

**STANDARD PRACTICE INSTRUCTION**

**DATE:** March 1, 2001

**SUBJECT:** Trenching and Excavation 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:** The Salisbury University 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 not 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 or if such is suspected or discovered.

**RESPONSIBILITY:** The University Safety Manager 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 Manager is the sole person authorized to amend these instructions and is authorized to halt any operation of the area where there is danger of serious personal injury.

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## **Salisbury University Trenching and Excavation Safety Program**

**1. Written Program.** The Salisbury University will review and evaluate this standard practice instruction:

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

Effective implementation of this program requires support from all levels of management within this University. 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.** Salisbury University will establish procedures for “trenching and excavation” undertaken by its employees, through the use of this document. Preventing future work-place injuries in our University is the principle purpose of this document. This document will provide a basis for ensuring that all procedures implemented, revised or modified meet our requirements for safety. This document will help identify hazards in our work-place 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 located so as to create a hazard to employees will be removed or supported, 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 University 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 the 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 Local response times should be determined for proper planning.

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 advise 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 in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline 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 person that has the competence to do so.

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

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 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 (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) 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 Trenches more than five (5) feet deep require shoring or will be laid back to a stable slope. In hazardous soil, trenches under five (5) feet will also be protected.

7.5 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.

7.6 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 (.61 m) below the bottom of a 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 provided 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 §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 Salisbury University 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 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation will be tested before employees enter excavations greater than 4 feet (1.22 m) 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, or 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 University 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) Safety toes work boot
- (5) Proper eye and face protection
- (6) Work glove, rubber or neoprene when working with or in chemicals
- (7) NIOSH approved respirator where or when the job hazard may require
- (8) Hearing protection

- (9) Rubber or neoprene boots when exposed to waste-water products (a sanitary washing University will be provided for cleanup)

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

**13. Material Handling Equipment.** All material handling equipment will be operated in accordance with established Salisbury University written policies, manufactures 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 ensure the stability of such structures for the protection of employees.

14.2 Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees 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 by 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 employees.

14.3 Sidewalks, pavements and appurtenant structures will not be undermined unless a support system or another 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 could 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 could 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 (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

## **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.

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 University 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 standard practice instruction.

18.1.4 All other employees whose work operations are or may be in an area where trenching and excavation operation are conducted shall be instructed to an awareness level about the 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 University 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 University 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 (1.52 m) 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, and throughout its use.

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.

## **21. Design of Support Systems, 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 and use of the protective system.

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 and use of the protective system.

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 identify 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, kickouts, 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 of the excavation. Members will be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

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 (.61 m) below the bottom of the members of a support system will be permitted, but only if the system 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 support system.

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 not greater than 2 feet (.61 m) 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 (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

**Bell-Bottom Pier Hole** - means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a 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 so that it could entrap, bury, or other wise injure and immobilize a person.

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

**Cross Braces** - mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

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

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

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

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

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

**Protective System** - means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from 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 sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

**Stable Rock** - means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock 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 (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

**Trench Box.** See "Shield."

**Trench Shield.** See "Shield."

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

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