, shields, and other similar systems, are used to protect all employees in excavations except when: • in solid rock, or • less than 5 feet deep and approved by competent persons			
31.	Protective systems have the capacity to provide protection			
32.	Sloping and benching systems are selected and constructed in accordance with (options): 1. Allowable configurations and slopes, or 2. determination of slopes and configurations using Appendices A and B, or 3. designs using other tabulated date, or 4. designed by a registered professional engineer			
33.	**SUPPORT SYSTEMS** Design of support systems, shield systems, and other protective systems is in accordance with (options): 1. Designs using Appendices A, C, and D, or 2. designs using manufacturer's tabulated data, or 3. designs using other tabulated data, or 4. designed by a registered professional engineer			
34.	Materials and equipment used for protective systems is free from damage or defects and maintained per the manufacturer's recommendations			
35.	Competent person examines damaged equipment and evaluates suitability for continued use			
36.	**INSTALLATION AND REMOVAL OR SUPPORT** Members of support systems are securely connected			
37.	Support is installed and removed so as to protect employees			

	from cave-ins, collapses, or being struck			
38.	Support members do not exceed design loads			
39.	Additional precaution is taken before temporary removal of members			
40.	Support removal begins at, and progresses from, the bottom			
41.	Backfilling progresses with support removal			
42.	**ADDITIONAL REQUIREMENTS FOR SUPPORT SYSTEMS FOR TRENCHES** Material is not excavated greater than 2 feet below the bottom of support members unless designed for full depth of the trench and there is no loss of soil behind or beolw supports.			
43.	Support systems are installed closely with excavation.			
44.	Employees do not work on faces of sloped or benched excavations above employees except when the employees below are protected from falling, rolling, or sliding material or equipment			
45.	Shields are not subjected to loads exceeding design			
46.	Shields are installed to restrict lateral or other hazardous movement			
47.	Employees entering and exiting areas protected by shields are protected from cave-ins			
48.	Employees are not allowed in shields when the shields are being installed, removed, or moved vertically			
49.	Excavations are not permitted greater than 2 feet below the bottom of the shield unless it is designed for such situations and there is no loss of soil behind or below the shield			
NOTES:				
Completed By: _____ Date: _____ Title: _____				

Appendix F, Section 0150

THE UNIVERSITY OF NORTH CAROLINA at GREENSBORO
EXCAVATION SOIL CLASSIFICATION CHECKLIST

Date: _____
Organization: _____ Facility: _____
Location: _____

Competent Person: _____
Title: _____ Telephone: _____

EXCAVATION DESCRIPTION:

TEST NUMBER	1	2	3	4	5	6	7	8
Competent Person's Initials								
Dates of Soil Classification								
Soil Classification								

SCOPE:

This soil classification sheet describes a method of classifying soil and rock depostis based on site and environmental conditions, and on the structure and composition of the earth deposits.

APPLICATION:

Information contained in this sheet applies when a sloping or benching system is designed in accordance with OSHA 29 CFR 1926.652 (b)(2) Standard for the design of sloping and benching systems as a method for protecting employees from cave-ins. The sheet also applies for timber shoring (Appendix C to Supart P, 1926) for excavations and when aluminum hydraulic shoring is designed per Appendix D. It further applies if other protective systems are designed and selected for use per 1926.652 (c), and the design data is predicated on the use of the soil classification system in this sheet.

CLASSIFICATION OF SOIL AND ROCK DEPOSITS

REQUIREMENTS:

Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions found in Appendix A.

BASIS OF CLASSIFICATION:

Classification shall be based on the results of at least one visual and at least one manual analysis. The analyses shall be conducted using the tests described below or on other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials (ASTM), or the U.S. Department of Agriculture Textural Classification System.

VISUAL AND MANUAL ANALYSES

Visual and Manual analyses: The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of Appendix A, shall be designed and conducted to provide sufficient quantitative and qualitative information and may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

LAYERED SYSTEMS

Layered systems: In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

RECLASSIFICATION

Reclassification: If after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as nescessary to reflect the changed circumstances.

ACCEPTABLE VISUAL AND MANUAL TESTS

VISUAL TESTS	**TEST RESULTS**
(1) **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 from excavated material. (i) 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. Soil composed primarily of coarse-grained sand or gravel is granular material. (ii) 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. (iii) Observe the side of the opened excavation and the surface area subject 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. (iv) 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. (v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers. (vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the	

excavation, or the location of the water table level. (vii) 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 (2) **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. (i) **Plasticity:** Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50mm) length of 1/8-inch thread can be held on one end without tearing, the soil is cohesive. (ii) **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. (iii) **Thumb penetration:** The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. [This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488 - "Standard Recommended Practice for Description of Soils (Visual-Manual Procedure)".] Type A soils with an unconfined compressive strength of 1.5 tsf 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 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of soil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly. (iv) **Other strength tests:** Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane. (v) **Drying test:** The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry: (A) If the sample develops cracks as it dries, significant fissures are	**TEST RESULTS**

	indicated. (B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material and the unconfined compressive strength should be determined. (C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.	

OTHER COMMENTS:

COMPETENT PERSON'S SIGNATURE: _____
Title: _____ Date: _____

Appendix G, Section 0150

DEFINITIONS

Accepted engineering practices means requirements which are compatible with standards of practice required by a registered professional engineer.

Aluminum Hydraulic Shoring means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

Bell-bottom Pier Hole means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

Benching (Benching System) means 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.

Cave-in means 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, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.
Competent Person means 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.

Cross Braces mean 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.

Excavation means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Faces or Sides means the vertical or inclined earth surfaces formed as a result of excavation work.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous Atmosphere means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout means the accidental release or failure of a cross brace.

Protective System means 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

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

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

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

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

Shield (shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields".

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sides. See "Faces"

Sloping (Sloping System) means a method of protecting employees form 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.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Structural ramp means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

Support system means a structure such as underpinning, bracing , or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Tabulated Data means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Trench (Trench excavation) means 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 (4.6 m). 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.

Trench Box. See "Shield."

Trench Shield. See "Shield."

Uprights means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

Wales means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

Appendix H, Section 0150

THE UNIVERSITY OF NORTH CAROLINA at GREENSBORO
TRENCHING & EXCAVATION TRAINING CHECKLIST

Dept:_____ Training by: _____ Date: _____

___ Hazards involved with trenching and excavating
___ Soil identification
___ Safe slopes for difference soil types and conditions
___ Proper installation and shoring
___ Stress patterns on trench walls
___ Effects on trench walls caused by utilites, foundations, etc.
___ Weather conditions and its effects
___ Recognition of buried drums, containers, tanks, and wells

Trainees:

EMPLOYEE NAME	EMPLOYEE ID NUMBER	SIGNATURE

Route Copy to: Office of Safety

Appendix I, Section 0150

THE UNIVERSITY OF NORTH CAROLINA at GREESNBORO
TRENCHING & EXCAVATION TRAINING CHECKLIST
(For Competent Person Level)

Dept:_____ Trainer: _____ Date: _____

___Hazards involved with trenching and excavating
___ Soil Identification
___ Safe slopes for different soil types and conditions
___ Proper installation and shoring
___ Stress patterns on trench walls
___ Effects on trench walls caused by utilites, foundations, etc.
___ Weather conditions and its effects
___ Recognition of buried drums, containers, tanks, and wells
___ Responsibilities for job shutdown if hazardous conditions develop
___ Responsibilities for daily and periodic inspections
___ Requirements for proper egress from open excavations

Trainees:

EMPLOYEE NAME	EMPLOYEE ID NUMBER	SIGNATURE

Route copies to: Office of Safety