STANDARD PRACTICE INSTRUCTION

DATE IMPLEMENTED: 4 April 2019

SUBJECT: Excavations and Trenching Safety

REGULATORY STANDARD: 29 CFR 1926.650 – 653

BASIS: OSHA requires all employers to maintain a written program. The primary hazard to which employees may be exposed during excavation work is a cave-in, which occurs when the soil forming the side of the excavation can no longer resist the forces applied to it. This results from a reduction in the frictional and cohesive capacities of the soil to resist forces. Changing environmental conditions, such as freezing and thawing, or the addition or removal of water from the pores of the soil can reduce the ability of a soil to resist forces. The addition of superimposed loads from spoil piles, or the placement of equipment or materials near the edge of the excavation also create forces that can exceed the ability of the soil to resist.

GENERAL: Nowland Associates, Inc. will ensure that whenever an excavation operation is being undertaken, that work practices and proper conditions are met prior to beginning, during and at the conclusion of such excavation operations. It should be assumed that every acceptable safety precaution is contained herein or that unusual circumstances may not require further or additional procedures, equipment and practices. Employees will cease operations if there is a question regarding a hazard of if such is suspected or discovered.

RESPONSIBILITY: The Safety Officer is solely responsible for all facets of this program and has full authority to make necessary decisions to ensure success of the program. The Safety Officer is the sole person authorized to amend these instructions and is authorized to halt any operation of the area where there is danger if serious personal injury.

Contents of the Excavations and Trenching Program

Nowland Associates, Inc.
Excavations and Trenching Program

1. Written Program. Nowland Associates, Inc. will review and evaluate this best practice instruction:

- On an annual basis
- When regulatory changes occur that prompt revision of this document
- When facility operational changes occur that require a revision of this document
- When there is an accident of close call that relates to this topic

1.1 Effective implementation of this program requires support from all levels of management within this company. This written program will be communicated to all personnel that are affected by it. It encompasses the total workplace, regardless of the number of workers employed or the number of work shifts. It is designed to establish clear goals, and objectives.

2. General Requirements. Nowland Associates, Inc. will establish procedures for "Trenching and excavation" undertaken by its employees, using this document. Preventing future work-place injuries in our company is the principal purpose of this document. This document will provide a basis for ensuring that all procedures implemented, revised or modified meet our requirement for safety. This document will help identify hazards in our workplace and enable us to determine the best course of action to take to reduce or eliminate known hazards.

3. Surface Encumbrances and Underground Installations Safety Guidelines. All surface encumbrances that are a hazard to employees will be removed, supported or located and marked as necessary to safeguard employees. The estimated location of 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, will be determined prior to opening an excavation. The following procedures are designed to provide employees of this company with a system for protection and safe conditions while working in a trenching or excavation environment. These guidelines are designed for use by employees at all levels within the work force.

3.1 Establish locations of all underground and overhead utilities and services before beginning trenching or excavation operations.

3.1.1 Contact utility and service companies to include municipal owned and advise them prior to the start of all actual excavation. No exceptions.

3.1.2 The following local response times for utility companies in our area to locate and advise us on underground installations or surface encumbrances are as follows:

Electric: 24 Hours

Gas: 24 Hours

Water: 24 Hours

Telephone: 24 Hours

Cable: 24 Hours

Other: 24 Hours

3.1.3 Utility companies or owners will be contacted:

- Within established or customary local response times;
- Advised of the proposed work, and;
- Asked to establish the location of the utility underground installations prior to the start of actual excavation and provide advice concerning surface encumbrances.

3.1.4 When excavation operations approach the estimated location of underground installations, the exact location of the installations will be determined by safe and acceptable means (modern techniques and customary types of equipment) where this determination is unclear the owning utility will be contacted for assistance.

3.1.5 While any excavation is open, underground installations will be protected, supported or removed as necessary to safeguard employees.

4. Protection from Hazards Associated with Water Accumulation.

4.1 Employees will not work in excavations in which there is accumulated water, or in excavations is 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 systems.

4.2 Inspect all excavations after any rainfall or other hazard producing occurrence to determine if any change to the soils capacity to resist the force has occurred. This will be done by a competent person.

4.2.1 Water should not be allowed to accumulate within the excavation. If such has occurred it will be removed utilizing proper pumping procedures and precautions.

4.3 Water will be controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations will be monitored by a competent person to ensure proper operation.

4.4 If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches or dikes, suitable means will be used 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 be inspected by a competent person.

5. Protection from Superimposed Loads.

5.1 Superimposed loads (crane, backhoe and other such equipment working close to the excavation edges) require extra sheet piling, shoring or other bracing to be used to assure the ability of the soil to resist. The use of mobile equipment near the excavation requires proper vehicle barricades and/or stop blocks.

6. Access and Egress from Excavations.

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

6.2 Means of egress from trench excavations (less than 20 ft deep). A stairway, ladder, ramp or other safe means of egress will be located in trench excavations that are 4 feet or more in depth so as to require no more than 25 feet of lateral travel for employees.

6.3 Means of egress from trench excavations (20 ft or greater in depth). Ladders will be equipped with ladder platforms at 20-foot intervals.

7. Trench Safety.

7.1 Trenches more than five feet deep require shoring or will be laid back to its angle of repose (stabilized slope).

7.2 In hazardous soil conditions (loosely compacted or rocky), trenches under five foot need protection.

7.3 There shall be at any excavation site a competently trained person, who is capable of identifying existing and predictable hazards and who shall have the authority to take prompt corrective action to eliminate them on the site, this individual shall be able to identify soil classifications and protective systems (shoring, bracing, and piling) to be used in accordance with OSHA trenching standards found in 29 CFR 1926.652.

7.4 Portable trench boxes or sliding trench boxes used in place of shoring and sloping shall be designed, constructed and maintained to provide protection at least equal to the required sheeting and shoring. Shields shall be designed by a registered professional engineer and will meet the standards found in 29 CFR 1926.652.

7.5 Shields shall be installed so as to restrict lateral or other hazardous movement. Trench boxes and shields shall extend to the bottom of the trench and no less than eighteen (18) inches above the vertical top of the trench or excavation face. Exceptions are found in 29 CFR 1926.652. Excavation to a level not greater than 2 feet below the bottom of the shield shall be 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. No employee shall be allowed within the shield, or trench box during the installation, removal or relocation. If at anytime trench boxes are stacked, means shall be provide to prevent separation.

8. Exposure to Vehicular Traffic.

Employees exposed to public vehicular traffic will be provided with, and will wear, warning vests or other suitable garments marked with or made of reflectorized or high visibility material.

9. Exposure to Falling Loads.

9.1 No employee will be permitted underneath loads handled by lifting or digging equipment.

9.2 Employees will be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials.

9.3 Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with 29 CFR 1926.601, to provide adequate protection for the operator during loading and unloading operations.

10. Warning Systems 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, a warning system will be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

11. Hazardous Atmospheres.

11.1 Testing and Controls. Confined space entry procedures will be adhered to in accordance with the Nowland Associates, Inc. Confined Space Entry Program. To prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements apply:

11.1.1 Oxygen deficiency. Where oxygen deficiency (atmospheres containing less than 19.5% 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, the atmospheres in the excavation will be tested before employees enter excavations greater than 4 feet in depth.

11.1.2 Flammable atmospheres. Adequate precaution will be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

11.1.3 Testing. When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing will be conducted as often as necessary to ensure that the atmosphere remains safe.

11.2 Emergency rescue equipment.

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

11.2.2 Lifelines. Employees entering bell bottom pier holes, of other similar deep and confined footing excavations, will wear a harness with a lifeline securely attached to it. The lifeline will be separate from any line used to handle materials, and will be individually attended at all times while the employee wearing the lifeline is in the excavation.

12. Personal Protective Equipment (PPE). The following procedures are designed to provide employees of this company with a checklist system or procedure to follow for the selection of proper PPE for operations under this program.

12.1 Checklist

(1) Hard Hat
(2) Long sleeve garment
(3) Trouser
(4) Steel toe safety shoe or boot.
(5) Proper eye and face protection
(6) Work gloves appropriate for the situation
(7) Approved respirator if circumstances require
(8) Hearing protection
(9) Rubber or neoprene boots if the circumstances require

Note: The first line supervisor or senior supervisor on the site will be responsible for compliance and proper utilization of PPE.

13. Material Handling Equipment. All material handling equipment will be operated in accordance with established Nowland Associates, Inc. written policies, manufacturer's procedures and applicable OSHA standards.

14. Stability of Adjacent Structures.

14.1 Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, Support systems such as shoring, bracing, or underpinning will be provided to insure the stability of such structures for the protection of the employees.

14.2 Excavation below the level of the base of footing of any foundation or retaining wall that could reasonably expected to pose a hazard to employees will not be permitted except when:

14.2.1 A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

14.2.2 The excavation is in stable rock; or

14.2.3 A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected buy the excavation activity: or

14.2.4 A registered professional engineer has approved the determination that such excavation work will not pose a hazard to the employees.

14.3 Sidewalks, pavements and appurtenant structures will not be undermined unless a support system or other method of protection is provided to protect employees from the possible collapse of such structures.

15. Protection of employees from Loose Rock or Soil.

15.1 Adequate protection will be provided to protect employees from loose rock or soil that would pose a hazard by falling or rolling from an excavation face. Such protection will 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.

15.2 Employees will be protected from excavated or other materials or equipment that would pose a hazard by falling or rolling into excavations. Protection will be provided by placing and keeping such materials or equipment at least 2 feet from the edge of excavations, or by the use or retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

15.3 Soil classifications will be determined by testing and protective systems designed according to soil classifications. See Appendix A of this Program for more details.

16. Site Inspections.

16.1 Daily inspections of excavations, the adjacent areas, and protective systems will 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. These inspections are only required when employee exposure can be reasonably anticipated. An inspection will be:

16.2 Conducted by the competent person prior to the start of work and as needed throughout the shift.

16.3 Inspections will also be made after every rainstorm or other hazard increasing occurrence.

16.4 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, exposed employees will be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

17. Fall Protection.

17.1 Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails will be provided when the lower level is at 6 feet in depth or more.

17.2 Adequate barrier physical protection will be provided at all remotely located excavations. All wells, pits, shafts, etc. will be barricaded or covered. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc. will be backfilled.

18. Training Requirements.

18.1 Initial Training.

18.1.1 This Company shall provide training to ensure the purpose and function of the trenching and excavation program is understood by employees and the knowledge and skills required for safe trenching and excavation operations is acquired by all affected employees. The training shall include as a minimum, the following:

18.1.2 Training in the recognition of applicable hazards associated with trenching and excavation operations.

18.1.3 Each affected employee shall be instructed in the purpose and use of this Best practice instruction.

18.1.4 All other employees whose work operations are or may be in an area where trenching and excavation operations are conducted shall be instructed to an awareness level about procedures, and prohibitions relating to work in such areas.

18.2 Refresher Training.

18.2.1 Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in equipment or processes that present a new hazard, or when there is a change in these procedures. **Note**: Retraining (to include a procedural review) will also be provided whenever there is a “close call” or these procedures fail.

18.2.2 Additional retraining shall also be conducted whenever a periodic inspection reveals, or whenever the Company has reason to believe, that there are deviations from or inadequacies in the employee’s knowledge or use of these procedures.

18.2.3 The retraining shall reestablish employee proficiency and introduce new or revised operational methods and procedures, as necessary.

18.3 Certification. The Company shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee’s name and dates of training.

19. Protection of Employees in Excavations.

19.1 Each employee in an excavation will be protected from cave-ins by an adequately designed protective system except when:

19.1.1 Excavations are made entirely in stable rock; or

19.1.2 Excavations are less than 5 feet in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

19.2 Protective systems will 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.

20. Design of Sloping and Benching Systems.

20.1 The slopes and configurations of sloping and benching systems will be properly selected and constructed as follows:

20.1.1 Option 1 – Allowable configurations and slopes. Excavations will be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

20.1.2 Option 2 – Determination of slopes and configurations is made using 29CFR 1926.652 appendices A and B Maximum allowable slopes, and allowable configurations for sloping and benching systems.

20.1.3 Option 3 – Designs using other tabulated data. Designs of sloping or benching systems will be selected from and in accordance with tabulated data, such as approved tables and charts. The tabulated data will be in written form and will include:

- Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;
- Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;
- Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

Note: At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, will be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data will be made available to OSHA upon request.

20.1.4 Option 4 – Design by a registered professional engineer.

20.2 Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) will be approved by a registered professional engineer. Designs will be in written form and will include at least the following:

20.2.1 The magnitude of the slopes that were determined safe for the particular project;

20.2.2 The configurations that were determined to be safe for the particular project;

20.2.3 The identity of the registered professional engineer approving the design.

Note: At least one copy of the design will be maintained at the jobsite while the slope is being constructed. After that time the design need not be on the jobsite, but a copy will be made available to OSHA upon request.

21. Design of Support System, Shield Systems, and other Protective Systems.

21.1 Designs of support systems, shield systems, and other protective systems will be selected and constructed in accordance with the following options:

21.1.1 Option 1 – Designs using Appendices A, C, and D of 29CFR 1926.652. Designs for timber shoring in trenches will be determined in accordance with the conditions and requirements set forth in Appendices A and C. Designs for aluminum hydraulic shoring will be in accordance with appendix D of 29CFR 1926.652, but if manufacturer's tabulated data cannot be utilized, designs will be in accordance with appendix D.

21.1.2 Option 2 – Designs using Manufacturer's tabulated data. Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data will be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

21.1.2.1 Deviation from the specifications, recommendations, and limitations, issued or made by the manufacturer will only be allowed after the manufacturer issues specific written approval.

21.1.2.2 Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations will be in written form at the jobsite during construction of the protective system. After this time this data may be stored off the jobsite, but a copy will be made available to OSHA upon request.

21.1.3 Option 3 – Designs using other tabulated data. Designs of support systems, shield systems, or other protective systems will be selected from and be in accordance with tabulated data, such as tables and charts. The tabulated data will be in written form and include all of the following:

21.1.3.1 Identification of the parameters that affect the selection of a protective system drawn from such data;

21.1.3.2 Identification of the limits of use of the data;

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

Note: At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, will be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data will be made available to the OSHA upon request.

21.1.4 Option 4 – Design by a Registered Professional Engineer. Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2, or Option 3, above, will be approved by a registered professional engineer. Designs will be in written form and will include the following:

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

21.1.4.2 The identity of the registered professional engineer approving the design.

22. Materials and Equipment used for Protective Systems.

22.1 Materials and equipment used for protective systems will be free from damage or defects that might impair their proper function.

22.2 Manufactured materials and equipment used for protective systems will be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

22.3 When material or equipment that is used for protective systems is damaged, a competent person will 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 the material or equipment will be removed from service, and will be evaluated and approved by a registered professional engineer before being returned to service.

23. Installation and Removal of Support Systems.

23.1 General Requirements.

23.1.1 Members of support systems will be securely connected together to prevent sliding, falling, kick outs, or other predictable failure.

23.1.2 Support systems will be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

23.1.3 Individual members of support systems will not be subjected to loads exceeding those which those members were designed to withstand.

23.1.4 Before temporary removal of individual members begins, additional precautions will be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

23.1.5 Removal will begin at, and progress from, the bottom the bottom of the excavation. Members will be released slowly so as to note any indication of possible failure of the remaining members of the structure of possible cave-ins of the sides of the excavation.

23.1.6 Backfilling will progress together with the removal of support systems from excavations.

23.2 Additional requirements for support systems for trench excavations.

23.2.1 Excavation of material to a level no greater than 2 feet below the bottom of the members of a support system will be permitted.

23.2.2 Installation of a support system will be closely coordinated with the excavation of trenches.

24. Sloping and benching Systems.

24.1 Employees will not be permitted 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.

25. Shield Systems.

25.1 Shield systems will not be subjected to loads exceeding those which the system was designed to withstand.

25.2 Shields will be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

25.3 Employees will be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

25.4 Employees will not be allowed in shields when shields are being installed, removed, or moved vertically.

25.5 Excavations of earth material to a level of not greater than 2 feet below the bottom of a shield will be 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.

26. Applicable Definitions

Accepted Engineering Practices – means those 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 (cross braces) 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 bell 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 the 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 to 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 the 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 the 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 an inclined walking or working surface that is used to gain access to one point from 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 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 premanufactured or job-built in accordance with 1926.652. 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 from cave-ins by excavating to form side of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of the 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 is considered to be stable when the 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 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 the 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 A to Subpart P of Part 1926 — Soil Classification

(a) Scope and application.

(1) 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.

(2) Application. This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in §1926.652(b)(2) as a method of protection for employees from cave- ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic 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 §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 on, in whole or in part, 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; and The National Bureau of Standards Report BSS-121.

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 clayey 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.

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 sheer vane.

Soil classification system means, for the purpose of this subpart, 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 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 to one vertical (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 less steep than four horizontal to one vertical (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 to one vertical (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 America 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) 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 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.

(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 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 level of the water table.

(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.

(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 (50 mm) 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 spoil, as soon as practicable after excavation to keep to a miminum 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 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.