

University of North Dakota
Safety and Environmental Health Office

**Standard
Practice
310**

**EXCAVATION &
TRENCHING**

Effective July, 21 2004

I. PURPOSE

To establish a safe practice for work that occurs in and around *excavations** and *trenches**.

II. POLICY

The University of North Dakota strives to provide a safe and healthy environment for its students, faculty, staff, and visitors. *Excavation** and *trenching** work are recognized as some of the most hazardous construction operations. They can pose serious threats to safety and health if not performed in a safe manner. Therefore, this comprehensive standard practice for *excavation** and *trenching** must be followed to minimize the risk of injury or death to personnel in and around *excavations** and *trenches**.

III. SCOPE

This standard practice applies to all university workers, students, contractors, and visitors. This standard practice does not apply to *excavations** less than twelve inches (12”) in depth, such as gardening, landscaping, and normal maintenance of roads and streets (if the maintenance does not change the original grade and does not involve the road ditch).

IV. REFERENCES

OSHA Publication 2226 (Excavations), revised 2002.

OSHA Technical Manual, Section V, Chapter 2 (Excavations: Hazard Recognition in Trenching and Shoring), revised 1999.

* See section V (Definitions)

OSHA Standard 29 CFR Part 1926 Sub-part P (Excavations) sections 1926.650, 1926.651, 1926.652, and Appendices A-F.

North Dakota Century Code, Chapter 49-23 (One-Call Excavation Notice System).

North Dakota Workforce Safety and Insurance website.

Webster's New World Dictionary. Third College Edition of American English. 1991. Prentice Hall. New York, NY.

V. **DEFINITIONS** (Italicized throughout this standard practice)

ADA stands for the Americans with Disabilities Act.

Benching (*benching system*) means a method of protecting persons from *cave-ins* by excavating the sides of a *heavy excavation* to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in is the separation of a mass of soil or rock material from the side of an *excavation*, or the loss of soil from under a trench *shield* or support system. Its sudden movement into the *excavation*, either by falling or sliding, could entrap, bury, or otherwise injure and immobilize a person.

CFR stands for the Code of Federal Regulations.

Competent person means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to persons, and who has authorization to take prompt corrective measures to eliminate them. He or she must have documented training, experience, and knowledge of: soil analysis, *protective systems*, and the requirements of OSHA Standard 29 CFR Part 1926 Sub-part P (Excavations) sections 1926.650, 1926.651, 1926.652, and Appendices A-F. Competent person training is accomplished by successfully completing an excavation and trenching workshop or seminar.

Drastic climate change means any major change in climate: heavy rain, snow, wind, or severe changes in temperature or humidity. The stability of an *excavation* or *trench* can adversely be affected by increases or decreases in soil moisture content due to dryness, precipitation, temperature, or humidity changes. High winds or heavy snow can also affect or damage barricades, hazard signs, or *protective systems*.

Egress means "exit". In *heavy excavation* operations, it refers to the provision or safe means for persons to exit an *excavation* or *trench*.

Excavation means any manmade cut, cavity, *trench*, or depression in the earth's surface.

Excavator is any person, company, or department conducting an *excavation*.

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.

Heavy excavation means any manmade cut, cavity, *trench*, or depression in the earth's surface deeper than twelve inches (12") that allows for human entry for any period of time. It is formed by earth removal, through the means of hand/power tools or power equipment/machinery. This includes digging, *trenching*, tunneling, grading, exhuming, scraping, or any other *excavation* deeper than twelve inches (12") that allows for human entry for any period of time.

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

Ingress means "entry". In *heavy excavation* operations, it refers to the provision or safe means for persons to enter an *excavation* or *trench*.

Landing area is the upper-most horizontal surface to which a ladder rises.

Light excavation means any manmade cut, cavity, *trench*, or depression in the earth's surface deeper than twelve inches (12") that does not allow for human entry for any period of time. It is formed by earth removal, through the means of hand/power tools or power equipment/machinery. This includes digging, drilling, ditching, boring, core sampling, pile driving, post or pole setting, tree plantation or removal, cable or pipe plowing and driving, or any other *excavation* deeper than twelve inches (12") that doesn't allow for human entry for any period of time.

OSHA stands for the Occupational Safety and Health Administration.

Protective system means a method of protecting persons from *cave-ins*, material that could fall or roll from an *excavation* face into a *heavy excavation*, or the collapse of adjacent structures. Protective systems include: *shoring*, *shielding*, *sloping*, *benching*, and other systems that provide necessary protection.

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 practice when approving designs for manufactured *protective systems*.

Shield (shield system) means a structure that is able to withstand the forces imposed on it by a *cave-in* and thereby protecting persons within the structure. Shields can be permanent structures or can be designed to be portable to move along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with *OSHA* Standard 29 *CFR* Part 1926 Sub-part P (Excavations) sections 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 designed to support the sides of a *heavy excavation* in an effort to prevent *cave-ins*. It could be a hydraulic, pneumatic, mechanical, or timber system.

Sloping (sloping system) means a method of protecting persons from *cave-ins* by excavating to form sides of a *heavy excavation* that are inclined away from the *excavation*. The angle of incline required to prevent a *cave-in* varies with differences in such factors as soil type, environmental conditions of exposure, and application of excessive vertical loads above the *heavy excavation*. Excessive vertical loads above a *heavy excavation* may be caused by *spoil*, overburden, vehicles, equipment, vibrations, or other activities affecting *trench* stability.

Spoil (spoil pile) is the material (soil and/or rock) removed during an *excavation*. After the *excavation* is complete, spoil serves as fill.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

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.

Surface encumbrance is something that causes an obstruction or hindrance for persons working in and around an *excavation*.

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

Timber shoring is a *shoring system* comprised of wood posts, wales, struts, and sheeting.

Trained person means an individual who has had documented training of the procedures contained in this standard practice as they relate to safely working in and around *light* and *heavy excavations*. This training could be provided by a *competent person* or by successfully completing an excavation and trenching workshop or seminar.

Trench (trench excavation) means a narrow *excavation* (in relation to its length) made below the surface of the ground. The depth is greater than the width, but the width measured at the bottom is not greater than fifteen feet (15'). 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 fifteen feet (15') or less (measured at the bottom of the *excavation*), the *excavation* is also considered to be a trench.

VI. PROCEDURE

A. Underground Utility Location

1. All underground utilities must be properly identified before any *excavation* work can begin. These include: water, steam, sewer, drain, electricity, gas, communication (telephone, cable, fiber optic, etc.), oil, or gasoline.
2. The *excavator* must be responsible for contacting the North Dakota One-Call Excavation Notice System (1-800-795-0555), or other applicable utility location service when *excavation* occurs outside of North Dakota. Except in an emergency, the *excavator* shall contact the notification center and provide at least a full 48-hour grace period (initiating from the time the call was placed) before any *excavation* work begins, excluding Saturdays, Sundays, and holidays. Refer to Chapter 49-23 of the North Dakota Century Code for more details on notification exceptions, holiday information, and *excavation* information required by the notification center.
3. In the event of an emergency *excavation*, local emergency responders must be alerted. An emergency locate request must also be made with North Dakota One-Call Excavation Notice System.

B. Light Excavation

1. Traffic Control

(a) Work Traffic Control

(1) Motorized Work Vehicle Traffic

- i. When motorized work vehicle traffic is interrupted, barricade all *light excavations* and provide flashers.
- ii. Provide a safe, alternate route for motorized work traffic if needed.

- iii. Use proper hazard signs for as long as the *light excavation* exists. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.

(2) Worker Foot Traffic

- i. Persons exposed to public vehicle traffic shall be provided with, and shall wear warning vests or other suitable garments. These shall be marked with or made of reflectorized or highly visible material.
- ii. When possible, re-route public vehicle traffic to completely avoid a construction site. Refer to the Barriers and Guards section found under Construction Safety in the Safety and Loss Control Manual.

(b) Public Traffic Control

(1) Motorized Public Vehicle Traffic

- i. Barricade all *light excavations* and provide flashers when motorized public vehicle traffic is interrupted.
- ii. Provide a safe, alternate route for motorized public traffic if needed.
- iii. Use proper hazard signs for as long as the *light excavation* exists. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.

(2) Non-motorized Public Vehicle Traffic (Refer to the Non-motorized Vehicle Safety section found under Vehicle Safety in the Safety and Loss Control Manual)

- i. Barricade all *light excavations* when non-motorized public vehicle traffic is interrupted.
- ii. Provide a safe, alternate route for non-motorized public vehicle traffic if needed.
- iii. Use proper hazard signs for as long as the *light excavation* exists. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.

(3) Public Foot Traffic

- i. Barricade all *light excavations* when public foot traffic is interrupted.
- ii. Provide a safe, alternate route if needed.

- iii. Use proper hazard signs for as long as the *light excavation* exists. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.

(4) Persons with Disabilities

If accessible public walkways, ramps, or parking must be blocked or altered at anytime for disabled persons, an alternate route or parking space must be provided that preserves original *ADA* requirements and guidelines. Refer to the *ADA* section found under General Safety in the Safety and Loss Control Manual.

2. Preliminary Work Procedure

- (a) Locate all underground utilities before any *light excavation* work begins. Refer to section **VI.A** (Underground Utility Location) of this standard practice for correct procedures on locating underground utilities.
- (b) All *surface encumbrances* that are located so as to create a hazard to persons shall be removed or supported as necessary, to ensure safety.
- (c) A *competent person* must decide if the *light excavation* presents the possibility of a *hazardous atmosphere*, depending on location and depth of *excavation*. Where there is the possibility of a *hazardous atmosphere* in a *light excavation*, extra precautions must be used. Refer to the Confined Spaces section found under Industrial Safety in the Safety and Loss Control Manual.
- (d) Plan for the control of traffic if applicable. Refer to section **VI.B.1** (Traffic Control for Light Excavation) of this standard practice for correct procedures on controlling traffic in and around a *light excavation*.

3. Work Procedure

- (a) Once the preliminary work procedures have been completed, contact the *competent person* or *trained person* to inspect the work site. Be sure the Pre-Inspection of Excavation Work (Form 310-A) has been completed before work begins.
- (b) Maintain safe general construction practices throughout the entire *light excavation*. Refer to the General Construction Safety section found under Construction Safety in the Safety and Loss Control Manual.

- (c) If it is suspected by a person that a *hazardous atmosphere* exists any time during the *light excavation*, an evaluation must be made immediately by a trained or *competent person* to determine whether work must cease and extra precautions be taken. Refer to the Confined Spaces section found under Industrial Safety in the Safety and Loss Control Manual.
- (d) Always use appropriate personal protective equipment. Refer to the Personal Protective Equipment section found under the same title in the Safety and Loss Control Manual.
- (e) For proper use of hand or power tools during a *light excavation*, refer to the Hand Tools/Power Tools section found under Industrial Safety in the Safety and Loss Control Manual.
- (f) Operators and workers must stay alert around excavation equipment and zones of danger when equipment is being used. No person shall operate any excavation machinery without proper training. Refer to the Heavy-Equipment section found under Vehicle Safety in the Safety and Loss Control Manual.
- (g) Notify the supervisor if one's ability to perform work safely becomes affected by taking any medication. Refer to the Drugs and Alcohol section found under General Safety in the Safety and Loss Control Manual.
- (h) Whenever natural light is insufficient to adequately illuminate the work site, artificial illumination shall be provided to enable the person to perform the work safely.
- (i) Take proper safety precautions while working around exposed utility lines. Prior to working around any located utility line, approval and assistance must be received from the utility manager.
- (j) Stand away at a safe distance from equipment or material being loaded or unloaded. Never go beneath a suspended load. Any time a load is left suspended, and there is a risk of traffic traveling beneath, the area beneath the load shall be properly barricaded. Proper hazard signs will be required for as long as the load is a risk. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- (k) If at any time the *light excavation* turns into a *heavy excavation* by definition, then *heavy excavation* procedures must be followed. Refer to section **VI.C** (Heavy Excavation) of this standard practice for correct procedures during *heavy excavation* work.

4. Postwork Procedure

Maintain proper control of traffic until job has been completed. All barricades, flashers, and warning signs are to remain in place until the *light excavation* is completely finished. If traffic has been detoured during the *excavation*, re-direct traffic back to the original route in a safe manner.

C. Heavy Excavation

1. Traffic Control

(a) Work Traffic Control

(1) Motorized Work Vehicle Traffic

- i. Work vehicles located close to the edge of a *heavy excavation* add an excessive vertical load of weight above the *excavation*. No vehicle shall be parked closer than twenty feet (20') from the edge of a *heavy excavation*, unless the *competent person* determines the *protective system* is designed to withstand the excess load.
- ii. Barricade all open *heavy excavations* and provide flashers when work vehicle traffic is interrupted.
- iii. Provide a safe, alternate route for motorized work traffic if needed.
- iv. Use proper hazard signs for as long as the *heavy excavation* stays open. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- v. Surface crossing of *heavy excavations* by motorized work vehicles should be discouraged. However, if *heavy excavations* must be crossed by a motorized work vehicle, such crossings must be designed by and installed under the supervision of a *registered professional engineer*.

(2) Worker Foot Traffic

- i. Persons exposed to public vehicular traffic shall be provided with and shall wear warning vests or other suitable garments. These shall be marked with or made of reflectorized or highly visible material.
- ii. When possible, re-route public vehicle traffic to completely avoid a construction site. Refer to the Barriers and Guards section found under Construction Safety in the Safety and Loss Control Manual.
- iii. Barricade all open *heavy excavations* when worker foot traffic is interrupted.
- iv. Provide a safe, alternate route for foot traffic if needed.

- v. Use proper hazard signs for as long as the *heavy excavation* stays open. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- vi. Surface crossing of *heavy excavations* by foot traffic should be discouraged. However, if *heavy excavations* must be crossed by foot traffic, walkways or bridges must be provided. Such crossings are permitted only when walkways or bridges meet the following conditions:
 - Have a safety factor of four (designed to hold four times the expected maximum load).
 - Have a minimum width of twenty inches (20”), or meet *ADA* requirements for workers with disabilities if any are present.
 - Are fitted with standard rails.
 - Extend to a minimum of twenty-four inches (24”) past the surface edge of the *heavy excavation*.

(b) Public Traffic Control

(1) Motorized Public Vehicle Traffic

- i. Barricade all open *heavy excavations* and provide flashers when motorized public vehicle traffic is interrupted.
- ii. Provide a safe, alternate route for motorized public traffic if needed.
- iii. Use proper hazard signs for as long as the *heavy excavation* stays open. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- iv. Public vehicle traffic creates dangerous vibrations through the ground. When *heavy excavations* five feet (5’) or deeper take place near areas with heavy traffic, a *competent person* shall either divert traffic to a safe distance or design a *protective system* capable of withstanding the added vibration.
- v. Surface crossings of *heavy excavations* by motorized public vehicles should be discouraged. However, if *heavy excavations* must be crossed by public motorized vehicles, such crossings must be designed by and installed under the supervision of a *registered professional engineer*.

(2) Non-motorized Public Vehicle Traffic (Refer to the Non-motorized Vehicle Safety section found under Vehicle Safety in the Safety and Loss Control Manual)

- i. Barricade all open *heavy excavations* when non-motorized public vehicle traffic is interrupted.

- ii. Provide a safe, alternate route for non-motorized public vehicle traffic if needed.
- iii. Use proper hazard signs for as long as the *heavy excavation* stays open. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- iv. Surface crossing of *heavy excavations* by non-motorized public vehicles is not permitted unless occupant has been removed from vehicle and walks across. Refer to the following section **VI.C.1(b)(3)iv** for correct procedures on surface crossing a *heavy excavation* by public foot traffic.

(3) Public Foot Traffic

- i. Barricade all open *heavy excavations* when public foot traffic is interrupted.
- ii. Provide a safe, alternate route if needed.
- iii. Use proper hazard signs for as long as the *heavy excavation* stays open. Refer to the Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- iv. Surface crossing of *heavy excavations* by public foot traffic should be discouraged. However, if *heavy excavations* must be crossed by public foot traffic, walkways or bridges must be provided. Such crossings are permitted only when walkways or bridges meet the following conditions:
 - Have a safety factor of four (designed to hold four times the expected maximum load).
 - Preserve the original width of the walkway, and meet *ADA* requirements for persons with disabilities.
 - Are fitted with standard rails.
 - Extend to a minimum of twenty-four inches (24”) past the surface edge of the *heavy excavation*.

(4) Persons with Disabilities

If accessible public walkways, ramps, or parking must be blocked or altered at anytime for disabled persons, an alternate route or parking space must be provided that preserves original *ADA* requirements and guidelines. Refer to the *ADA* section found under General Safety in the Safety and Loss Control Manual.

2. Specific Safety Requirements for Heavy Excavations and Trenches

The following *OSHA* Specific Excavation Requirements can be found in *OSHA* Standard 29 *CFR* section 1926 Sub-part P (Excavations) section 1926.651. These must be followed to ensure safety in and around *heavy excavations* and *trenches*. These include:

Surface encumbrances, ingress, egress, structural ramping, falling load exposure, mobile equipment warning systems, hazardous atmospheres, emergency rescue equipment, standing water and water accumulation, stability of adjacent structures, inspections, protection of persons from loose rock or soil, and fall protection.

3. Preliminary Work Procedure

(a) Heavy excavation resulting in a hole or trench one foot (1') or greater but not exceeding four feet (4') in depth:

- (1) Locate all underground utilities before any work begins. Refer to section **VI.A** (Underground Utility Location) of this standard practice for correct procedures on locating underground utilities.
- (2) All *surface encumbrances* that are located so as to create a hazard to persons shall be removed or supported as necessary to ensure safety.
- (3) A *competent person* must decide if the *heavy excavation* presents the possibility of a *hazardous atmosphere*, depending on location and depth of *heavy excavation*. Where there is the possibility of a *hazardous atmosphere* in a *heavy excavation*, extra precautions must be used. Refer to the Confined Spaces section found under Industrial Safety in the Safety and Loss Control Manual.
- (4) Plan for the control of traffic if applicable. Refer to section **VI.C.1** (Traffic Control for Heavy Excavation) of this standard practice for correct procedures on controlling traffic in and around a *heavy excavation*.

(b) Heavy excavation resulting in a hole or trench four feet (4') or greater but not exceeding five feet (5') in depth:

- (1) Locate all underground utilities before any work begins. Refer to section **VI.A** (Underground Utility Location) of this standard practice for correct procedures on locating underground utilities.

- (2) All *surface encumbrances* that are located so as to create a hazard to persons shall be removed or supported as necessary to ensure safety.
 - (3) A *competent person* must decide if the *heavy excavation* presents the possibility of a *hazardous atmosphere*, depending on location and depth of *heavy excavation*. Where there is the possibility of a *hazardous atmosphere* in a *heavy excavation*, extra precautions must be used. Refer to the Confined Spaces section found under Industrial Safety in the Safety and Loss Control Manual.
 - (4) A *competent person* must examine conditions to determine possibility for *cave-in*. If the potential for *cave-in* exists, refer to Appendix A of this standard practice to determine what type of *protective system* design is required. If soil classification is needed, refer to Appendix D.
 - (5) Provide a safe *ingress and egress*, such as a ladder, staircase or *structural ramp*. Ramps made of soil or rock, are not considered *structural ramps*. *Egress* must be within twenty-five feet (25') of every person inside the *heavy excavation*. Ladders must extend three feet (3') above the *landing area*. Refer to the Ladder section found under Industrial Safety in the Safety and Loss Control Manual for safe guidelines while working with ladders.
 - (6) *Spoil piles* must be placed no closer than two feet (2'), measured from the edge of the *heavy excavation* to the edge of the *spoil pile*. Also, keep materials or equipment that might fall or roll into a *heavy excavation* at least two feet (2') from the edge of the *excavation* or use retaining devices, or both.
 - (7) Plan for the control of traffic if applicable. Refer to section **VI.C.1** (Traffic Control for Heavy Excavation) of this standard practice for correct procedures on controlling traffic in and around a *heavy excavation*.
- (c) **Heavy excavation resulting in a hole or trench five feet (5') or greater but not exceeding twenty feet (20') in depth:**
- (1) Locate all underground utilities before any work begins. Refer to section **VI.A** (Underground Utility Location) of this standard practice for correct procedures on locating underground utilities.
 - (2) All *surface encumbrances* that are located so as to create a hazard to persons shall be removed or supported as necessary, to ensure safety.

- (3) A *competent person* must decide if the *heavy excavation* presents the possibility of a *hazardous atmosphere*, depending on location and depth of *excavation*. Where there is the possibility of a *hazardous atmosphere* in a *heavy excavation*, extra precautions must be used. Refer to the Confined Spaces section found under Industrial Safety in the Safety and Loss Control Manual.
 - (4) An adequate *protective system* must be used to protect against *cave-ins*, unless *heavy excavation* is entirely in *stable rock*. Refer to Appendices B and C of this standard practice to determine what *protective system* design is required. If soil classification is needed, refer to Appendix D.
 - (5) Provide a safe *ingress and egress*, such as a ladder, staircase or *structural ramp*. Ramps made of soil or rock, are not considered structural ramps. *Egress* must be within twenty-five feet (25') of every person inside *heavy excavation*. Ladders must extend three feet (3') above the *landing area*. Refer to the Ladder section found under Industrial Safety in the Safety and Loss Control Manual for safe guidelines while working with ladders.
 - (6) *Spoil piles* must be placed no closer than two feet (2'), measured from the edge of the *heavy excavation* to the edge of the spoil pile. Also, keep materials or equipment that might fall or roll into a *heavy excavation* at least two feet (2') from the edge of the *excavation* or use retaining devices, or both.
 - (7) Plan for the control of traffic if applicable. Refer to section **VI.C.1** (Traffic Control for Heavy Excavation) of this standard practice for correct procedures on controlling traffic in and around a *heavy excavation*.
- (d) Heavy excavation resulting in a hole or trench exceeding twenty feet (20') in depth:**
- (1) All preliminary work procedures previously mentioned for *heavy excavations* greater than five feet (5') but less than twenty feet (20') in depth must be followed, except for determining an adequate *protective system*.
 - (2) A *registered professional engineer* must design the *protective system*.

4. Work Procedure

- (a) Once the preliminary work procedures have been completed, contact the *competent person* to inspect the *protective system* and work site. Be sure the Pre-Inspection of Excavation Work (Form 310-A) has been completed before work begins.
- (b) Maintain safe general construction practices throughout the entire *heavy excavation*. Refer to the General Construction Safety section found under Construction Safety in the Safety and Loss Control Manual.
- (c) If it is suspected by a person that a *hazardous atmosphere* exists any time during the *heavy excavation*, an evaluation must be made immediately to determine whether work must cease and extra precautions be taken. Refer to the Confined Spaces section found under Industrial Safety in the Safety and Loss Control Manual.
- (d) A *competent person* must inspect the *heavy excavation* site before every eight-hour work shift, or if any *drastic climate change* occurs.
- (e) While working in and around the *heavy excavation*, follow all of the *OSHA* regulations in *OSHA* Standard 29 *CFR* Part 1926 Sub-part P (Excavations).
- (f) Always use appropriate personal protective equipment. Refer to the Personal Protective Equipment section found under the same title in the Safety and Loss Control Manual.
- (g) For proper use of hand or power tools during a *heavy excavation*, refer to the Hand Tools/Power Tools section found under Industrial Safety in the Safety and Loss Control Manual.
- (h) Operators and workers must stay alert around excavation equipment and zones of danger when equipment is being used. No person shall operate any excavation machinery without proper training. Refer to the Heavy-Equipment section found under Vehicle Safety in the Safety and Loss Control Manual.
- (i) Notify the supervisor if one's ability to perform work safely becomes affected by taking any medication. Refer to the Drugs and Alcohol section found under General Safety in the Safety and Loss Control Manual.

- (j) Whenever natural light is insufficient to adequately illuminate the work site, artificial illumination shall be provided to enable the person to perform the work safely.
- (k) Take proper safety precautions while working around exposed utility lines.
- (l) Prohibit persons from working on faces of *sloped* or *benched heavy excavations* at levels above other persons, unless you provide the persons at the lower levels adequate protection from the hazard of falling, rolling, or sliding material or equipment.
- (m) Stand away at a safe distance from equipment or material being loaded or unloaded. Never go beneath a suspended load. Any time a load is left suspended and there is a risk of traffic traveling beneath, the area beneath the load shall be properly barricaded. Proper hazard signs will be required for as long as the load is a risk. Refer to Signs and Warning Labels section found under General Safety in the Safety and Loss Control Manual.
- (n) Maintain proper control of traffic while working in and around *heavy excavations*. Refer to section **VI.C.1** (Traffic Control for Heavy Excavation) of this standard practice for correct procedures on controlling traffic in and around a *heavy excavation*.

5. Postwork Procedure

Maintain proper control of traffic until job has been completed. All barricades, flashers, and warning signs are to remain in place until *heavy excavation* is completely finished. If traffic has been detoured during the *heavy excavation*, re-direct traffic back to the original route in a safe manner.

D. Training

All persons working in and around (within twenty feet (20')) *light excavations* and/or *heavy excavations* or *trenches* must be either a *trained* or *competent person*.

- 1. Competent person** (see definitions)
- 2. Trained Person** (see definitions)

VII. RESPONSIBILITIES

A. Safety and Environmental Health Will:

1. Ensure that the requirements of this standard practice remain current with applicable regulatory directives.
2. Coordinate/consult with departments on *heavy excavation* and *trenching* issues.
3. Provide resources on safe *heavy excavation* and *trenching* standards.
4. Provide or assist supervisors in coordinating training for *competent person(s)* and *trained person(s)*.

B. Supervisors shall:

1. Ensure that requirements of this standard practice are being followed in their work area by conducting reviews, spot checks, and other warranted follow-up action.
2. Plan for the necessary funding to ensure safe work procedures are implemented for all *heavy excavation* and *trench* work.
3. Initiate corrective action for deficient items noted in their area of supervision.
4. Ensure adequate training be provided and documented.

C. Personnel shall:

1. Follow the requirements of this standard practice.
2. Report any problems of unsafe practices to their supervisor.

This standard practice is approved.

Chair, University Loss Control Committee

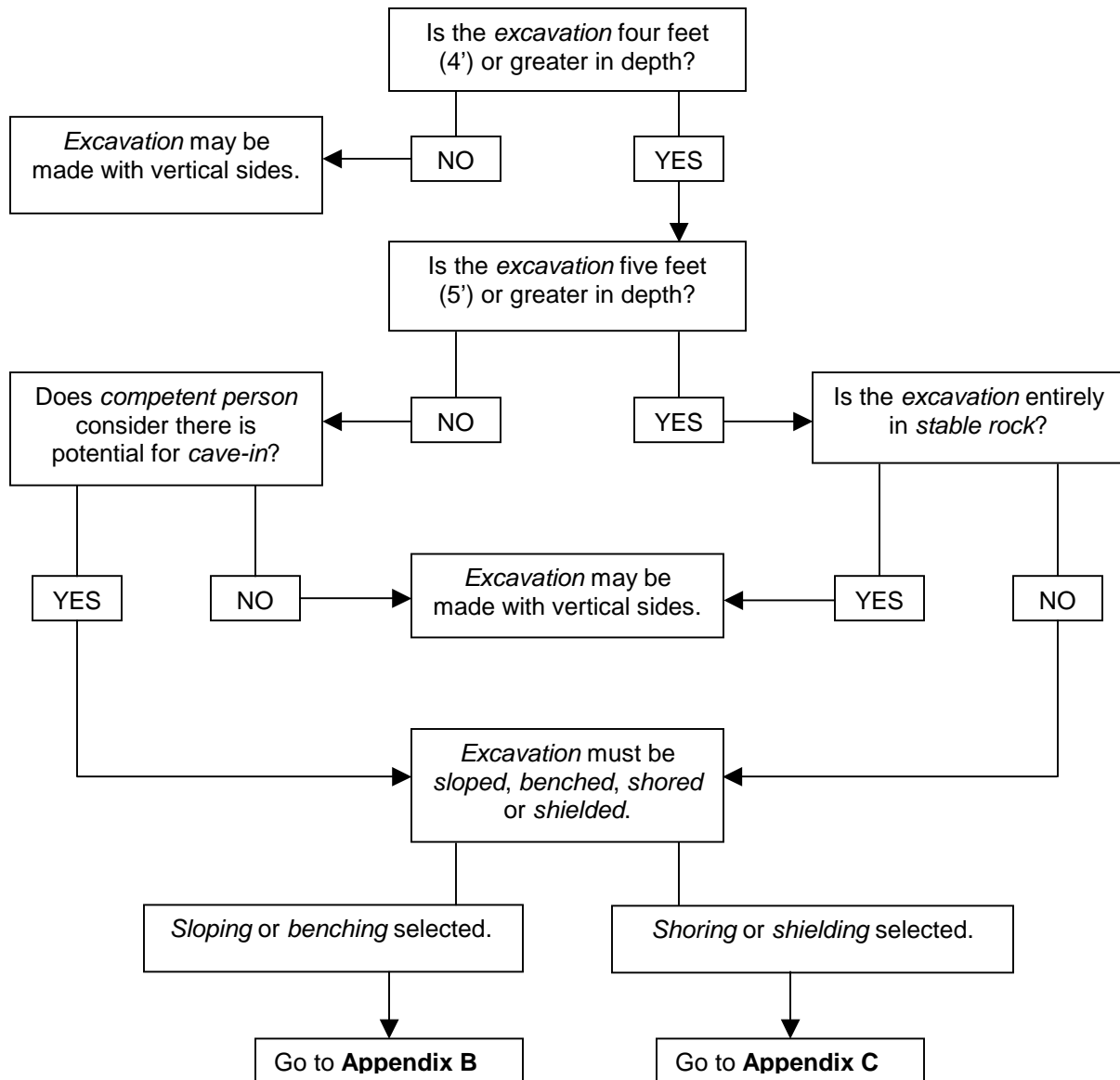
Vice President, Finance and Operations

VIII. APPENDICES

The following figures are a graphic summary of the for *excavations* twenty feet (20') or less in depth. (These flow charts are not designed for *heavy excavations* over twenty feet (20') in depth. *Protective systems* for use in *excavations* greater than twenty feet (20') in depth must be designed by a *registered professional engineer* in accordance with *OSHA* Standard 29 *CFR* Part 1929 Sub-part P (*Excavations*) sections 1926.652(b) and (c)).

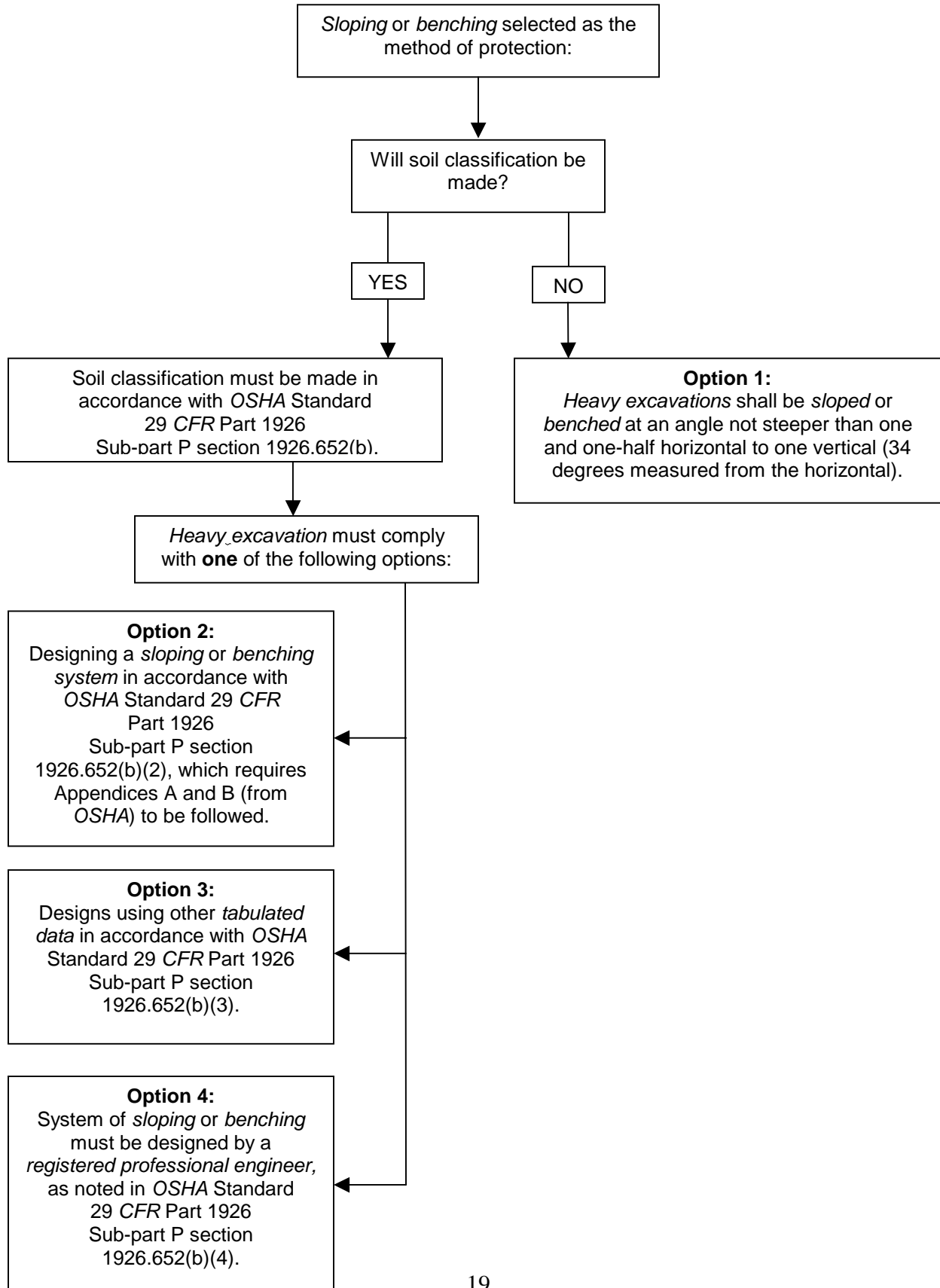
Appendix A – Preliminary Decision for Heavy Excavation

Italicized terms are defined in section V (*Definitions*) of Standard Practice 310 *Excavation & Trenching*



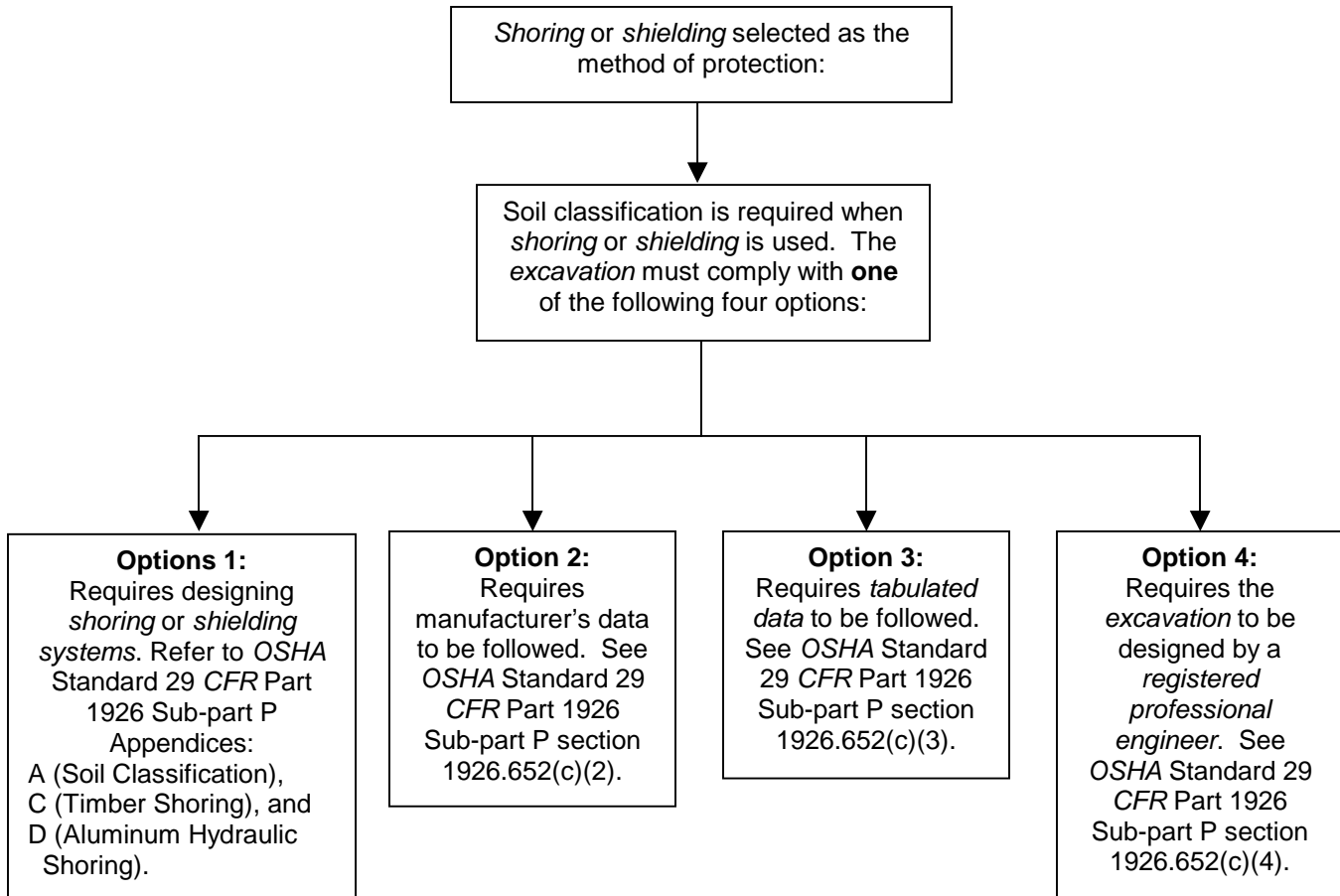
Appendix B – Sloping or Benching Options

Italicized terms are defined in section V (Definitions) of Standard Practice 310 Excavation & Trenching



Appendix C – Shoring and Shielding Options

Italicized terms are defined in section V (Definitions) of Standard Practice 310 Excavation & Trenching



Appendix D – Soil Classification

(a) Scope and application

Scope:

This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

Application:

This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in *OSHA* Standard 29 *CFR* Part 1926 Sub-part P (Excavations) section 1926.652(b)(2) as a method of protection for persons from cave-ins. This appendix also applies when timber shoring for heavy excavations is designed as a method of protection from cave-ins in accordance with Appendix C to sub-part P (Excavations) of part 1926, and when hydraulic (aluminum) shoring is designed in accordance with appendix D. This appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in *OSHA* Standard 29 *CFR* Part 1926 Sub-part P (Excavations) section 1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) Definitions

The definitions and examples given below are based, in whole or in part, on the following; American Society for Testing Materials (ASTM) Standards D653-85 and D2488; The Unified Soils Classification System; The U.S. Department of Agriculture (USDA) Textural Classification Scheme; The National Bureau of Standards Report BSS-121; and Webster's New World Dictionary.

"Cemented soil" means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

"Cohesive soil" means clay (fine grained soil) or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry and exhibits significant cohesion when submerged. Cohesive soils include clay silt, sandy clay, silty clay, clay and organic clay.

"Dry soil" means soil that does not exhibit visible signs of moisture content.

"Fissured" means a soil material that has a tendency to break along definite planes of fracture with little resistance or a material that exhibits open cracks, such as tension cracks in an exposed surface.

"Granular soil" means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

"Layered system" means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

"Micaceous seam" means a layer of soil containing mica-any of a group of minerals (complex silicates) that crystallize in thin, somewhat flexible, translucent or colored, easily separated layers, resistant to heat and electricity.

"Moist soil" means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

"Plastic" means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

"Saturated soil" means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

"Soil classification system" means, for the purpose of this sub-part, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

"Stable rock" means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

"Submerged soil" means soil which is underwater or is free seeping.

"Type A" means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or

- (ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
- (iii) The soil has been previously disturbed; or
- (iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal units to one vertical unit (4H:1V) or greater; or
- (v) The material is subject to other factors that would require it to be classified as a less stable material.

"Type B" means:

- (i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or
- (ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
- (iii) Previously disturbed soils, except those which would otherwise be classed as Type C soil.
- (iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
- (v) Dry rock that is not stable; or
- (vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope ratio less steep than four horizontal units to one vertical unit (4H:1V), but only if the material would otherwise be classified as Type B.

"Type C" means:

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

"Unconfined compressive strength" means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

"Wet soil" means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) Requirements

- (1) Classification of soil and rock deposits. 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 set forth in paragraph (b) of this appendix.
- (2) Basis of classification. The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.
- (3) Visual and manual analyses. The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.
- (4) 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.
- (5) Re-classification. 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 re-classified as necessary to reflect the changed circumstances.

(d) Acceptable visual and manual tests

- (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.
 - (ii) 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.
 - (iii) 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.

- (iv) 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.
 - (v) 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.
 - (vi) 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.
 - (vii) 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 level of the water table.
 - (viii) 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.
- (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 (2") 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 and breaks 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 spoil, 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 shear vane.
- (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 (1") thick (2.54 cm) and six inches (6") in diameter (15.24 cm) until it is thoroughly dry:
 - (A) If the sample develops cracks as it dries, significant fissures are 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.

IX. FORMS

Form 310-A Pre-Inspection of Excavation Work

Is it possible for human entry (intentional or accidental) during this excavation? (Fill in correct box)

- YES If YES, complete only **Part 1**, skip **Part 2**
 NO If NO, complete only **Part 2**, skip **Part 1**

Part 1 (To be completed by competent person trained in heavy excavation)

Name of Competent Person: _____ Date: _____ Time: _____ AM/PM	
Site Location: _____ Excavator: _____	
Excavation Depth: _____ Excavation Width: _____	
Type of Protective System Used (if applicable): _____	
Soil Type (if applicable): _____ Soil Classification (if applicable): _____	
<p>Indicate for each item: YES, NO, or N/A (not applicable). No work shall continue until all questions below have been answered YES (or N/A).</p>	
Has the North Dakota One-Call Excavation Notice System (or other applicable utility location service) been contacted at least 48 hours prior?	
Are all underground utilities marked?	
Have precautions been taken to control vehicle and/or pedestrian traffic?	
Are all persons exposed to public vehicle traffic wearing proper warning vests?	
Do all workers have correct personal protective equipment?	
Have surface encumbrances been removed or supported?	
Is there sufficient light to illuminate work area?	
Are barricades in place for all open excavations?	
Are proper precautions being taken if there is the possibility of a hazardous atmosphere?	
Are all work vehicles parked away from the edge of any heavy excavation, unless protective system allows otherwise?	
Has safe ingress and egress been established?	
If trenches must be crossed, are walkways, bridges, and/or vehicle crossings constructed safely according to requirements?	
Have fall prevention measures been put in place?	
Are spoil piles of heavy excavations placed at least two feet (2') from edge of excavation?	
Are all emergency procedures in place?	
Have all workers been properly trained for safe work in and around the excavation or trench?	
If wet conditions exist inside the excavation, have proper precautions been taken to protect persons from accumulation of water?	
Are workers protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation?	
If necessary, has a registered professional engineer approved engineering plans for the protective system?	
Continue to Part 3	

Part 2 (To be completed by a person trained in light excavation)

Name of Trained Person: _____ Date: _____ Time: _____ AM/PM	
Site Location: _____ Excavator: _____	
Purpose of Excavation: _____ Excavation Depth: _____	
<p>Indicate for each item: YES, NO, or N/A (not applicable). No work shall continue until all questions below have been answered YES (or N/A).</p>	
Has the North Dakota One-Call Excavation Notice System (or other applicable utility location service) been contacted at least 48-hours prior?	
Are all underground utilities marked?	
Have precautions been taken to control vehicle and/or pedestrian traffic?	
Are all persons exposed to public vehicle traffic wearing proper warning vests?	
Do all workers have correct personal protective equipment?	
Are proper precautions being taken if there is the possibility of a hazardous atmosphere?	
Is there sufficient light to illuminate work area?	
Continue to Part 3	

Part 3

Names of Employees Working on Project:		
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Signature of Competent Person (Required only if **Part 1** was completed)

Date _____ Time _____ AM/PM

Signature of Trained Person (Required only if **Part 2** was completed)

Date _____ Time _____ AM/PM