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THE UNIVERSITY OF MAINE
TRENCHING AND EXCAVATION SAFETY PROGRAM

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1. Purpose

The University of Maine (“UMaine”) is committed to conducting its Trenching and Excavation operations in the safest manner possible, with concern for the individual and in accordance with applicable Federal and State statutes. The University of Maine’s Trenching and Excavation Safety Program,, has been prepared to comply with regulations promulgated by the Federal Occupational Safety and Health Administration (OSHA) and various State of Maine organizations, including Department of Labor (DOL).

This program establishes requirements for university and contractor personnel in order to work in, or around, any excavation operations, at the University of Maine or any of its remote sites. This program describes the training and certification requirements, rules of operation, accident reporting and other related information.

The primary goal of the Trenching and Excavation Safety Program is to protect human life and University of Maine property. The following program has been created as a guideline for conducting trenching and excavation projects. These projects will encompass all activities which involve the removal of earth to a depth of five (5) feet or greater. This includes hazardous and non-hazardous atmospheres.

2. University of Maine Approval

This program establishes the minimum requirements that University of Maine workers must follow in order to perform related to Trenching and Excavation work. Departments may utilize their own Trenching and Excavation Safety Program only if their program is equal to, or exceeds the minimum requirements set forth by this program.

This program has been reviewed and approved by:

//Signed// Signature on File in SEM

President of the University of Maine (or Designee)

Date

//Signed// Signature on File in SEM

Department of Safety & Environmental Management (SEM), Director

Date

//Signed// Signature on File in SEM

Associate Vice President for Administration and Finance

Date

3. Background

Excavation projects which are conducted on the University of Maine campus and remote sites present a significant threat to the health and safety of UMaine employees, students and visitors located within the vicinity of these sites.

Entry into trenches and excavations is a necessary work practice on campus and campus-owned locations. An objective of UMaine is to reduce the potential risk associated with these types of activities. Awareness training, project planning, evaluation of hazards (prior to the commencement of work), use of engineering controls (to reduce or eliminate environmental risks) and the use of personal protective equipment (PPE) and atmospheric monitoring equipment through the duration of the work are aimed at reducing risk associated with trenching excavation and work.

4. Scope of Trenching and Excavation Safety Program

Any UMaine employee, contractor, student or visiting researcher who operates within an UMaine facility or remote site and performs tasks involving trenching or excavation, shall comply with the rules set forth in this document.

Student interns and Co-operative (Co-op) students that work outside UMaine's premises and do not use UMaine owned equipment, are governed by the safety rules and regulations of the sponsoring organization. Sponsoring organizations are required to have written rules, which address safety and standard operating procedures.

Interns and Co-op students who either work on UMaine premises or use UMaine owned equipment must comply with this policy.

5. Program Administration and Responsibilities

The following departments and personnel shall be responsible for implementing this program and its policies to ensure the health and safety of UMaine personnel.

5.1 Department of Safety and Environmental Management (SEM)

The SEM department shall act as "Program Administrator" and shall be responsible for the following:

- Developing and Maintaining the written Trenching and Excavation Safety Program (Excavation Program);
- Periodically review and update the program as new regulations are promulgated;
- Periodically review and assess the implementation and management of the written excavation program;
- Conducting periodic site evaluations of on-going excavation projects for health and safety considerations for the campus community not directly associated with the excavation projects; and,
- Developing and implementing an excavation safety training program.

5.2 The Responsible Department (i.e., FM, Telecom, Farms, Research Departments or other entity) will be responsible for the following:

- Reviewing all work orders, requiring or potentially requiring excavation activities;
- Assigning a project manager (PM) for planning and coordinating the work activities and impacted shops or remote sites;
- Assigning a trained, competent person (CP) for overseeing the daily activities at the excavation site;
- Notifying the UMaine's "Dig-Safe" program coordinator of proposed trenching or excavation activities;
- Arranging the use of monitoring equipment to be used by the excavation crew;
- Documenting and maintaining records related to Excavation Safety Training;
- Maintaining all training documentation for a period not less than three (3) years;
- Maintaining all project related documentation for a period not less than one (1) year;
- Reviewing all site-specific work plans prepared by the Project Manager (PM); and,
- Ensuring that all the necessary equipment and materials are available for the use in the excavation prior to the commencement of excavation activities.

It is important to note that Facilities Management (FM) shall be responsible for all excavation and trenching work completed on campus or on properties administered by UMaine. (Note: Facilities Management and SEM shall be notified of all trenching and excavation work performed by other departments.)

5.3 Individual Project Managers (PM) or Qualified Person (QP) for in-house projects shall:

- Review the proposed excavation work and prepare the site-specific excavation work plan;
- Submit the site-specific work plan to the "Responsible Department" for review and approval prior to the commencement of excavation activities (allowances will be made for emergency situations);
- Request assistance from Department Safety Staff and SEM for work place evaluations as needed;
- For planned projects on campus, notify the FM Engineering Services at least 24 hours prior to the commencement of excavation operations to request an "Excavation Permit." For other projects performed by university personnel on non-university owned property, notify "Dig-Safe" at least three days prior to the commencement of excavation activities.
- Ensure appropriate engineering controls, personal protective equipment and monitoring equipment are available and properly used;
- Ensure Competent Person (CP) and other personnel working in and around the excavation have been properly trained in potential safety hazards and safe excavation work practices;
- Monitor safety performance of personnel assigned to the project;
- Correct any work practice or condition that may result in injury;
- Stop site operations in the event of an emergency or to correct unsafe work practices;
- Request correction of any work practices that may endanger university personnel;
- Report any unsafe work practices to supervisor;

- Remove any person from the work area who endangers other personnel or that may be causing a safety hazard to the persons in the work area; and,
- Make changes to the site-specific work plan, based upon changing site conditions.

5.4 UMaine Project Managers (PM) while supervising outside Contractor Projects shall:

- Require the contractor to submit a site specific work plan to FM Safety;
- Shall notify the contractor to stop site operations in the event of an emergency or to correct unsafe work practices;
- Shall complete a contractor observation form;
- Shall provide the contractor with a copy of UMaine required forms contained in this policy including notification, checklist and log.

The UMaine Project Manager provides minimal oversight for the day-to-day trenching and excavation operations. It is the responsibility of the contractor to provide a safe working environment as per the requirements of the UMaine contract and specifications. The contractor must have a Competent Person onsite at all times and must be provided with a copy of this program prior to the commencement of work.

5.5 The Competent Person (CP) shall:

- Maintain a thorough understanding and knowledge of the OSHA excavation standard;
- Classify soils based on the OSHA excavation standard (for simplicity, classify all soils as "Type C Soils");
- Install appropriate protective systems necessary to provide adequate engineered personnel protection;
- Develop a site-specific Emergency Response Plan (ERP);
- Notify appropriate emergency response agencies or the Orono Fire Department of the planned excavation project. The location, work schedule and scope of work should be provided if the space is determined to be a confined space.
- Conduct inspections necessary to identify potentially hazardous conditions;
- Conduct site safety meetings to review site-specific health and safety issues related to the excavation project and emergency response plan;
- Ensure monitoring equipment is properly calibrated and used and that results are properly recorded and filed;
- Ensure appropriate engineering controls, personal protective equipment and monitoring equipment are available and properly used;
- Inspect equipment and materials that are used for protective systems for condition and suitability of use;
- Monitor safety performance of personnel assigned to the project;
- Correct any work practice or condition that may result in injury;
- Identify existing and predictable hazards in the surroundings or working conditions which are hazardous, unsanitary, or dangerous to employees;
- Be authorized to stop site operations in the event of an emergency or to correct unsafe work practices;

- Request correction of any work practices that may endanger university personnel;
- Report any unsafe work practices to the appropriate PM;
- Make changes to the site-specific work plan based upon changing site conditions.

5.6 Contractors working on excavation projects shall:

- Be familiar with safe excavation practices and the UMaine's Trenching and Excavation Safety Program;
- Take the necessary precautions to prevent injury to themselves and other UMaine employees;
- Perform only those tasks that they can do safely, and immediately report any accidents and/or unsafe conditions to the CP, QP or PM;
- Complete safe excavation work site plan review prior to starting a job with all employees;
- Immediately report any hazardous or potentially hazardous situations to the CP, QP or PM;
- Evacuate any excavation where hazards or potentially hazardous situations have been identified; and,
- Shall provide a site safety plan that includes the name and contact information of the competent person listed in the plan.

6. Hazard Identification, Evaluation and Mitigation

During the course of routine maintenance activities, renovation, construction and research, UMaine personnel may be required to work in or around excavations. Potential health and safety hazards that may be associated with these excavations include:

- Surface encumbrances including structures, fencing, piping, dirt, debris piles or stored material (spoil) and vegetation;
- Limited means of egress;
- Surface and subsurface utilities including water, sewer, electric, gas, cable, steam, telephone and fiber optics;
- Overhead utilities (power lines);
- Vehicle and equipment traffic in the vicinity or around the excavation;
- Falling loads from digging or lifting equipment;
- Water accumulation in the excavation;
- Hazardous atmospheres (i.e., oxygen deficiency, flammable gases, toxic fumes, etc.) which may occur in the excavation;
- Cave-in of loose soil and rock from the excavation face; and,
- Falling or driving into unprotected or unmarked excavations.

Prior to excavation activities, the site will be evaluated for potential health and safety concerns and an appropriate, site-specific plan of action will be prepared.

6.1 Surface Encumbrances

Surface encumbrances such as structures, fencing, piping, stored materials, vegetation, and other items, which may interfere with safe excavation, shall be removed prior to the start of excavation activities. Those structures that cannot be removed, such as buildings, foundations or footings, shall be assessed for stability by a registered professional engineer (PE). Any structures affected by the excavation shall be adequately supported using such systems as shoring, bracing or underpinning. All supports shall be engineered specifically for the type of structure to be supported and the excavation characteristics. Any support system in use shall be evaluated on a daily basis by the CP for strength and integrity. Excavations below the level of the base of a footing of a retaining wall shall not be permitted unless one of the following criteria is met:

- A support system is provided to ensure the safety of the employees and the stability of the structure;
- The excavation is in stable rock;
- A registered PE has determined that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activities; or,
- A registered PE has determined that such excavation work will not pose a hazard to university personnel.

6.2 Means of Egress

For excavations four (4) feet deep or greater an adequate means of egress such as a ladder, steps or ramp(s) shall be provided. A means of egress must be provided every 25 feet along the length of the excavation. The use of an excavator bucket or other heavy equipment means to lower and raise personnel into an excavation will not be considered as a means of egress and will not be allowed on any UMaine project.

6.3 Underground Utilities

Facilities Management Department is responsible for managing UMaine's "Dig-Safe" program. (It is based on 23 MSRA§ 3360-A). This regulation requires that the University participate in a damage protection program, manage notification of digging operation to all appropriate shops and organizations, and notify affected departments and buildings when a digging or trenching operation will be taking place.

For work performed on the Orono Campus, this is managed through Facilities Management (FM) Engineering Services at 581-2682. For remote sites, "Dig Safe" will be contacted directly for a site mark-out.

Prior to excavation activities the FM engineering staff or the remote site project manager shall determine if underground utilities are present in the area or vicinity of the excavation.

The party responsible for conducting an excavation will:

- Mark the proposed excavation area with approximate boundaries using highly visible spray paint or stakes.

- For planned projects, notify the University “Dig-Safe” Program Manager at least 3 days before an excavation operation begins. All boundaries of the proposed excavation will be noted on the permit.
- If blasting is required during the excavation process, the “Dig-Safe” Program Manager shall be modified at least 3 days in advance. For emergency situations, notification shall be made in writing at least 4 hours in advance of the commencement of the blasting activities.
- Ask the “Dig-Safe” Program Manager to establish the approximate location of utilities in underground installations prior to the start of the excavation/trenching project. This will include the locations of all underground utilities such as sewer, telephone, fuel lines, electric, water, cable, steam and fiber optic.

During the excavation process, the CP will:

- Identify the exact location of the underground installations when the operations are near the estimated location of these installations;
- Provide detection equipment or other acceptable means to locate the utilizes if the exact location of the underground utilities cannot be established;
- Protect, support or remove (as necessary), any underground installations upon opening a trench or excavation.

For all work performed off-campus, the “Dig-Safe” system shall be complied with. (See Appendix A)

6.4 Overhead Utilities

The University will comply with the HP 894 – L.D. 1247 “An Act to Create the Overhead High-Voltage Line Safety Act.”

When working under or in the vicinity of overhead power lines, a minimum distance of 10 feet shall be maintained or the lines will be de-energized. De-energizing and/or removal of overhead power lines shall be coordinated with and completed by the University of Maine’s FM Electric Shop. Once the line is de-energized, UMaine “Lock out/Tag out” procedures will be followed. The CP shall be responsible for maintaining the required minimum distance of 10 feet throughout the course of the work. (See Appendix B)

6.5 Vehicle and Equipment Traffic

University personnel and contractors exposed to public vehicular traffic during the course of excavation related work will be provided with and shall wear warning vests or other suitable garments marked with or made of highly visible reflective material. Personnel working at night will be fitted with high visible reflective material designed for evening conditions.

All excavation work occurring on streets or other vehicle accessible travel lanes shall be conducted in accordance with established Maine Department of Transportation (MDOT) guidelines. The work area shall be delineated through the use of approved signs, signals, traffic cones or barricades. Signs, signals and barricades shall be fully illuminated at night. If the CP determines that these methods

are not adequate, a flag person will be provided to direct traffic. Barricade type and placement shall be determined prior to the commencement of the excavation work.

When mobile equipment is operated adjacent to the excavation or when it is required to approach the edge of an excavation, and the operator does not have a clear or direct view of the edge of the excavation, a warning system such as barricades, hand or mechanical signals, or stop logs shall be used. If possible, the surrounding grade should be situated away from the excavation.

6.6 Exposure to Falling Loads

University personnel and contractors shall not work underneath loads handled by digging or lifting equipment. Personnel will be required to stand at an adequate distance from any vehicle being loaded or unloaded to avoid being struck by any falling materials.

All personnel working in an excavation shall wear adequate head protection (hard hats) and eye protection.

6.7 Water Accumulation

University personnel and contractors will not work in excavations where there is accumulated water or in excavations where water is accumulating. If this is unavoidable, precautions are being undertaken such as shielding and dewatering.

Precautions to protect employees vary with each situation and may include support or shield systems to protect from cave-ins, water removal to control the level of accumulating water and the use of safety harnesses and lifelines.

If water accumulation is controlled by a water removal/pumping system, the equipment and function shall be monitored by the CP to ensure proper operation. If the excavation interrupts the natural drainage of surface water, diversion ditches, dikes or swales, suitable methods shall be used to divert the flow of surface water from entering the excavation. (The top of the faces and sidewalls of the excavation should be sloped to divert water away from the excavation.) Excavations exposed to heavy rainfall or high water tables shall be subject to the recommendations above and shall be inspected regularly by the CP for stability and integrity.

6.8 Sidewalks, Pavements and Other Horizontal Surfaces

Sidewalks, pavements and other objects and surfaces shall not be undermined or undercut unless a support system or other precaution is provided to protect employees from possible collapse. Employees will not work under unsupported vertical or horizontal structures.

Walkways, runways and sidewalks adjacent to excavations will be kept clear of excavated material (spoil pile) or other obstructions.

6.9 Cave-ins of Loose Soil from Excavation Phase (Spoil Pile)

Loose rock, excavated soil or other material and spoils will be stored and retained at least two (2) feet or more from all edges of the excavation or adjacent excavations.

Any exceptions due to location of the excavation or quantity of spoils or excavated materials, shall be reviewed by the PM or CP prior to the commencement of an excavation, or as necessitated by changing conditions and the site safety plan shall be updated.

6.10 Falling into Unprotected or Unmarked Excavations

Walkways shall be provided where employees or equipment are required or permitted to cross over excavations.

Guardrails are required where walkways are six (6) feet or more above lower levels. These guardrails shall be 42 inches, plus or minus three (3) inches, above the walking/working level. The mid-rails will be placed at 21 inches and installed with screens or mesh between the top edge and the walking/working surface and the along the entire length of the exposed opening. The top-rail of the guardrail system shall be capable of withstanding a force of 200 pounds. The mid-rail should be capable of withstanding a force of 125 pounds. No more than 8 feet should separate each top-rail.

All wells, test pits or shafts will be barricaded. Upon completion of operations, these openings will be backfilled immediately.

6.11 Hazardous Atmospheres

Hazardous atmospheres, such as oxygen deficiency (below 19.5 % and above 23.5 %), flammable gases or vapor (above 10%) and toxic gases or vapors may occur in any excavation on a UMaine campus or remote site. Acceptable entry conditions are between 19.5 % and 23 % for oxygen and below 10% for LEL. Toxic substances have varying entry level conditions that are contaminant dependent.

In excavations greater than four (4) feet in depth or locations where oxygen deficiency or hazardous atmosphere conditions are possible, such as sewer lines, manure pits, steam pits, aqua-cultural fish tanks, or near swamps or high traffic areas, the CP will test the air prior to allowing personnel to enter the area. The air will be tested using a calibrated, direct read Confined Space Entry Monitor. The CP shall be trained and proficient in the use of this monitor See Form MF10153.)

If a hazardous atmosphere exists or is likely to develop, engineering controls such as ventilation will be employed. Respiratory protection may also be required in addition to ventilating the excavation. When engineering controls (ventilation) or other controls are used to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted by the CP as often as necessary to ensure that the atmosphere remains safe. Standing water may also present a hazardous atmosphere and this must be monitored.

6.12 Confined Space Classifications

Excavations greater than four (4) feet in depth shall be considered confined spaces as defined by 29 CFR 1910.146, until it has been evaluated by the competent person (CP). Confined space

evaluations shall consider the excavation's configuration, available access and egress and the presence of hazardous atmospheres. The evaluation shall be included in the site safety plan.

If it is determined that a hazardous atmosphere exists within the excavation, it shall be considered a "Permit-required Confined Space." A permit must be obtained and all confined space entry protocols and procedures will be followed. (Refer to the "University of Maine's Confined Space Entry Program" for more information on confined spaces or permit-required confined spaces.)

7. Planning and Site Preparation

7.1 Notifications

For all work occurring on UMaine owned or administered properties, at a minimum, the following organizations or entities shall be notified prior to the commencement of excavation activities (Example form, Appendix C), and an attached map indicating the exact location of the excavation activity planned to:

- Facilities Management (FM);
- Impacted building(s); and,
- University of Maine's Safety and Environmental Management (SEM);

For work occurring at remote sites, local public safety organizations such as fire and ambulance as well as FM, shall be contacted prior to commencing excavation activities. These notifications shall also be included in the site safety plan.

7.2 Area Restrictions

Based upon the determined regulated area, appropriate barricades or other warning devices shall be selected and installed prior to the commencement of any excavation. Barricades used shall protect the health and safety of individuals in the area. Barricade tape, used alone, shall not be considered an acceptable means of restricting an excavation area.

The established barriers shall be maintained in place throughout the duration of the excavation project. Barriers shall be inspected on a daily basis to ensure the excavation is adequately isolated.

8. Work Restrictions

8.1 Staffing

All excavation projects will be staffed by a minimum of two (2) full-time employees, including one (1) who is trained as the competent person (CP). The competent person may periodically leave an excavation site as long as hazardous or potentially hazardous conditions do not exist and at least two (2) employees remain at the excavation site. These sites will be staffed by a minimum of two (2) persons when work is in progress.

8.2 Project Schedule

An estimated project schedule, including proposed hours of work, shall be included with the submitted excavation notification form. (See Form MF10152)

8.3 Work Coordination

As determined by the PM, a pre-construction meeting shall be held to review the scope and impact of the work. This meeting will include appropriate impacted groups. The purpose of this meeting will be to discuss the project schedule, extent of work, restricted areas, site contacts and other issues relevant to the project. The PM will be responsible for planning and scheduling the pre-construction meeting.

9. General Trenching and Excavation Requirements

Work that involves the removal of earth to a depth greater than five (5) feet shall be considered an excavation. Protective systems shall be designed and utilized specifically for all excavations greater than five (5) feet. These protective systems may include sloping or benching of the sides of the excavation or, supporting the sides of the excavation or by using a shield, such as a trench box, between the work area and the excavation side. Each protective system shall be designed specifically for the project-related excavation.

The installation and use of protective systems are not required when an excavation is made entirely in stable/competent rock or is less than five (5) feet deep and a competent person has examined the ground and found no indication of a potential cave-in.

The design of the protective system shall take into account the following factors:

- Soil classification;
- Depth of cut;
- Installation and removal of support systems;
- Hazardous atmospheres;
- Water/frost content of soil;
- Weather and climate; and,
- Other operations in the vicinity of the excavation.

9.1 Soil Classification

Any excavation activity, which occurs within the confines of UMaine property, shall be assumed to be Type C soil. For all excavations outside of the campus boundaries, soils shall be classified in accordance with 29 CFR 1926.650 (Subpart P Appendix A, OSHA Excavation Standard) prior to the commencement of excavation activities. (See Appendix D)

9.2 Depth of Cut

For all excavations greater than four (4) feet, but less than five (5) feet, the CP shall assess the cut (or excavation) for potential cave-in hazards. The CP will have the authority to install any protective systems necessary to protect the person(s) working in excavation from cave-ins. The CP shall also

determine if a hazardous atmosphere exists before persons are allowed to work within the excavation.

Personnel shall not be permitted to work on the faces of sloped excavations at levels above other employees, except when employees at lower levels are adequately protected from the hazards of falling, rolling or sliding materials or equipment.

For excavations five (5) feet in depth or greater, protective systems shall be used. The CP and individual department policies shall determine the actual use of a specific protective system described below. Protective systems that may be employed are sloping, benching, shoring and shielding.

9.2.1 Sloping

Sloping is a method of protecting employees from cave-ins by forming sides that are inclined away from the excavation. The angle of the incline required will vary with the soil type and environmental conditions. Since we are operating under the assumption that all soils on the property are to be considered Class Type C soils, the walls of the excavation will be sloped at an angle not steeper than 1 ½ horizontal to 1 vertical (1.5 : 1) or thirty-four (34°) degrees measured from the horizontal plane.

This is the only non-structural protective method allowed in Class Type C soil.

Maximum allowable slopes and sloping configurations will be determined according to soil type as described in Appendix A and B of the OSHA excavation standard. It is presented herein as Appendix G.

9.2.2 Benching

Benching is a method of protecting employees from cave-ins by forming one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels. This method may only be used in Class Type A or Class B soils.

Maximum allowable number and configuration of benches will be determined according to soil type as described in Appendix A and B of the OSHA excavation standard. It is presented herein as Appendix D.

9.2.3 Shoring and Shielding

The CP shall select and oversee the construction of support systems, shield systems and other protective devices designed for the protection of personnel working in excavations. Materials and equipment used in protective systems will not be damaged or defective. Manufactured materials and equipment used for protective systems will be used and maintained safely and according to manufacturer's recommendations. The CP is responsible for daily inspections of the protective systems. General structural integrity and the ability to adequately support the excavation walls will be observed by the CP.

Excavation of the material shall not exceed two (2) feet below the bottom of the members of the support system. Excavation greater than two (2) feet below the bottom of the support system may be permitted only if reviewed and approved by a registered Professional Engineer (PE), and there are no indications of a possible loss of soil from behind or below the bottom of the support system.

9.2.4 Shoring

Structures such as metal, hydraulic, mechanical or timber-bracing systems that support the sides of the excavation and are designed to prevent cave-ins are acceptable shoring systems. All shoring systems shall be designed according to the conditions and requirements of Appendix C and D of the OSHA Excavation Standard. It is presented herein as Appendix D.

9.2.5 Shielding

A shield is a structure that protects employees and is able to withstand forces imposed upon it created by a cave-in. Shields may be permanent or designed to be portable and moved as the work progresses. Shields may also be manufactured to meet the project-specific needs of the excavation site. A trench box is an example of a shielding system.

The manufacturer's tabulated data for the trench box or shield that is used in the excavation project will be kept on-site at all times. This must be readily accessible to an inspector reviewing the site.

For excavations other than those described in the 29 CFR 1926.652 Subpart P or this document (i.e., excavations greater than 20 feet in depth), protective systems shall be designed and approved by a registered PE and the written design shall include at a minimum a plan indicating the sizes, types and configurations of materials to be used in the protective system and the name of the registered PE approving the design.

At least one (1) copy of the design shall be maintained at the job site during the construction of the protective system. After that time, the design may be stored off-site but shall be available for review upon request.

9.3 Installation and Removal of Support Systems

Support systems shall be installed and removed in a manner which protects employees from cave-ins, structural collapses or being struck by members of the support system. Members of support systems shall be securely connected together to prevent sliding, falling, kick-outs or other predictable failure. The individual members of support systems shall not be subjected to loads exceeding those for which they were designed to withstand.

Prior to installation of any support system, the system shall be inspected by the CP for structural integrity. The CP shall ensure that the selected support system is appropriate for the excavation activity (i.e., size, depth, height, work activity and configuration). The depth of the excavation shall not be greater than one (1) foot above the top of the installed support system.

Removal of support systems shall begin at the bottom of the excavation. Before removal begins, additional precautions shall be taken to ensure the safety of employees, such as installing other

temporary structural members to carry the loads imposed on the support system. Members shall be removed slowly, noting any indication of possible failure of the remaining members or possible cave-ins. Backfilling shall progress with the removal of the support systems from the excavation.

The number of employees present in the excavation shall be limited to only those necessary for the installation or removal of the support system.

9.4 Materials and Equipment for Protective Systems

All materials and equipment used for protective systems shall be free from any damage or defects that impair their proper function. These materials and equipment shall be maintained in accordance with the manufacturer's recommendations. They shall also be used in a manner that will prevent employee exposure to hazards. If the materials or equipment becomes damaged, the CP shall evaluate the damaged and determine the suitability for continued use. If the CP cannot assure the material or equipment is suitable for safe use then the item(s) will be removed from service. The item(s) shall be evaluated and approved by a registered PE before being returned to service.

9.5 Hazardous Atmospheres

Hazardous Atmospheres such: as oxygen deficiency (atmospheres containing less than 19.5% or more than 23.5% oxygen by volume), the presence of flammable gases or vapors and the presence of toxic gases or vapors may be present, or may occur, in excavations. Situations where hazardous atmospheres may occur include, but are not limited to: steam tunnels, sewer-related work, manure pits, aquaculture fish tanks or excavations in high vehicle traffic areas.

In locations where hazardous atmospheres are possible and in excavations greater than or equal to four (4) feet in depth, the CP will test the air in the excavation before employees are permitted to enter. Engineering controls will be established as specified in the site-specific work plan to maintain acceptable atmospheric conditions. When flammable gases or explosive atmospheres (at levels which are above an established percentage of the LEL) are present, adequate ventilation will be provided and sources of ignition will be eliminated. When using the Confined Space Entry Monitor, the monitor will be programmed to automatically indicate the presence of an explosive or flammable atmosphere by sounding an alarm.

Ventilation or respiratory protection will be provided to prevent personnel exposures to oxygen deficient or toxic atmospheres. Periodic retesting of the excavation will be conducted by the CP to verify that the atmosphere in the excavation is acceptable. Testing will occur, at a minimum, four (4) times throughout the workday. Testing should coincide with entry or reentry into the trench (i.e., in the morning, prior to beginning work, at the close of break times and after lunch).

All test results shall be recorded and maintained in the competent persons' inspection log. (See Form MF10153.)

9.6 Condition of Soil

The CP shall evaluate the soils in and around the excavation for conditions that may result in cave-ins. These hazardous conditions include frost, frozen soil and water content. Existing conditions

such as frozen ground are subject to change when exposed to ambient air temperatures or sunlight. These conditions shall be considered when designing protective devices.

9.7 Weather Conditions

Weather conditions including changes in temperature, humidity and precipitation will impact the integrity of the excavation sides. As weather changes, protective devices and work practices may require alteration to accommodate for the changing site conditions. The CP shall include observations of changing weather conditions as part of the routine inspection process. An inspection of the excavation, the adjacent areas and protective systems shall be performed after every rainstorm or other weather-related, hazard-increasing occurrence.

9.8 Access and Egress

Safe access and egress to the excavation shall be maintained at all times. For excavations greater than or equal to four (4) feet in depth, adequate means of egress must be provided. An appropriate ladder, ramps or other safe means of access and egress must be provided every 25 feet along the length of the excavation. If structural ramps are used as a means of employee access or egress, they must be designed by a CP. If structural ramps are used as a means of equipment access or egress, they must be designed by a registered PE and shall be constructed in accordance with the design. Structural members used for ramps or runways must be uniform in thickness and joined in a manner to prevent slipping, tripping or displacement. Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom surface of the runway to avoid tripping.

Steps, ramps or other safe means of access or egress will be provided with a handrail that meets OSHA requirements for walking and working surfaces (29 CFR 1926.651). Handrails must be between 39"– 45" in height and contain both a mid-rail and toe-board. The top rail should be capable of supporting 200 pounds and the mid-rail should be capable of supporting 125 pounds.

9.9 Other Operations in the Vicinity of the Excavation Site

Operations in the vicinity of the excavation site shall be evaluated by the CP for potential impact on the excavation. Any activities determined to have an impact on site safety or the integrity of the excavation shall be curtailed for the duration of the excavation project.

10. Personal Protective Equipment (PPE)

Prior to the commencement of any excavation, an assessment will be made by the CP as to appropriate PPE required to safely work in and around the excavation. The CP will ensure, at a minimum, that the following PPE is worn at all times by workers and visitors at the site:

- Hard hats;
- Safety-toed shoes;
- Impact-resistant eye protection; and,
- Appropriate gloves or hand protection.

Other issues such as hearing protection and respiratory protection must also be considered when assessing the project for PPE requirements. FM Department Safety Staff and SEM Staff will be available to advise and assist in the selection of appropriate PPE.

All employees and visitors shall wear the required PPE at all times while on the excavation site.

11. Site Safety

Prior to the commencement of the excavation project, site safety protocols shall be established in writing and discussed with all project personnel. Safety protocols may consist of established standard procedures; however, these established procedures shall be amended to incorporate any site-specific issues. These protocols shall become part of the site safety plan and will include the following elements:

- Restriction of site access to authorized personnel only;
- Installation of adequate engineering controls and barriers;
- Site authority and management responsibilities;
- Visitor's access protocols; and,
- General work practices and procedures.

These protocols shall be observed and maintained throughout the duration of the excavation project.

12. Inspection Requirements

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

Where the CP observes evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmosphere or other conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

The CP is responsible for maintaining a daily inspection report of the excavation project (Form MF10153.) This report will become part of the permanent project documentation. The following items shall be included in the CP's daily report:

- List of personnel on-site;
- Evaluation of physical hazards;
- Evaluation of atmospheric hazards and all monitoring data;
- Changing site conditions (including a change in the project scope, weather or vehicular traffic);

- Visitors;
- Summary of project-related activities.

The CP shall complete and sign the daily inspection logs before attaching them to the project documentation. A copy of the signed log shall be kept on-site for the duration of the project. (See Form MF10153.)

13. Emergency Response

Prior to excavation activities and as part of the site-specific work plan development, procedures for emergency response shall be determined and implemented. Personnel involved with a specific project shall be made familiar with project specific emergency response procedures as outlined in the site safety plan. These emergency response procedures shall include at a minimum the following items:

- Protocol for notification of emergency response agencies;
- Responsibilities of individuals on the site;
- Posting of local emergency response agencies;
- Notification of these agencies of the scheduled work prior to commencement; and,
- Identification of the nearest telephone, radio or other telecommunication device.

If the excavation is located on the Orono campus, Facilities Management (FM), and UMaine's Safety and Environmental Management (SEM); should be listed in the emergency section of the site safety plan and receive notification where the excavation is (building) and when the project commencement date and time.

If the excavation is located at one of the remote sites, the local fire department and ambulance needs to be listed in the emergency response plan and notified of the project commencement date and time.

For excavations where hazardous atmospheric conditions exist or may be reasonably expected to develop during the course of the work in the excavation, emergency rescue equipment such as safety harnesses, lifelines and basket stretchers shall be on-site and available to personnel working at the excavation site or responding to the site in the event of an emergency.

Personnel working in bell-bottomed pier holes or other deep and confined excavations shall follow all permit required confined space procedures and wear a safety harness with a lifeline securely attached to it. The lifeline shall be attended at all times while the employee wearing the line is in the excavation. The lifeline shall not be used to handle materials or equipment.

14. Accident and Injury Reports

Any serious injuries that require immediate medical attention requires contacting EMS at 911 or 581-4040. All injuries shall be reported to the UMaine Project Manager. All injuries occurring during excavation projects shall be reported to Safety and Environmental Management (SEM) within 24 hours of the incident. Accidents involving property damage shall be reported to the FM Risk Manager within 24 hours of occurrence.

15. Training

All University personnel working in or around excavations shall receive training to familiarize them with the OSHA excavation standard and other issues related to excavation projects. At a minimum, the following topics shall be discussed during the Annual Trenching Awareness training:

- Potential safety hazards of excavations;
- Safe excavation work practices;
- Hazardous atmosphere testing;
- Excavation inspection procedures;
- Requirements for protective systems; and,
- Standard rescue procedures

In addition to the awareness training, the Competent Person will attend a Designated Competent Person training program. These courses are offered free of charge by the Maine Department of Labor—Safety Works. This one-time, 8-hour training shall include soils evaluation; site inspection procedures; protective systems; and, a confined space overview. The CP will be required to attend annual Trenching Awareness Training.

The CP shall conduct a Site Safety meeting prior to the start of any excavation work. During the meeting, the CP will review the potential safety hazards of the project, safe work practices, site-specific health and safety issues and emergency rescue procedures.

16. Documentation and Recordkeeping Requirements

The Department responsible for the excavation work shall maintain copies of training records for all personnel completing excavation safety or CP training. These records shall be maintained for a minimum period of three (3) years. Project related records such as inspection forms, project logs and atmospheric evaluations shall be maintained for a minimum of one (1) year.

17. Enforcement

University personnel and contractors shall comply with the procedures described within this program. (Personnel deemed out-of-compliance shall be subject to enforcement actions in accordance with the UMaine Policy. All contractors and subcontractors that work on UMaine property will also comply with this Policy.)

Revision Page

DATE	TYPE	PAGE NUMBERS
May 22, 2008	Major New Template Conformity/Appearance	Throughout Document and All Appendices
May 23 2008	“Qualified Person” changed to “Competent Person”	Throughout Document
May 23, 2008	Department of Environmental Health & Safety (EH&S) changed to Safety and Environmental Management (SEM)	Throughout Document
May 23, 2008	Figures that were part of the original program dated 3/8/2000 were revised and incorporated into a separate Appendix Section.	Appendix E Figures
May 23, 2008	The document is one contiguous document with exception to the three forms.	Throughout document.
June 2, 2008	Defined Project Manager’s responsibilities for Outside Contractors and included the review of a Site Safety Plan.	Throughout responsibilities section.
June 2, 2008	Updated Dig Safe Law, Overhead High Voltage & Line Safety Act	Appendix A & B.
August 1, 2008	Example forms were removed from document and assigned form numbers.	Form numbers MF10152, MF10153 and MF10154 on the SEM Forms Web Page
November 25, 2008	Minor change to Trenching and Excavation Log, to include a non- confined space assessment by a competent person.	Form # MF10153

Appendix A

Dig Safe Law

Insert



Dig Safe System, Inc.

1-888-DIG-SAFE MA - ME - NH - RI - VT

What is Dig Safe ®?

State laws require anyone who digs to notify utility companies before starting, and for good reason. Digging can be dangerous and costly without knowing where underground facilities are located.

Dig Safe System, Inc. is a communication network, assisting excavators, contractors and property owners in complying with state law by notifying the appropriate utilities before digging. Dig Safe®, a free service, notifies member companies of proposed excavation projects. In turn, these member utilities respond to the work area and identify the location of underground facilities. Callers are given a permit number as confirmation.

Member utilities, or contracted private locators, use paint, stakes or flags to identify the location of buried facilities. Color coding is used to identify the type of underground facilities:

RED	ELECTRIC
YELLOW	GAS, OIL, STEAM
ORANGE	COMMUNICATIONS
BLUE	POTABLE WATER
PURPLE	RECLAIMED WATER
GREEN	SEWER / DRAINAGE
PINK	SURVEY MARKS
WHITE	PROPOSED EXCAVATION

Dig Safe is a not-for profit corporation, funded entirely by member utility companies, to promote public safety, protect vital utility services and safeguard against property and environmental damage.

Dig Safe processes all locate requests Monday through Friday from 6 a.m. to 6 p.m., not including holidays (see Observed Holiday list below). Off hour coverage is provided for emergency work only.

The toll free number for anyone who digs in Massachusetts, Maine, New Hampshire, Rhode Island and Vermont is...

888-DIG-SAFE (344-7233)

Before calling, please prepare to provide us with the following information:

Caller Details

Contractor ID: _____
 Name: _____
 Title: _____
 Phone: _____
 Alt. Phone: _____
 Fax: _____

[Home](#) | [Quick-Ticket](#) | [Company Info](#) | [Membership Info](#) | [Laws & Enforcement](#) | [Services](#) | [Contact Us](#)

Business
Hours: _____
Company
Name: _____
Address: _____

Location Details

State: _____
City/Town: _____
Latitude/Longitude:
(optional) _____ / _____
Address/Intersection: _____
Cross
Street: _____
Additional Information: _____
Type of
Work: _____
Depth
(feet): _____
Area to be
marked: _____
(i.e. street to house, in the street, sidewalk area, right side of house)
Area Premarked? Y _____ / N _____
Excavator doing
work: _____

In Massachusetts, Maine and New Hampshire, state law requires advance notice of at least 3 business days.

In Rhode Island and Vermont, state law requires advance notice of at least 2 business days.

Observed Holidays

New Year's Day
M.L.K. Day
President's Day
Patriot's Day (MA,ME only)
Memorial Day
Independence Day
Victory Day (RI only)
Labor Day
Columbus Day
Veteran's Day
Thanksgiving Day
Day After Thanksgiving
Christmas Day

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Last Update: May 5, 2008

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Title 23, §3360-A, Protection of underground facilities

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§3360-A. Protection of underground facilities

1. Definitions. As used in this section, unless the context otherwise indicates, the following terms shall have the following meanings.

A. "Business day" means any day other than Saturday, Sunday or a legal holiday. [1979, c. 362, §2 (new).]

A-1. "Borrow pit" has the same meaning as provided in Title 38, section 482, subsection 1-A. [1999, c. 718, §1 (new).]

A-2. "Commercial timber harvesting activity" means the cutting or removal of timber for the primary purpose of selling or processing forest products and includes the attendant operation of mobile or portable chipping mills and of cutting and skidding machinery and the creation, use and maintenance of skid trails, skid roads, winter haul roads and other roads to facilitate timber harvesting. [1999, c. 718, §1 (new).]

B. "Emergency excavation" means immediate excavation necessary to prevent injury, death or loss of an existing vital service. [1979, c. 362, §2 (new).]

C. "Excavation" means any operation in which earth, rock or other material below the ground is moved or otherwise displaced, by means of power tools, power equipment or explosives and including grading, trenching, digging, ditching, drilling, augering, tunneling, scraping and cable or pipe driving, except tilling of soil and gardening or displacement of earth, rock or other material for agricultural purposes. [2001, c. 577, §1 (amd).]

C-1. "Excavator" means any person proposing to make, making or contracting for an excavation. [1991, c. 437, §1 (new); §12 (aff).]

D. "Person" means an individual, partnership, municipality, state, county, political subdivision, utility, joint venture or corporation and includes the employer of an individual. [1979, c. 362, §2 (new).]

D-1. "Shoulder-grading activity" means highway maintenance work that involves the use of a motorgrader or other suitable construction equipment with a blade on the shoulder of a road to remove accumulated sand, gravel, sod or other material to establish drainage away from the traveled portion of the highway. [2001, c. 577, §2 (new).]

E. "Underground facility" means any item of personal property buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephonic or telegraphic communications, electric energy, oil, gas or other substances and including, but not limited to, pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments, appurtenances and those parts of poles below ground. This definition shall not include highway drainage culverts or under drains. [1979, c. 362, §2 (new).]

F. "Underground facility operator" means the owner or operator of any underground facility, other than an underground oil storage facility as defined in Title 38, section 562-A, subsection 21 or an airport aviation fuel hydrant piping system, used in furnishing electric, telephone, telegraph, gas, petroleum transportation or cable television service. "Underground facility operator" does not include a municipality or a public utility with fewer than 5 full-time employees or fewer than 300 customers or a person that owns underground facilities on its own property for commercial or residential purposes. [2001, c. 577, §3 (amd).]

G. "Utility" means any public utility as defined in Title 35-A, section 102, subsection 13. [1991, c. 437, §1 (new); §12 (aff).]

[2001, c. 577, §§1-3 (amd).]

1-A. Damage prevention system. Each underground facility operator shall be a member of and participate in an underground facility damage prevention system, referred to in this section as the "system." The system shall operate during regular business hours throughout the year and maintain adequate operations at all other times to receive and process emergency notifications of proposed

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excavations. The system shall receive notices of proposed excavations and immediately transmit those notices to underground facility operators whose facilities may be affected. The cost for operation of the system must be apportioned equitably among members. Nothing in this subsection prohibits a municipality, utility or other entity that owns or operates an underground facility from voluntarily becoming a member of the system. Notwithstanding subsection 1, paragraph F, a person that voluntarily becomes a member of the system is deemed an underground facility operator for the purposes of this section.

[1999, c. 718, §2 (amd).]

2. Responsibility of designers.

[2001, c. 577, §4 (rp).]

3. Notice by excavator. A person may not begin excavation without first giving notice as required by this section, unless exempted pursuant to this section.

A. In addition to any other notices required under this section, each excavator shall notify the system of the location of the intended excavation at least 3 business days but not more than 30 calendar days prior to the commencement of excavation, except as provided in paragraph G. [2003, c. 373, §1 (amd).]

B. Notice may be in writing, by telephone or by electronic facsimile as long as an excavator acquires and records an acknowledgement of the receipt of any notice the excavator sends by electronic facsimile. For purposes of this section, the system shall provide a toll-free telephone number. [1991, c. 437, §3 (new); §12 (aff).]

C. Prior to notifying the system, the area of proposed excavation must be marked by the excavator in a manner designed to enable the operator of the underground facility to know the approximate boundaries of the proposed excavation. [1991, c. 437, §3 (new); §12 (aff).]

D. If an excavation involves blasting, the excavator shall provide written notice of that blasting, either in the initial notice or in a subsequent notice, accurately specifying the date and location of that blasting. This written notice must be given and received at least 24 hours in advance except that, in the case of an unanticipated obstruction requiring blasting, the excavator shall provide written notice not less than 4 hours in advance of that blasting. [1991, c. 437, §3 (new); §12 (aff).]

E. If the proposed excavation or blasting does not commence within 30 calendar days of notification under this subsection or the excavation or blasting will be expanded outside of the location originally specified in the notification, the excavator responsible for that excavation shall again notify the system as specified in paragraph A. [1991, c. 437, §3 (new); §12 (aff).]

F. In the case of an excavation involving subcontractors or other arrangements in which more than one entity qualifies as the excavator under this section, the excavator directly responsible for performing the excavation shall ascertain that all notifications required by this subsection and subsections 5, 5-A and 10 are performed. [2001, c. 577, §5 (new).]

G. If an excavator notifies the system and nonmember operators as required by this section and is informed by the system and each nonmember operator, including private landowners, that no underground facilities exist in the proposed excavation area, then the excavator is not required to wait the 3 days as required by this subsection and subsection 10 and may begin excavation immediately. [2003, c. 373, §2 (new).]

[2003, c. 373, §§1, 2 (amd).]

3-A. Notification by system. Upon receiving notice of excavation, the system shall notify immediately all members whose underground facilities may be affected. The system shall maintain adequate records to document compliance with requirements of this chapter.

[1991, c. 437, §4 (new); §12 (aff).]

3-B. Additional notification by certain utilities. In addition to providing any other notices required under this section and before commencing any excavation for the purposes of working on an underground gas transmission line, a gas utility as defined in Title 35-A, section 102, subsection 8 or a natural gas pipeline utility as defined in Title 35-A, section 102, subsection 10 shall provide to the fire department within whose service area the excavation will occur notice of its intent to excavate. This notice must be in writing or by telephone and must be given at least 3 business days prior to the utility commencing work. The utility may not commence work until it has received from the fire department an acknowledgment of the notice either by telephone or in writing.

[1991, c. 437, §4 (new); §12 (aff).]

3-C. Information provided to municipalities, fire departments and emergency response agencies. Each gas utility as defined in Title 35-A, section 102, subsection 8 or natural gas pipeline utility as defined in Title 35-A, section 102, subsection 10 shall provide maps to:

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A. Each municipality within which it operates gas or natural gas underground transmission facilities. These maps must clearly indicate the location and depth of all main supply underground transmission facilities located within the jurisdiction of the municipality; [1991, c. 437, §4 (new); §12 (aff).]

B. Each fire department within whose service territory it operates gas or natural gas underground transmission facilities. These maps must clearly indicate the location and depth of all main supply underground transmission facilities located within the jurisdiction of the fire department; [1991, c. 437, §4 (new); §12 (aff).]

C. Each county emergency management agency within which it operates gas or natural gas underground transmission facilities. These maps must clearly indicate the location and depth of all main supply underground transmission facilities located within the jurisdiction of the county emergency management agency; and [1991, c. 437, §4 (new); §12 (aff).]

D. The Maine Emergency Management Agency. These maps must clearly indicate the location and depth of all main supply underground transmission facilities that the utility operates in this State. [1991, c. 437, §4 (new); §12 (aff).]

The utility must provide updated maps to the appropriate entities whenever changes occur in the configuration of the utility's main supply underground facilities.

[1991, c. 437, §4 (new); §12 (aff).]

4. Operator response to notice locating facilities. An underground facility operator shall, upon receipt of the notice provided for in subsection 3-A, advise the excavator of the location and size of the operator's underground facilities and all underground facilities used in furnishing electric or gas service that are connected to the operator's facilities, located in the public way and known to the operator in the proposed excavation area by marking the location of the facilities with stakes, paint or by other identifiable markings. The marking must identify a strip of land not more than 3 feet wide directly over the facility or a strip of land extending not more than 1 1/2 feet on each side of the underground facility and must indicate the depth of the underground facility, if known. The underground facility operator shall complete this marking no later than 2 full business days after receipt of the notice. After the underground facility operator has marked the location of that operator's underground facilities in the proposed excavation area, the excavator is responsible for maintaining the markings at the location, unless the excavator requests remarking at the location due to obliteration, destruction or other removal of the markings. The underground facility operator shall remark the location within one business day following the receipt of a request to remark.

If the proposed excavation is of such length or size that the underground facility operator advises the excavator that the operator can not reasonably respond with respect to all the operator's underground facilities within 2 full business days, the excavator shall notify the operator of the specific location in which excavation will first be made and the operator shall respond with respect to the operator's underground facilities in that location within 2 full business days and for the remaining facilities within a reasonable time thereafter.

The system may adopt rules requiring, under certain circumstances, face-to-face meetings between excavators and underground facility operators.

[2001, c. 577, §6 (amd).]

4-A. Alternative notice by certain excavators.

[1999, c. 718, §4 (rp).]

4-B. Modification and revocation of clearance.

[1999, c. 718, §4 (rp).]

4-C. Excavation methods. An excavator may not use mechanical means of excavation when excavating within 18 inches of any marked underground facilities until the underground facilities have been exposed, except that mechanical means may be used, as necessary, for initial penetration and removal of pavement, rock or other materials requiring use of mechanical means of excavation. Once the underground facilities have been exposed, further excavation must be performed employing reasonable precautions to avoid damage to the underground facilities, including, but not limited to, any substantial weakening of structural or lateral support of the facilities or penetration or destruction of the facilities or their protective coatings. For the purposes of this subsection, "mechanical means of excavation" means excavation using any device or tool powered by an engine except air vacuum methods of excavation.

[1999, c. 718, §5 (new).]

4-D. Abandoned or inactive facilities. Beginning on the date an owner or operator of underground facilities is required by the Public Utilities Commission to implement electronic mapping, the owner or operator shall indicate the existence of facilities abandoned or inactive after that date on its electronic mapping system and shall notify an excavator when abandoned or inactive facilities exist in the area of an excavation. If an owner or operator of an underground facility does not maintain an electronic mapping system, the owner or

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operator shall notify the excavator if the operator is aware of abandoned or inactive facilities in the area of an excavation.

[2001, c. 577, §7 (new).]

5. Emergency excavations. In an emergency, an excavator may commence an excavation after having taken all reasonable steps, consistent with the emergency, to notify the system and to mark the excavation site consistent with subsection 3, paragraph C. Each underground facility operator shall locate its underground facilities as soon as practicable after receiving notification of an emergency excavation whether or not the excavation has begun.

[1999, c. 718, §6 (rpr).]

5-A. Notice of damage. When an underground facility is damaged, the excavator causing the damage shall immediately notify the affected underground facility operator. The excavator may not backfill an excavation where damage has occurred without first receiving permission from the affected operator.

[1991, c. 437, §6 (new); §12 (aff).]

5-B. Exemption; commercial forestry and borrow pit operations. A person is exempt from the notice requirements of subsection 3 for any excavation undertaken in conjunction with a commercial timber harvesting activity or borrow pit as long as the excavation:

A. Is not conducted in a public place, on public land or within a public easement, including, but not limited to, a public way;

[1999, c. 718, §7 (new).]

B. Is not conducted within 100 feet of an easement or land owned by an underground facility operator; [1999, c. 718, §7 (new).]

C. Is not conducted within 100 feet of an underground facility; and [1999, c. 718, §7 (new).]

D. Does not involve the use of explosives. [1999, c. 718, §7 (new).]

[1999, c. 718, §7 (new).]

5-C. Exemptions; written agreements. A person undertaking an excavation in conjunction with a commercial timber harvesting activity within 100 feet of an underground facility or on an easement or land owned by an underground facility operator or within 100 feet of an easement or land owned by an underground facility operator is exempt from the notice requirements of subsection 3 and from the provisions of subsection 4-C if the person:

A. Has contacted the system to determine the identity of all underground facility operators that own or operate underground facilities within the area of the excavation; [1999, c. 718, §7 (new).]

B. Has entered into written agreements with all underground facility operators owning or operating facilities in the area of the excavation and with all persons owning the land on which the excavation occurs; and [1999, c. 718, §7 (new).]

C. Undertakes the excavation in accordance with the terms of the written agreements. [1999, c. 718, §7 (new).]

[1999, c. 718, §7 (new).]

5-D. Exemption; cemeteries. An excavator is exempt from the notice requirements of subsection 3 and subsection 10 for any excavation undertaken within the boundaries of a cemetery if the following procedures are followed.

A. The person responsible for operating the cemetery shall provide notice pursuant to subsections 3 and 10 identifying the entire cemetery as a potential excavation site. Owners and operators of underground facilities within the cemetery shall mark those facilities in accordance with subsections 4 and 10, as applicable. Thereafter, the person responsible for operating the cemetery shall maintain sufficient records or markings to identify the location of underground facilities within the cemetery. [2001, c. 577, §8 (new).]

B. The person responsible for operating the cemetery shall identify the location of any underground facilities within the excavation area and take appropriate action to avoid damage to the facilities. [2001, c. 577, §8 (new).]

[2001, c. 577, §8 (new).]

5-E. Shoulder-grading procedure. An excavator that is a licensing authority as defined by Title 35-A, section 2502, subsection 1 or its designee may be exempt from subsection 4-C for any excavation that is shoulder-grading activity if the excavator complies with this subsection. If an excavator chooses to excavate under this subsection, all owners of underground facilities within the area of excavation must comply with this subsection.

A. The excavator shall provide notice as required by subsections 3 and 10 and the owner or operator of underground facilities shall

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respond as required by subsections 4 and 10. [2001, c. 577, §8 (new).]

B. The excavator shall contact each owner or operator of underground facilities within the area of proposed shoulder-grading activity and describe the scope of its proposed shoulder-grading activity, including the anticipated depth of grading. [2001, c. 577, §8 (new).]

C. The owner or operator of each underground facility shall within 3 business days determine and notify the excavator whether the depth of its facility is sufficient to avoid damage. [2001, c. 577, §8 (new).]

D. After receipt of notice provided pursuant to paragraph C, the excavator may commence its shoulder-grading activity in a manner that does not disturb the facilities indicated by the owners or operators of the underground facilities or, if a facility is located at an insufficient depth to allow the proposed shoulder-grading activity, prior to the shoulder-grading activity the licensing authority may require the owner or operator of the underground facility to lower or otherwise move its facility in accordance with applicable law and the terms of its license. [2001, c. 577, §8 (new).]

[2001, c. 577, §8 (new).]

5-F. Water well construction; rulemaking. The Public Utilities Commission shall by rule establish notice requirements for excavation associated with drinking water well construction. In establishing the rule, the commission shall consider:

A. Whether notice requirements established in the rule should be limited to the drilling of a well or should also apply to other excavation associated with well construction activities, such as trenching for installation of pipes and equipment; [2003, c. 373, §3 (new).]

B. Whether notice requirements established in the rule should be based on factors such as geographic location, population density or other criteria bearing on the efficiency and effectiveness of the notification process and any offsetting public safety risks; [2003, c. 373, §3 (new).]

C. Whether the amount of time required for notice prior to excavation should be reduced; and [2003, c. 373, §3 (new).]

D. Any notice requirements associated with drinking water well construction that the commission determines appropriate. [2003, c. 373, §3 (new).]

Rules adopted pursuant to this subsection are major substantive rules as defined in Title 5, chapter 375, subchapter 2-A.

[2003, c. 373, §3 (new).]

5-G. Alternative notice requirement procedures for excavations; rulemaking. The Public Utilities Commission may by rule extend alternative notice requirements established for excavation associated with drinking water well construction pursuant to subsection 5-F to other types of excavation. Rules adopted under this subsection are major substantive rules as defined in Title 5, chapter 375, subchapter 2-A.

[2005, c. 334, §1 (new).]

5-H. Newly installed underground facilities in active excavation areas; rulemaking. The Public Utilities Commission shall by rule establish procedures to reduce the incidence of damage to newly installed underground facilities in active excavation areas as defined by the commission by rule. In establishing the rule, the commission may consider adopting additional requirements for excavators or operators, including renotification and marking requirements and system notification procedures. Rules adopted pursuant to this subsection are major substantive rules as defined in Title 5, chapter 375, subchapter 2-A.

[2005, c. 334, §1 (new).]

6. Liability of excavator. If an excavator complies with subsection 3 and if information pursuant to subsections 3-A and 4 is not provided within the time specified or if the information provided fails to identify the location of the underground facilities in accordance with subsection 4 then an excavator damaging or injuring underground facilities is not liable for any damage or injury caused by the excavation, except on proof of negligence.

[1999, c. 718, §8 (amd).]

6-A. Forfeitures.

[1999, c. 718, §9 (rp).]

6-B. Failure to notify. An excavation that is made without the excavator providing any or all of the notices required by this section that results in any damage to an underground facility or facilities is prima facie evidence in any civil or administrative proceeding that the

Title 23, §3360-A, Protection of underground facilities

damage was caused by the negligence of the excavator.

[1999, c. 718, §10 (amd).]

6-C. Penalties. In an adjudicatory proceeding, the Public Utilities Commission may, in accordance with this subsection, impose an administrative penalty for any violation of this subsection. The administrative penalty may not exceed \$500, except that, if the person has been found in violation of this subsection within the prior 12 months, the administrative penalty may not exceed \$5,000. Administrative penalties imposed pursuant to this subsection are in addition to any other remedies or forfeitures provided by law and any liability that may result from the act or omission constituting the violation. Before imposing any penalties under this subsection, the commission shall consider evidence of the record of the violator, including, to the extent applicable, the number of successful excavations undertaken by the violator or the number of locations successfully marked by the violator during the prior 12 months. The commission may require a person who violates any provision of this section to participate, at the expense of the violator, in an educational program developed and conducted by the system.

The Public Utilities Commission may impose administrative penalties for any of the following violations:

- A. Failure of an excavator to give notice of an excavation as required under subsection 3, except to the extent the excavator is exempt from the provisions of subsection 3 pursuant to other provisions of this section; [1999, c. 718, §11 (new).]
- B. Excavation by an excavator in a reckless or negligent manner that poses a threat to an underground facility; [1999, c. 718, §11 (new).]
- C. Excavation by an excavator that does not comply with the requirements of subsection 4-C, except to the extent the excavator is exempt from the provisions of subsection 4-C pursuant to subsection 5-C; [RR 1999, c. 2, §27 (cor).]
- D. Failure of an underground facility operator to mark the location of the operator's underground facilities within the time limits required by subsection 4; [2001, c. 577, §9 (amd).]
- E. Marking by an underground facility operator of the location of an underground facility in a reckless or negligent manner; or [2001, c. 577, §10 (amd).]
- F. Failure of an excavator to comply with the requirements of subsection 5-C, 5-D or 5-E. [2001, c. 577, §11 (new).]

The commission shall establish by rule standards for when and at what level penalties must be assessed under this subsection. Rules adopted under this subsection are major substantive rules as defined in Title 5, chapter 375, subchapter 2-A.

[2005, c. 334, §2 (amd).]

7. Imprudent action. Compliance with this section does not excuse a person from acting in a careful and prudent manner nor does compliance with this section excuse a person from liability for damage or injury for failure to so act.

[1979, c. 362, §2 (new).]

8. Effect on existing statutes or ordinances. Nothing contained in this section shall be construed to effect or impair any statute or ordinance requiring permits for excavation in a street or public highway.

[1979, c. 362, §2 (new).]

9. Exceptions.

[1991, c. 437, §9 (rp); §12 (aff).]

10. Further notice requirements. The following provisions govern excavations in areas where there are underground facilities owned or operated by a person who is not an underground facility operator as defined in subsection 1 and who is not a voluntary member of the system established under subsection 1-A.

A. In addition to other notice requirements under this section and except for an employee with respect to an employer's facility, an excavator shall notify any person who is not a member of the system and has underground facilities in the area of the proposed excavation. This notice must be in writing or in person and must be given at least 3 business days prior to the commencement of excavation. [1991, c. 437, §10 (new); §12 (aff).]

B. A person owning or operating an underground facility shall, upon receipt of the notice provided for in paragraph A, advise the excavator of the location and size of the underground facilities in the proposed excavation area by marking the location of the facilities with stakes, paint or by any other identifiable markings within 36 inches horizontally from the exterior sides of the underground facilities and the depth of the underground facilities, if known. The person providing information shall respond no later than 2 full business days after receipt of the notice. It is the responsibility of the excavator to maintain those location markings until

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the excavations are completed. [1991, c. 437, §10 (new); §12 (aff).]

If an excavator complies with paragraph A and if information pursuant to paragraph B is not provided within the time specified or if the information fails to identify the location of the underground facilities in accordance with paragraph B, then an excavator damaging or injuring underground facilities is not liable for any damage or injury caused by the excavation, except on proof of negligence.

[1991, c. 437, §10 (new); §12 (aff).]

11. Enforcement. The Public Utilities Commission may adopt procedures necessary and appropriate to gather information and hear and resolve complaints concerning failure to comply with the provisions of this section.

[1999, c. 718, §12 (rpr).]

12. Injunctions; costs. The owner or operator of an underground facility may request that the Public Utilities Commission issue a cease and desist order to prevent a person from undertaking an excavation that may result in damage to the underground facility. The Public Utilities Commission may issue a cease and desist order if the commission determines that the excavation or proposed excavation:

A. Is being conducted or is likely to be conducted in a negligent or unsafe manner; and [1997, c. 229, §2 (new).]

B. Is causing or is likely to cause damage to the underground facility. [1997, c. 229, §2 (new).]

If the owner or operator prevails in an action brought pursuant to this subsection, the owner or operator is entitled to an award of the costs of bringing the action, including reasonable attorney's fees.

[2003, c. 505, §4 (amd).]

13. Rules. The Public Utilities Commission may adopt rules necessary to implement this section. Except as otherwise specified in this section, rules adopted under this section are major substantive rules as defined in Title 5, chapter 375, subchapter 2-A.

[2005, c. 334, §3 (new).]

14. Discovered facilities. When an underground facility is discovered during an excavation and the location of that facility was, prior to the discovery, unknown or unclear to the underground facility operator, the Public Utilities Commission may direct that operator to determine and map the location of the facility for a reasonable distance, as determined by the commission, from the point of discovery.

[2005, c. 334, §3 (new).]

PL 1979, Ch. 362, §2 (NEW).
PL 1985, Ch. 111, §1 (AMD).
PL 1985, Ch. 111, §2 (AMD).
PL 1989, Ch. 109, § (AMD).
PL 1991, Ch. 437, §1-10 (AMD).
PL 1991, Ch. 437, §12 (AFF).
PL 1997, Ch. 229, §1,2 (AMD).
PL 1997, Ch. 631, §1-4 (AMD).
PL 1999, Ch. 718, §1-13 (AMD).
RR 1999, Ch. 2, §27 (COR).
PL 2001, Ch. 577, §1-11 (AMD).
PL 2003, Ch. 373, §1-3 (AMD).
PL 2003, Ch. 505, §3,4 (AMD).
PL 2005, Ch. 334, §1-3 (AMD).

Appendix B
Overhead High Voltage & Line Safety Act

Insert

MRS Title 35-A, Chapter 7-A: OVERHEAD HIGH-VOLTAGE LINE SAFETY ACT

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35-A §751. Short title

This Act may be known and cited as the "Overhead High-voltage Line Safety Act." [1995, c. 348, §1 (NEW).]

SECTION HISTORY

1995, c. 348, §1 (NEW).

35-A §752. Definitions

As used in this chapter, unless the context otherwise indicates, the following terms have the following meanings. [1995, c. 348, §1 (NEW).]

1. Covered equipment or items. "Covered equipment or items" means any mechanical equipment, hoisting equipment, antenna or boat mast or rigging, any part of which is capable of vertical, lateral or swinging motion that causes any portion of the equipment or item to come within 10 feet of an overhead high-voltage line during erection, construction, operation or maintenance, including, but not limited to, equipment such as cranes, derricks, power shovels, backhoes, dump trucks, drilling rigs, pile drivers, excavating equipment, hay loaders, hay stackers, combines, portable grain augers or elevators and items such as ladders, scaffolds, boat masts and outriggers, houses or other structures in transport and gutters, siding and other construction materials.

[1995, c. 348, §1 (NEW) .]

2. Overhead high-voltage line. "Overhead high-voltage line" means all above-ground bare or insulated electrical conductors of voltage in excess of 600 volts, measured between conductors or measured between a conductor and the ground, that are owned or operated by a transmission and distribution utility, except those conductors that are:

A. Enclosed in a rigid metallic conduit or flexible armored conduit; or [1995, c. 348, §1 (NEW) .]

B. On the premises of mines that are subject to the provisions of the Federal Mine Safety and Health Act of 1977, 30 United States Code, Section 801 and regulations adopted pursuant to that Act by the federal Mine Safety and Health Administration. [1995, c. 348, §1 (NEW) .]

[1999, c. 398, Pt. A, §19 (AMD); 1999, c. 398, Pt. A, §§104, 105 (AFF) .]

3. Person. "Person" means natural person, firm, business association, company, partnership, corporation or other legal entity.

[1995, c. 348, §1 (NEW) .]

4. Person responsible. "Person responsible" means the person performing or controlling the job or activity that necessitates the precautionary safety measures required by this chapter.

[1995, c. 348, §1 (NEW) .]

5. Warning sign. "Warning sign" means a weather-resistant sign of not less than 5 inches by 7 inches with at least 2 panels: a signal panel and a message panel. The signal panel must contain the signal word "WARNING" in black lettering and a safety alert symbol consisting of a black triangle with an orange exclamation point, all on an orange background. The message panel must contain the following words, either in black letters on a white background or white letters on a black background: "UNLAWFUL TO OPERATE THIS EQUIPMENT WITHIN 10 FEET OF OVERHEAD HIGH-VOLTAGE LINES - Contact with power

lines may result in death or serious burns." A symbol or pictorial panel may also be added. The warning sign language, lettering, style, colors, size and format must meet the requirements of the American National Standard Institute, Standard Z535.4-1991, Product Safety Signs and Labels, or its successors.

[1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW). 1999, c. 398, §A19 (AMD). 1999, c. 398, §§A104,105 (AFF) .

35-A §753. Duty and responsibility

It is the duty and responsibility of employers of persons and individuals who use any covered equipment or items, for the benefit of themselves or others, to acquaint themselves and their employees or agents using the equipment or items or engaged in the work operations or other activities with the provisions of this chapter and the rules prescribed and adopted pursuant to it. [1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §754. Prohibited activities

The following activities are prohibited until the requirements of sections 756 and 757 are met. [1995, c. 348, §1 (NEW) .]

1. Perform work. A person may not individually or through an agent or as an agent or employee perform any work or activity on any land, building, highway or other premises that may cause:

- A. A person to be placed within 10 feet of an overhead high-voltage line; or [1995, c. 348, §1 (NEW) .]
- B. A tool or material used by a person to be brought within 10 feet of an overhead high-voltage line. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

2. Erect; construct; operate; maintain; transport; store. A person may not, individually or through an agent or employee or as an agent or employee, erect, construct, operate, maintain, transport or store any covered equipment or item within 10 feet of an overhead high-voltage line, except as allowed in this subsection. The clearance from an overhead high-voltage line may be less than 10 feet but not less than 4 feet for the following covered equipment or items in the following circumstances:

- A. A sail boat on high water; [1995, c. 348, §1 (NEW) .]
- B. Covered equipment lawfully driven or transported on public streets and highways in compliance with the height restriction applicable to that street or highway; or [1995, c. 348, §1 (NEW) .]
- C. Refuse collection equipment wherever operated. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

3. Operate airplane or helicopter. A person may not, individually or through an agent or employee or as an agent or employee, operate or cause to be operated an airplane or helicopter within 20 feet of an overhead high-voltage line, except that no clearance is specified for licensed aerial spray applicators that may incidentally pass within the 20-foot limitation during normal operation.

[1995, c. 348, §1 (NEW) .]

4. Store. A person may not, individually or through an agent or employee or as an agent or employee, store or cause to be stored, underneath or in proximity to an overhead high-voltage line, any materials that are expected to be moved or handled by covered equipment in a manner that could bring the materials or the covered equipment within 10 feet of an overhead high-voltage line.

[1995, c. 348, §1 (NEW) .]

5. Provide additional clearance. A person may not, individually or through an agent or employee or as an agent or employee, provide or cause to be provided additional clearance by:

A. Raising, moving or displacing an overhead utility line of any type or nature, including high-voltage, low-voltage, telephone, cable television, fire alarm or other line; or [1995, c. 348, §1 (NEW) .]

B. Pulling or pushing a pole, guy or other structural appurtenance. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §755. Clearance reduced

If the overhead high-voltage line is covered with a mechanical barrier, in accordance with section 758, the required clearance under section 754, subsections 1 and 2 may be reduced to the designed working dimensions of the mechanical barrier. If the line is de-energized and grounded, in accordance with section 758, subsection 5, the required clearance under section 754, subsections 1 and 2 is reduced from 10 feet to 2 feet. Under no circumstances may the overhead high-voltage line or its covering be contacted. If the overhead high-voltage lines are temporarily raised or moved to accommodate the expected work or other activity, without also being insulated or de-energized and grounded, the required clearance under section 754, subsections 1 and 2 may not be reduced. [1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §756. Warning signs

A person may not, individually or through an agent or employee or as an agent or employee, operate covered equipment in the proximity of an overhead high-voltage line unless there are posted and maintained warning signs as follows: [1995, c. 348, §1 (NEW) .]

1. In covered equipment. A sign must be located in the covered equipment and readily visible and legible to the operator of the covered equipment when at the controls of the covered equipment; and

[1995, c. 348, §1 (NEW) .]

2. Outside covered equipment. Signs must be located on the outside of covered equipment in numbers and locations that are readily visible and legible at a distance of 12 feet by people engaged in the work operations.

[1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §757. Notification

1. Notification. When a person is going to carry on any work or activity in closer proximity to an overhead high-voltage line than permitted by this chapter, the person responsible for the work or activity must notify the owner or operator of the overhead high-voltage line prior to the time the work or activity is to be commenced. Notification must be at least 72 hours in advance of the work or activity, excluding Saturday, Sunday and legal state and federal holidays, except in emergency situations that include police, fire and rescue emergencies, in which case notification must be made as soon as possible. When the person responsible for the work activity is under contract or agreement with a government entity and the government entity and the owner or operator of the overhead high-voltage lines have already made satisfactory mutual arrangements, further arrangements for that particular activity are not required.

[1995, c. 348, §1 (NEW) .]

2. Information. A notice served by a person on an owner or operator of an overhead high-voltage line pursuant to this section must contain the following information:

- A. The name of the individual serving the notice; [1995, c. 348, §1 (NEW) .]
- B. The location of the proposed work or activity; [1995, c. 348, §1 (NEW) .]
- C. The name, address and telephone number of the person responsible for the work or activity; [1995, c. 348, §1 (NEW) .]
- D. The field telephone number at the site of the work or activity, if one is available; [1995, c. 348, §1 (NEW) .]
- E. The type and extent of the proposed work or activity; [1995, c. 348, §1 (NEW) .]
- F. The name of the person for whom the proposed work or activity is being performed; [1995, c. 348, §1 (NEW) .]
- G. The time and date of the notice; and [1995, c. 348, §1 (NEW) .]
- H. The date and time when the work or activity is to begin. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

3. Telephone notification. If the notification required by this section is made by telephone, a record of the notification must be maintained by the owner or operator of the overhead high-voltage line and by the person giving the notice to document compliance with the requirements of this section.

[1995, c. 348, §1 (NEW) .]

4. Address and telephone. To facilitate the notification required by this section, every owner or operator of overhead high-voltage lines that does not participate in an association for mutual receipt of notification of activities close to overhead high-voltage lines shall file with the commission the addresses and telephone numbers of the contact persons or offices of the owner or operator of overhead high-voltage lines in the State to whom all notifications concerning proposed work in the service territory of the owner or operator is directed. The information must be maintained by the commission in a manner determined by the commission.

[1995, c. 348, §1 (NEW) .]

5. Form association. Owners or operators of overhead high-voltage lines may form and operate an association providing for mutual receipt of notification of activities close to overhead high-voltage lines in a specified area. In areas where an association is formed, the following must occur:

- A. Notification of work activities to the association must be effected as set forth in this section; [1995, c. 348, §1 (NEW) .]

B. Owners or operators of overhead high-voltage lines in the area:

- (1) May become members of the association;
- (2) May participate in and receive the services furnished by the association; and
- (3) Shall pay their proportionate share of the cost for the services furnished; [1995, c. 348, §1 (NEW) .]

C. The association whose members or participants have overhead high-voltage lines within the State shall file a list containing the name, address and telephone number of each owner or operator of overhead high-voltage lines within the area of an association with the commission; and [1995, c. 348, §1 (NEW) .]

D. If notification is made by telephone, record must be maintained by the association to document compliance with the requirements of this section. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §758. Precautionary safety arrangements

1. Precautionary safety arrangements. Installation or performance of precautionary safety arrangements must be performed by the owner or operator of overhead high-voltage lines only after mutually satisfactory arrangements are negotiated between the owner or the operator of the overhead high-voltage lines and the person responsible for the work or activity to be done. The negotiations must proceed promptly and in good faith with the goal of accommodating the work or activity consistent with the owner's or operator's service needs and the intent to protect the public from the danger of contact with overhead high-voltage lines.

[1995, c. 348, §1 (NEW) .]

2. Appropriate for work. The precautionary safety measures must be appropriate for the work or activity for which the owner or operator of overhead high-voltage lines has received notification. During negotiations, the person responsible for the work or activity may change the notification of intended activities to include different or limited work or activities so as to reduce the precautionary safety measures required to accommodate the work or activities. The precautionary safety measures may not violate the requirements of the National Electrical Safety Code.

[1995, c. 348, §1 (NEW) .]

3. Agreement for payment. Agreements for payments of the costs of precautionary safety measures are governed by the following provisions.

A. If the owner or operator of the overhead high-voltage line has standard rates that apply to the provision of precautionary safety arrangements, the owner or operator of the overhead high-voltage line is not required to provide precautionary safety measures until payment has been made by the person requesting the safety measures or an agreement for payment has been reached. [1995, c. 348, §1 (NEW) .]

B. If the owner or operator of the overhead high-voltage line does not have standard rates, the owner or operator of the overhead high-voltage lines is not required to provide the precautionary safety arrangements until an agreement for payment has been made, except that, if there is a dispute over the amount to be charged by the owner or operator of the overhead high-voltage lines for providing the arrangements, the owner or operator shall commence providing precautionary safety measures as if an agreement had been reached. If an agreement for payment has not been reached within 14 days from the

completion of precautionary safety measures, the owner or operator and the person or business entity responsible for the work activities shall resolve the dispute by arbitration or other legal means. [1995, c. 348, §1 (NEW).]

[1995, c. 348, §1 (NEW) .]

4. Initiate; timely fashion. Unless otherwise agreed, the owner or operator of the overhead high-voltage lines shall initiate the agreed upon precautionary safety arrangements within 3 working days after the date of agreement for payment, if required, has been reached or within 5 working days of notice that the work activity is being done without an agreement. Once initiated, the owner or operator of the overhead high-voltage lines shall complete the work promptly and without interruption, consistent with the owner's or operator's service needs. If the owner or operator of the overhead high-voltage lines fails to provide the agreed upon precautionary safety arrangements within the period agreed upon, the owner or operator of the overhead high-voltage lines is liable for costs or loss of production of the person or business entity requesting the precautionary safety arrangements in order to work in proximity to overhead high-voltage lines, except that no liability exists during times of emergency, such as storm repair.

[1995, c. 348, §1 (NEW) .]

5. Inclusion. Precautionary safety arrangements may include:

A. Placement of temporary mechanical barriers separating and preventing contact between material, equipment or persons and overhead high-voltage lines; [1995, c. 348, §1 (NEW) .]

B. Temporary de-energization and grounding; [1995, c. 348, §1 (NEW) .]

C. Temporary relocation or raising of the overhead high-voltage lines; or [1995, c. 348, §1 (NEW) .]

D. Any other measures that are appropriate in the judgment of the owner or operator of the overhead high-voltage lines. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

6. Expense. The actual expense incurred by an owner or operator of overhead high-voltage lines in taking precautionary measures, including wages of its workers involved in making safety arrangements, must be paid by the person responsible for the work or activity to be done except when:

A. Prior arrangements for payment are made between a government entity for whom the work is to be done and the owner or operator of the overhead high-voltage line; or [1995, c. 348, §1 (NEW) .]

B. The owner or operator of the overhead high-voltage line has not installed the overhead high-voltage line in conformance with the applicable edition of the National Electrical Safety Code. If the overhead high-voltage line is not installed in conformance with the applicable edition of the National Electrical Safety Code, the liability of the person responsible for the work or activity is limited to the amount required to accommodate the work or activity minus the amount required to bring the installation into compliance with the National Electrical Safety Code. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §759. Enforcement

The provisions of this chapter are considered safety and health standards of the State. A person who causes, permits or allows work or other activity in violation of the provisions of this chapter may be assessed a civil penalty not exceeding \$1,000 for each day the violation continues. [1995, c. 348, §1 (NEW) .]

Civil penalties may be recovered in a civil action in the name of the State brought in the Superior Court for the county where the violation is alleged to have occurred or where the violator resides or has its principal office. Interest accrues on the penalties at a rate of 1 1/2% per month except that the interest is suspended during the pendency of an appeal. [1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §760. Indemnification

A person is liable to the owner or operator of the overhead high-voltage line and 3rd parties, if any, for all damages to facilities, injuries to persons and all costs, expenses and liabilities incurred by the owner or operator of the overhead high-voltage lines and 3rd parties, if any, as a result of any contact with an overhead high-voltage line if the person causes, permits or allows any work or activity in violation of a provision of this chapter and, as a result, a physical or electrical contact with an overhead high-voltage line occurs. [1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

35-A §761. Exemptions

1. Overhead electrical; communication circuits; conductors. This chapter does not apply to any person while engaged in the construction, reconstruction, operation and maintenance of overhead electrical or communication circuits or conductors and their supporting structures and associated equipment, if the person is an employee of the owner or operator of the overhead electrical or communication circuits or conductors or an independent contractor engaged on behalf of the owner or operator of the overhead electrical or communication circuits or conductors, including, but not limited to, employees of and independent contractors working for the following:

- A. Any business operating rail transportation systems; [1995, c. 348, §1 (NEW) .]
- B. Any business operating electrical generating, transmission or distribution systems; [1995, c. 348, §1 (NEW) .]
- C. Any business operating communication systems; or [1995, c. 348, §1 (NEW) .]
- D. Any business operating cable television systems. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

2. Agricultural activities. The provisions of sections 756 and 757 do not apply to a person operating agricultural equipment for agricultural purposes. If the equipment is likely to be routinely brought within 10 feet of an overhead high-voltage line, the owner or operator of the equipment must in each calendar year, prior to using the equipment, provide the owner or operator of the high-voltage line with the information required in section 757, subsection 2.

[1995, c. 348, §1 (NEW) .]

3. Water and sewer system operators. This chapter does not apply to any employee or independent contractor engaged on behalf of:

A. A water utility; [1995, c. 348, §1 (NEW) .]

B. A sewer district or sanitary district; or [1995, c. 348, §1 (NEW) .]

C. A municipal sewer department. [1995, c. 348, §1 (NEW) .]

[1995, c. 348, §1 (NEW) .]

SECTION HISTORY

1995, c. 348, §1 (NEW) .

Appendix C

Definitions

Accepted Engineering Practices: requirements compatible with standards of practice required by a registered professional engineer.

Aluminum Hydraulic Shoring: a manufactured shoring system consisting of aluminum hydraulic cylinders (cross braces) used with vertical rails (uprights) or horizontal rails (also known as wales).

Barricade: a movable structure designed to restrict access of unauthorized personnel, equipment or vehicles to the excavation work area.

Bell-bottom Pier Hole: the bottom of the excavation is bell shaped. A type of shaft or footing excavation in which the bottom is made larger than the cross section above to form a belled-shape.

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

Cave-in: the movement of soil or rock into the excavation, or loss of soil from under a trench shield or support system, in amounts large enough to entrap, bury or otherwise injure and immobilize a person.

CFR: Code of Federal Regulations

Competent Person (CP): a person capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authority to take prompt corrective measures to eliminate excavation hazards.

Confined Space: a space that has the following characteristics: is large enough and so configured that an individual can bodily enter and perform assigned work, has limited or restricted means for entry or exit and is not designed for continuous employee occupancy.

Cross Braces: the horizontal members of a shoring system installed perpendicular (side to side) to the sides of an excavation. The cross braces bear against either uprights or wales.

Department: any department or unit at the university that conducts work in excavations.

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

Faces: faces or sides are the vertical or inclined earth surfaces formed as a result of excavation work.

Failure: the movement or damage through breakage, displacement or permanent deformation of a structural member, or connection, that makes it unable to support loads.

FM: Facilities Management.

Hazardous Atmosphere: an atmosphere that is explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic or otherwise harmful, that may cause death, illness or injury.

Kick-out: the accidental movement or failure of a cross brace.

Layered Geologic Strata: where soils are configured in layers. The soil should be classified on the basis of the weakest soil layer classification. Each layer may be classified individually if a more stable layer lies below a less stable layer.

MSRA: Maine State Regulations Annotated

Permit - Required Confined Space: a confined space that contains one or a combination of the following conditions: hazardous atmosphere, engulfment hazard, a configuration that can trap or suffocate and entrant, mechanical or electrical hazards, or any other recognized safety and health hazards.

Program Administrator: an individual or department responsible for the developing, reviewing, updating and implementing the Excavation & Trenching program for the university.

Protective System: a method of protecting employees from cave-ins or from objects that could fall or roll from an excavation face, 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.

Qualified Person (QP): an individual who, by possession of a recognized degree, certificate or professional standing, or who, by professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated their ability to solve or resolve problems relating to the subject matter, the work or the project.

Ramp: 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 (RPE): a person who is registered as a professional engineer in the state where the work is to be performed.

Responsible Department: entity planning and conducting the excavation or trenching project (e.g.: FM, Telcom, Remote sites, Research Departments).

SEM: Safety & Environmental Management Department.

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

Shield: a structure that is able to withstand the forces imposed upon it by a cave - in and thereby protect personnel within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Shields used in trenches are referred to as *trench boxes* or *trench shields*.

Shoring: a structure that is built or placed to support the sides of an excavation and designed to prevent cave-ins. Examples are metal – hydraulic, mechanical or timber shoring.

Sloping: a method of protecting employees from cave-ins by excavating or sloping the sides of an excavation away from the excavation to protect employees from cave-ins. The required slope or *angle of incline* will vary with soil type, weather, and surface or near surface loads that may affect the soil in the area of the trench. This could include adjacent buildings or vehicles located near the edge of the trench.

Stable Rock: natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed.

Structural Ramp: a ramp built of steel or wood, used for vehicle access. Ramps made of soil or rocks are not considered structural ramps.

Support System: 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: tables and charts approved by a Registered Professional Engineer and used to design and construct a protective system.

Trench: a narrow excavation (in relation to its width) 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.

Type A Soil: cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf), previously undisturbed clays, silty clay, sandy clay, clay and loam, caliche or hard pan or bedrock. Soil that has been previously disturbed, is fissured, subject to vibration from heavy traffic, etc., cannot be considered Type A soil. (Type A is the most stable and cannot contain seeping water.)

Type B Soil: cohesive soils with an unconfined compressive strength greater than 0.5 tsf, but less than 1.5 tsf, or granular cohesion-less soils including; angular gravel, silt, silt and loam, sandy loam, previously disturbed soils except those which would be considered type C soil, dry rock that is not stable, and soils that meet Type A requirements but are fissured or subject to vibrations. (Type B soil meets Type A classifications but it is fissured or subject to vibration.)

Type C Soil: consist of either granular soils; including gravel, sand and loamy sand, submerged soil or soil from which water is freely seeping, submerged rock that is not stable, material in a sloped layered system where the layers dip into the excavation or soils with an unconfined compressive strength of 0.5 tsf.

Uprights: 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. They are often called *sheeting*.

Wales: horizontal members of a shoring system placed in the direction of the excavation face whose sides bear against the uprights or sheeting (vertical members) of the shoring system or earth.

Appendix D
OSHA 1926 Subpart P Standard

Insert

Title 29: Labor

PART 1926—SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

Subpart P—Excavations

Authority: Sec. 107, Contract Worker Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable, and 29 CFR part 1911.

Source: 54 FR 45959, Oct. 31, 1989, unless otherwise noted.

§ 1926.650 Scope, application, and definitions applicable to this subpart.

(a) *Scope and application.* This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

(b) *Definitions applicable to this subpart.*

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

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

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

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or 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 otherwise injure and immobilize a person.

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

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

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

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

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

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

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

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from 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 (c)(3) or (c)(4). Shields used in trenches are usually referred to as “trench boxes” or “trench shields.”

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

Sides. See “Faces.”

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

Trench box. See “Shield.”

Trench shield. See “Shield.”

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

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

§ 1926.651 Specific excavation requirements.

(a) *Surface encumbrances.* All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

(b) *Underground installations.* (1) 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, shall be determined prior to opening an excavation.

(2) Utility companies or owners shall 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. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

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

(4) While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

(c) *Access and egress*—(1) *Structural ramps.* (i) Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

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

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

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

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

(2) *Means of egress from trench excavations.* A stairway, ladder, ramp or other safe means of egress shall 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.

(d) *Exposure to vehicular traffic.* Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

(e) *Exposure to falling loads.* No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with §1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

(f) *Warning system for mobile equipment.* When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

(g) *Hazardous atmospheres—(1) Testing and controls.* In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50–1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

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

(ii) Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

(iii) Adequate precaution shall 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.

(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

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

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

(h) *Protection from hazards associated with water accumulation.* (1) Employees shall 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.

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

(3) If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall 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 require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

(i) *Stability of adjacent structures.* (1) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

(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 shall not be permitted except when:

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

(ii) The excavation is in stable rock; or

(iii) A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

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

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

(j) *Protection of employees from loose rock or soil.* (1) Adequate protection shall 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 shall 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.

(2) Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall 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.

(k) *Inspections.* (1) Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

(2) 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 shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

(l) Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with §1926.502(b) shall be provided where walkways are 6 feet (1.8 m) or more above lower levels.

[54 FR 45959, Oct. 31, 1989, as amended by 59 FR 40730, Aug. 9, 1994]

§ 1926.652 Requirements for protective systems.

(a) *Protection of employees in excavations.* (1) Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

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

(ii) Excavations are less than 5 feet (1.52m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(2) Protective systems shall 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.

(b) *Design of sloping and benching systems.* The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3), or, in the alternative, paragraph (b)(4), as follows:

(1) *Option (1)—Allowable configurations and slopes.* (i) Excavations shall 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.

(ii) Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

(2) *Option (2)—Determination of slopes and configurations using Appendices A and B.* Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of sloping or benching systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

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

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

(B) Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

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

(iii) At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall 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 shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

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

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

(B) The configurations that were determined to be safe for the particular project; and

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

(iii) At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

(c) *Design of support systems, shield systems, and other protective systems.* Designs of support systems shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

(1) *Option (1)—Designs using appendices A, C and D.* Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

(2) *Option (2)—Designs Using Manufacturer's Tabulated Data.* (i) Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

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

(iii) Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time

this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

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

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

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

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

(iii) At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall 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 shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

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

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

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

(iii) At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

(d) *Materials and equipment.* (1) Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

(2) Manufactured materials and equipment used for protective systems shall 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.

(3) When material or equipment that is used for protective systems is damaged, a competent person shall 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 such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

(e) *Installation and removal of support*—(1) *General*. (i) Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

(ii) Support systems shall 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.

(iii) Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

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

(v) Removal shall begin at, and progress from, the bottom of the excavation. Members shall 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.

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

(2) *Additional requirements for support systems for trench excavations*. (i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall 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.

(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems*. Employees shall 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.

(g) *Shield systems*—(1) *General*. (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall 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.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material 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.

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 side slopes, 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 shear 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 on 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 minimum

the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are 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 a 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.

Appendix B to Subpart P of Part 1926—Sloping and Benching

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in §1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and raveling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements*—(1) *Soil classification*. Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope*. The maximum allowable slope for a soil or rock deposit shall be determined from Table B–1 of this appendix.

(3) *Actual slope*. (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least 1/2 horizontal to one vertical (1/2H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with §1926.651(i).

(4) *Configurations*. Configurations of sloping and benching systems shall be in accordance with Figure B–1.

TABLE B-1
MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [2]
STABLE ROCK	VERTICAL (90°)
TYPE A [2]	3/4 : 1 (53°)
TYPE B	1:1 (45°)
TYPE C	1½ : 1 (34°)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

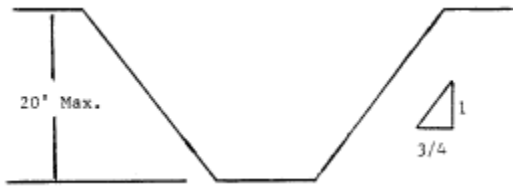
Figure B-1

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

B-1.1 Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of 3/4:1.



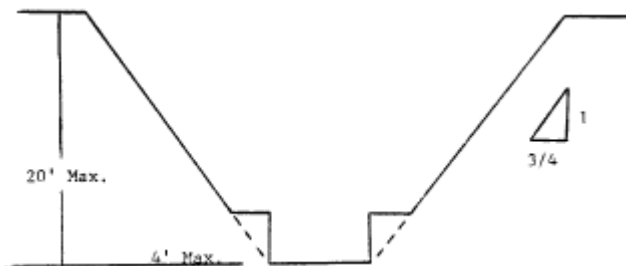
Simple Slope—General

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of 1/2:1.

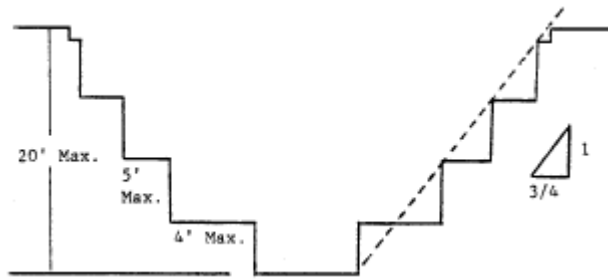


Simple Slope—Short Term

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 3/4 to 1 and maximum bench dimensions as follows:

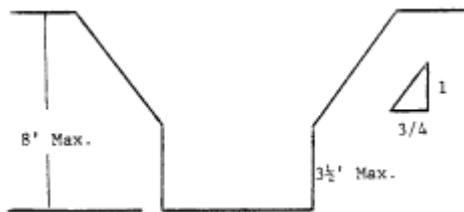


Simple Bench



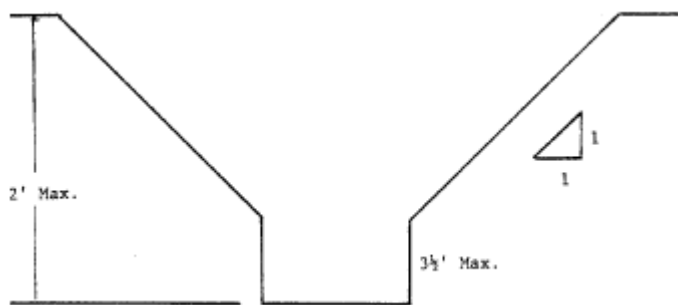
Multiple Bench

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3 1/2 feet.



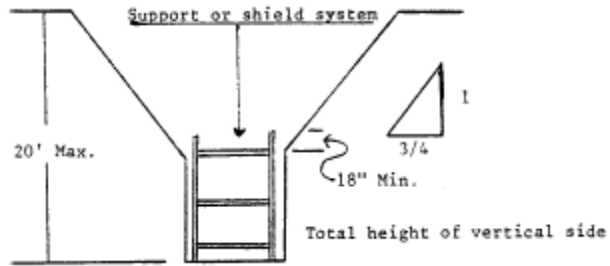
Unsupported Vertically Sided Lower Portion—Maximum 8 Feet in Depth

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3 1/2 feet.



Unsupported Vertically Sided Lower Portion—Maximum 12 Feet in Depth

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of 3/4:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

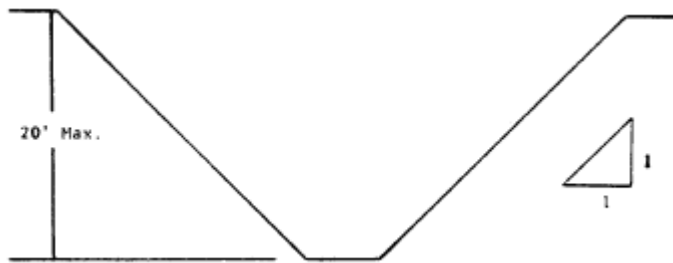


Supported or Shielded Vertically Sided Lower Portion

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under §1926.652(b).

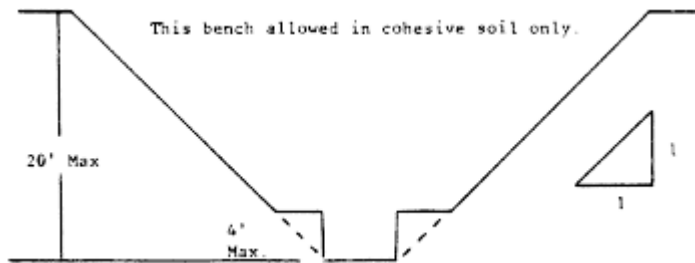
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

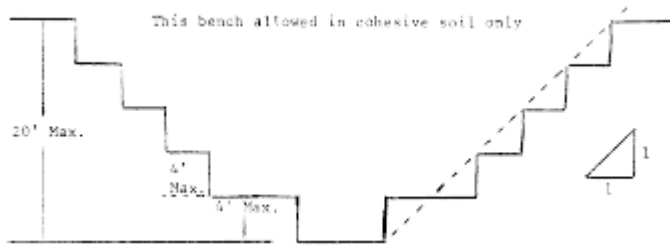


Simple Slope

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

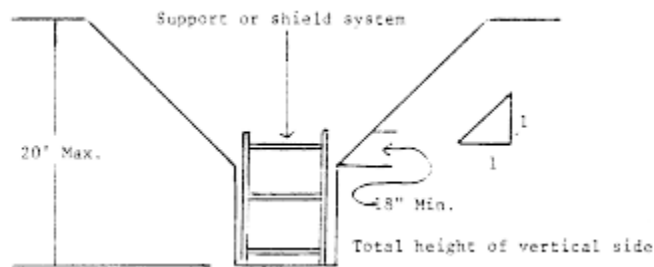


Single Bench



Multiple Bench

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.



Vertically Sided Lower Portion

4. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

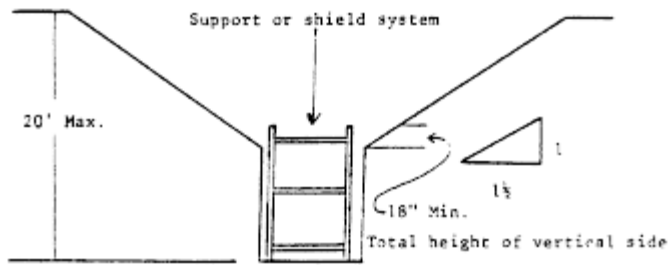
B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1 1/2:1.



Simple Slope

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1 1/2:1.

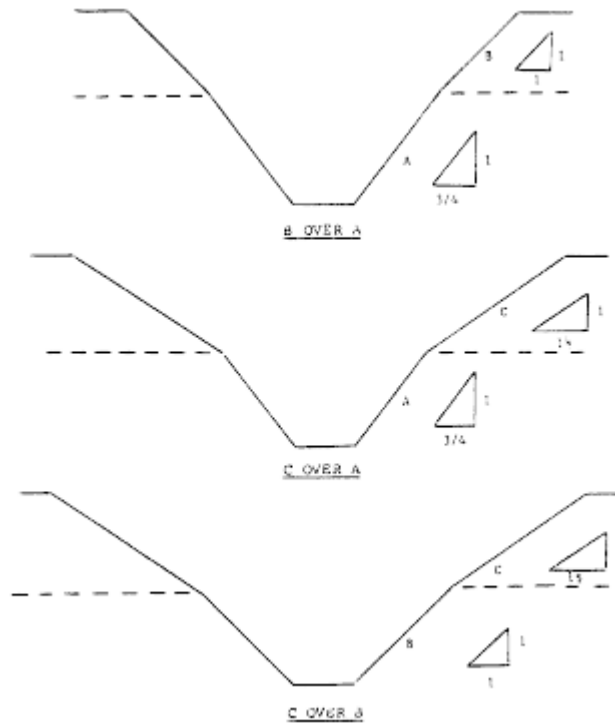


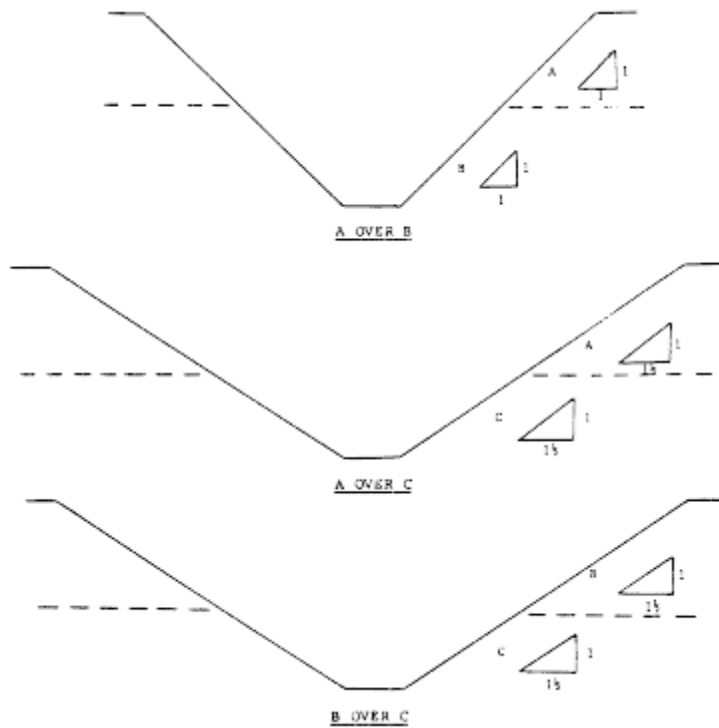
Vertical Sided Lower Portion

3. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

B-1.4 Excavations Made in Layered Soils

1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.





2. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

Appendix C to Subpart P of Part 1926—Timber Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with §1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in §1926.652(b) and §1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C-1.1, C-1.2, and C-1.3, and Tables C-2.1, C-2.2 and C-2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal

spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C–1.1 through C–1.3 and Tables C–2.1 through C–2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C–1.1 through C–1.3 are taken from the National Bureau of Standards (NBS) report, “Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations.” In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C–1.1 through C–1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C–2.1 through C–2.3, or have this choice under §1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in §1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with §1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term “adjacent” as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From *Table C-1.1*, for acceptable arrangements of timber can be used.

Arrangement #B1

Space 4×4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3×8 uprights at six feet horizontally. This arrangement is commonly called “skip shoring.”

Arrangement #B2

Space 4×6 crossbraces at eight feet horizontally and four feet vertically.

Space 8×8 wales at four feet vertically.

Space 2×6 uprights at four feet horizontally.

Arrangement #B3

Space 6×6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8×10 wales at four feet vertically.

Space 2×6 uprights at five feet horizontally.

Arrangement #B4

Space 6×6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10×10 wales at four feet vertically.

Spaces 3×8 uprights at six feet horizontally.

(2) Example 2.

A trench dug in Type B soil in 13 feet deep and five feet wide. From Table C–1.2 three acceptable arrangements of members are listed.

Arrangement #B1

Space 6×6 crossbraces at six feet horizontally and five feet vertically.

Space 8×8 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #B2

Space 6×8 crossbraces at eight feet horizontally and five feet vertically.

Space 10×10 wales at five feet vertically.

Space 2×6 uprights at two feet horizontally.

Arrangement #B3

Space 8×8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Space 2×6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From Table C–1.3 two acceptable arrangements of members can be used.

Arrangement #B1

Space 8×8 crossbraces at six feet horizontally and five feet vertically.

Space 10×12 wales at five feet vertically.

Position 2×6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #B2

Space 8×10 crossbraces at eight feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Position 2×6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C–1.3. Only one arrangement of members is provided.

Space 8×10 crossbraces at six feet horizontally and five feet vertically.

Space 12×12 wales at five feet vertically.

Use 3×6 tight sheeting.

Use of Tables C–2.1 through C–2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in §1926.652(c), “Design of Protective Systems.”

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches

thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 36 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

TABLE C-1.3

TIMBER TRUSS SHEDS -- MINIMUM TRUSS REQUIREMENTS *
SOIL TYPE C, $\gamma = 80$ pcf, $\phi = 72$ pcf (2 ft. Surcharge)

DEPTH OF ANCHOR (FEET)	SIZE, LOCATION, AND SPACING OF MEMBERS**										MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)	
	TOP BRACES					VERT. BRACES						
	BRACE SPACING (FEET)	UP TO DOWN TO	UP TO DOWN TO	UP TO DOWN TO	UP TO DOWN TO	BRACE SPACING (FEET)	UP TO DOWN TO	UP TO DOWN TO	UP TO DOWN TO	UP TO DOWN TO		
5	UP TO DOWN TO	6	6X8	6X8	8X8	3	8X10	5	2X6			
TO	8	8X8	8X8	8X8	8X10	3	10X12	5	2X6			
10	UP TO DOWN TO	10	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
15	UP TO DOWN TO	15	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
20	UP TO DOWN TO	20	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
25	UP TO DOWN TO	25	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
30	UP TO DOWN TO	30	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
35	UP TO DOWN TO	35	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
40	UP TO DOWN TO	40	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
45	UP TO DOWN TO	45	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
50	UP TO DOWN TO	50	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
55	UP TO DOWN TO	55	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
60	UP TO DOWN TO	60	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
65	UP TO DOWN TO	65	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
70	UP TO DOWN TO	70	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
75	UP TO DOWN TO	75	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
80	UP TO DOWN TO	80	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
85	UP TO DOWN TO	85	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
90	UP TO DOWN TO	90	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
95	UP TO DOWN TO	95	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
100	UP TO DOWN TO	100	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
105	UP TO DOWN TO	105	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
110	UP TO DOWN TO	110	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
115	UP TO DOWN TO	115	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
120	UP TO DOWN TO	120	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
125	UP TO DOWN TO	125	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
130	UP TO DOWN TO	130	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
135	UP TO DOWN TO	135	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
140	UP TO DOWN TO	140	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
145	UP TO DOWN TO	145	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
150	UP TO DOWN TO	150	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
155	UP TO DOWN TO	155	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
160	UP TO DOWN TO	160	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
165	UP TO DOWN TO	165	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
170	UP TO DOWN TO	170	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
175	UP TO DOWN TO	175	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
180	UP TO DOWN TO	180	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
185	UP TO DOWN TO	185	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
190	UP TO DOWN TO	190	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
195	UP TO DOWN TO	195	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
200	UP TO DOWN TO	200	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
205	UP TO DOWN TO	205	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
210	UP TO DOWN TO	210	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
215	UP TO DOWN TO	215	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
220	UP TO DOWN TO	220	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
225	UP TO DOWN TO	225	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
230	UP TO DOWN TO	230	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
235	UP TO DOWN TO	235	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
240	UP TO DOWN TO	240	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
245	UP TO DOWN TO	245	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
250	UP TO DOWN TO	250	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
255	UP TO DOWN TO	255	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
260	UP TO DOWN TO	260	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
265	UP TO DOWN TO	265	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
270	UP TO DOWN TO	270	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
275	UP TO DOWN TO	275	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
280	UP TO DOWN TO	280	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
285	UP TO DOWN TO	285	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
290	UP TO DOWN TO	290	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
295	UP TO DOWN TO	295	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
300	UP TO DOWN TO	300	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
305	UP TO DOWN TO	305	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
310	UP TO DOWN TO	310	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
315	UP TO DOWN TO	315	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
320	UP TO DOWN TO	320	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
325	UP TO DOWN TO	325	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
330	UP TO DOWN TO	330	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
335	UP TO DOWN TO	335	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
340	UP TO DOWN TO	340	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
345	UP TO DOWN TO	345	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
350	UP TO DOWN TO	350	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
355	UP TO DOWN TO	355	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
360	UP TO DOWN TO	360	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
365	UP TO DOWN TO	365	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
370	UP TO DOWN TO	370	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note 1											
375	UP TO DOWN TO	375	8X10	8X10	8X10	3	12X12	5	2X6			
	See Note											

* Based On or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TRENCH SHIELDING -- MINIMUM TRENCH REQUIREMENTS *
SOIL TYPE A P = 25 K N + 72 psf (2 ft. surcharge)

DEPTH OF TRENCH (FEET)	UPPER BEAMS SIZE, USES AND SPACING OF MEMBERS **									
	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)				
	UP TO 6	6 TO 8	8 TO 10	10 TO 12	12 TO 14	UP TO 6	6 TO 8	8 TO 10	10 TO 12	12 TO 14
5	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
10	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
15	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
20	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
25	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
30	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
35	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
40	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
45	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
50	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
55	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
60	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
65	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
70	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
75	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
80	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
85	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
90	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
95	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
100	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
105	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
110	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
115	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
120	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
125	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
130	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
135	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
140	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
145	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
150	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
155	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
160	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
165	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
170	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
175	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
180	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
185	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
190	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
195	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6
200	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6	CP 6 TO 6

SEE NOTE 1

* Douglas fir or equivalent with a bending strength not less than 1300 psi.
** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.3

TRENCH SHORING --- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C F = 80 X H + 72 per 12 ft. Surcharge

DEPTH OF TRENCH (FEET)	CHUSS BRACES				SIZE (INCH) AND SPACING OF MEMBERS **		MAXIMUM ALLOWABLE HORIZONTAL SPACING	
	HORIZ. SPACING (FEET)		VERT. SPACING (FEET)		VERT. SIZE (INCH)	VERT. SPACING (FEET)	CLASS	(FEET)
	UP TO 6	UP TO 10	UP TO 12	UP TO 15				
3	8X6	8X6	8X6	8X6	5	5	3X6	
4	8X6	8X6	8X6	8X6	5	5	3X6	
5	8X6	8X6	8X6	8X6	5	5	3X6	
6	8X6	8X6	8X6	8X6	5	5	3X6	
7	8X6	8X6	8X6	8X6	5	5	3X6	
8	8X6	8X6	8X6	8X6	5	5	3X6	
9	8X6	8X6	8X6	8X6	5	5	3X6	
10	8X6	8X6	8X6	8X6	5	5	3X6	
11	8X6	8X6	8X6	8X6	5	5	3X6	
12	8X6	8X6	8X6	8X6	5	5	3X6	
13	8X6	8X6	8X6	8X6	5	5	3X6	
14	8X6	8X6	8X6	8X6	5	5	3X6	
15	8X6	8X6	8X6	8X6	5	5	3X6	
16	8X6	8X6	8X6	8X6	5	5	3X6	
17	8X6	8X6	8X6	8X6	5	5	3X6	
18	8X6	8X6	8X6	8X6	5	5	3X6	
19	8X6	8X6	8X6	8X6	5	5	3X6	
20	8X6	8X6	8X6	8X6	5	5	3X6	
OVER 20	8X6	8X6	8X6	8X6	5	5	3X6	

* Douglas fir or equivalent with a bending strength not less than 1500 psi.
 ** Manufactured members of equivalent strength may be substituted for wood.

Appendix D to Subpart P of Part 1926—Aluminum Hydraulic Shoring for Trenches

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with §1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D-1.1, D-1.2, D-1.3 and E-1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D-1.1 and D-1.2 are for vertical shores in Types A and B soil. Tables D-1.3 and D1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D–1.1 through D–1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled “Aluminum Hydraulic Shoring; Typical Installations.”

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D–1 Tables. Aluminum material is 6061–T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in §1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with §1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D-1.1, D-1.2, D-1.3 and D-1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D-1.1 and D-1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D-1.3 and D-1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 6 feet deep and 3 feet wide. From Table D-1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 13 feet deep and 5 feet wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 16 feet deep and 9 feet wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote #B2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically, plywood (per footnote (g)(7) to the D-1 Table) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D–1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D–1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3×12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D–1.1, D–1.2, D–1.3, and D–1.4.*

(1) For applications other than those listed in the tables, refer to §1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to §1926.652(c)(2) and §1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5×3.5×0.1875) oversleeves, or structural oversleeves of manufacturer's specification, extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch. thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

- (8) See appendix C for timber specifications.
- (9) Wales are calculated for simple span conditions.
- (10) See appendix D, item (d), for basis and limitations of the data.

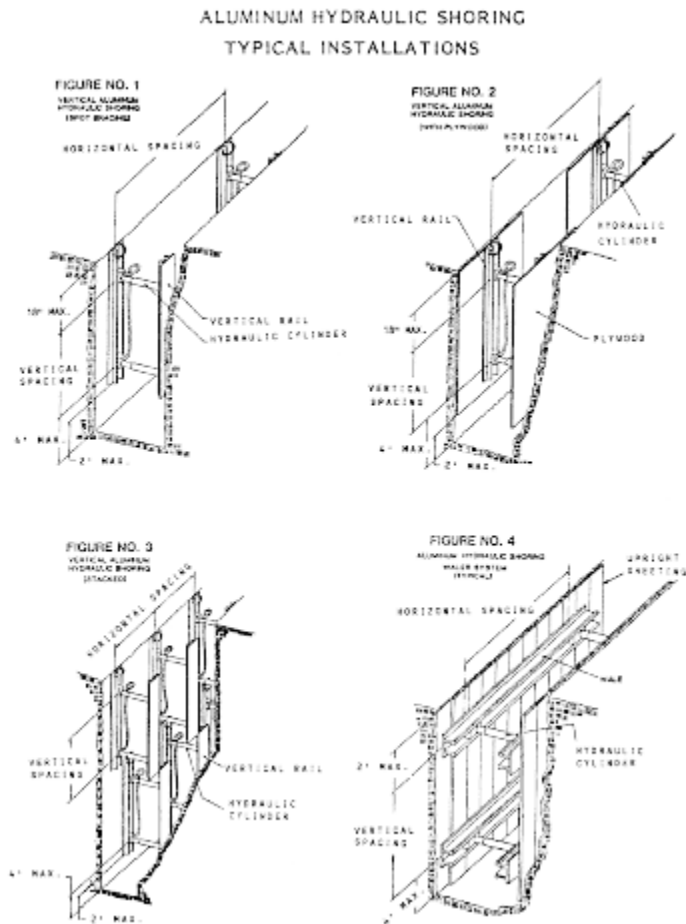


TABLE D-11
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE A

HYDRAULIC CYLINDERS				
DEPTH OF TRENCH (FEET)	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)	
			UP TO 8	OVER 8 UP TO 12
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)
OVER 10 UP TO 15	8			
OVER 15 UP TO 20	7			
OVER 20	NOTE (1)			

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g).

Note (1): See Appendix D, Item (g) (1).

Note (2): See Appendix D, Item (g) (2).

TABLE D - 1.2
ALUMINUM HYDRAULIC SHORING
VERTICAL SHOES
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS			
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)	
			UP TO 8	OVER 8 UP TO 12
OVER 5 UP TO 10	8	4	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5			
OVER 15 UP TO 20	5.5			
OVER 20	NOTE (1)			

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)

Note (1): See Appendix D, Item (g) (1)

Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.4
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS				TIMBER UPRIGHTS	
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN ⁴)	WIDTH OF TRENCH (FEET)				MAX. HORIZ. SPACING (IN. CENTER)	SOLID SHEET 3 FT.
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15	HORIZ. CYLINDER SPACING DIAMETER		
OVER 5 UP TO 10	4	3.5	6.0	2 IN.	6.0	6.0	3 IN.	
		7.0	6.5	2 IN.	6.5	6.5	3 IN.	3x12
		14.0	10.0	3 IN.	10.0	10.0	3 IN.	
OVER 10 UP TO 15	4	3.5	4.0	2 IN.	4.0	4.0	3 IN.	
		7.0	5.5	3 IN.	5.5	5.5	3 IN.	3x12
		14.0	8.0	3 IN.	8.0	8.0	3 IN.	
OVER 15 UP TO 20	4	3.5	3.5	2 IN.	3.5	3.5	3 IN.	
		7.0	5.0	3 IN.	5.0	5.0	3 IN.	3x12
		14.0	6.0	3 IN.	6.0	6.0	3 IN.	
OVER 20			NOTE (1)					

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g).

Notes (1): See Appendix D, Item (g) (1).

Notes (2): See Appendix D, Item (g) (2).

* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

TABLE D - 1.3
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS				TIMBER UPRIGHTS	
	VERTICAL SPACING (FEET)	SECTION MODULUS (IN ⁴)	WIDTH OF TRENCH (FEET)				MAX. HORIZ. SPACING (IN. CENTER)	SOLID SHEET 2 FT.
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15	HORIZ. CYLINDER SPACING DIAMETER		
OVER 5 UP TO 10	4	3.5	8.0	2 IN.	8.0	8.0	3 IN.	
		7.0	9.0	2 IN.	9.0	9.0	3 IN.	3x12
		14.0	12.0	3 IN.	12.0	12.0	3 IN.	
OVER 10 UP TO 15	4	3.5	6.0	2 IN.	6.0	6.0	3 IN.	
		7.0	8.0	3 IN.	8.0	8.0	3 IN.	3x12
		14.0	10.0	3 IN.	10.0	10.0	3 IN.	
OVER 15 UP TO 20	4	3.5	5.5	2 IN.	5.5	5.5	3 IN.	
		7.0	6.0	3 IN.	6.0	6.0	3 IN.	3x12
		14.0	9.0	3 IN.	9.0	9.0	3 IN.	
OVER 20			NOTE (1)					

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g).

Notes (1): See Appendix D, Item (g) (1).

Notes (2): See Appendix D, Item (g) (2).

* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

Appendix E to Subpart P of Part 1926—Alternatives to Timber Shoring

Figure 1. Aluminum Hydraulic Shoring

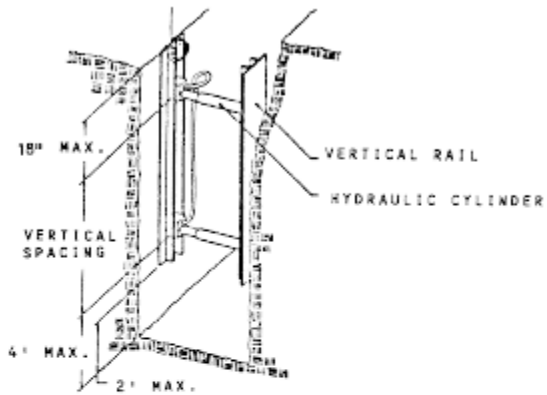


Figure 2. Pneumatic/hydraulic Shoring

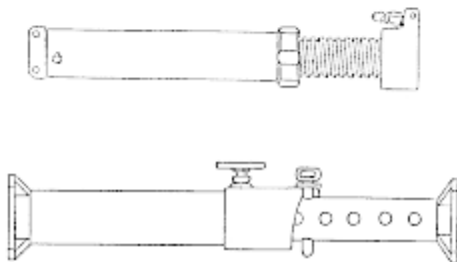


Figure 3. Trench Jacks (Screw Jacks)

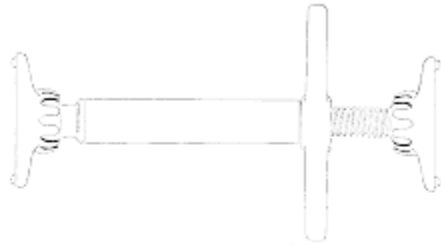
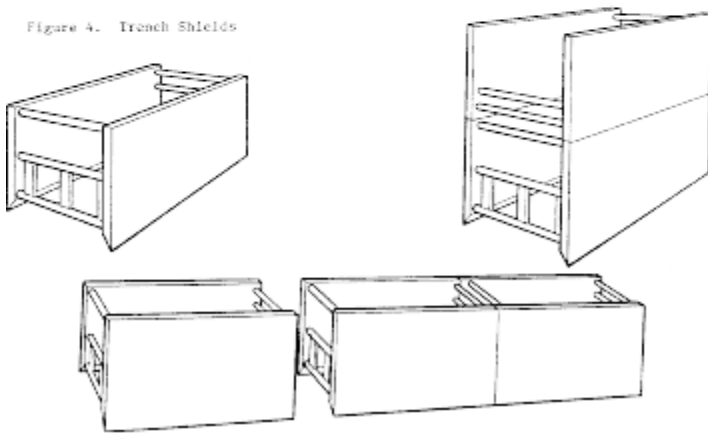


Figure 4. Trench Shields



Appendix F to Subpart P of Part 1926—Selection of Protective Systems

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with §1926.652 (b) and (c).

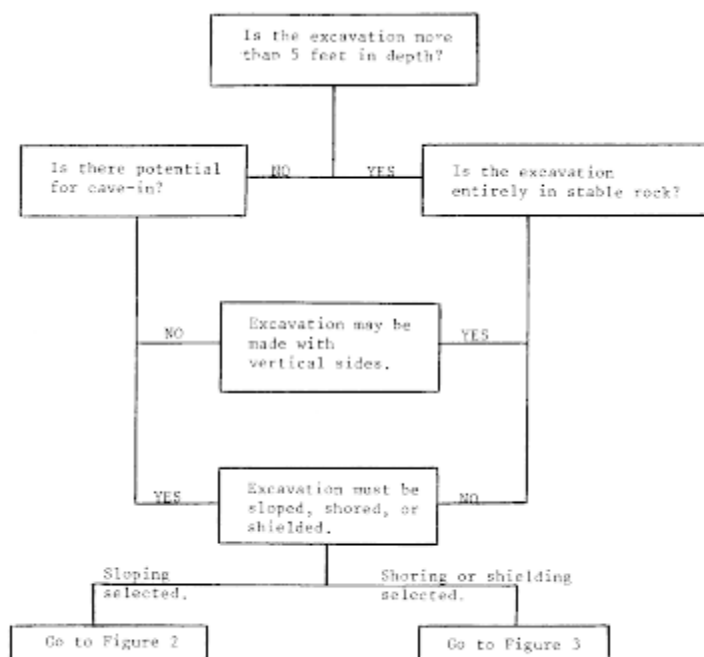


FIGURE 1 - PRELIMINARY DECISIONS

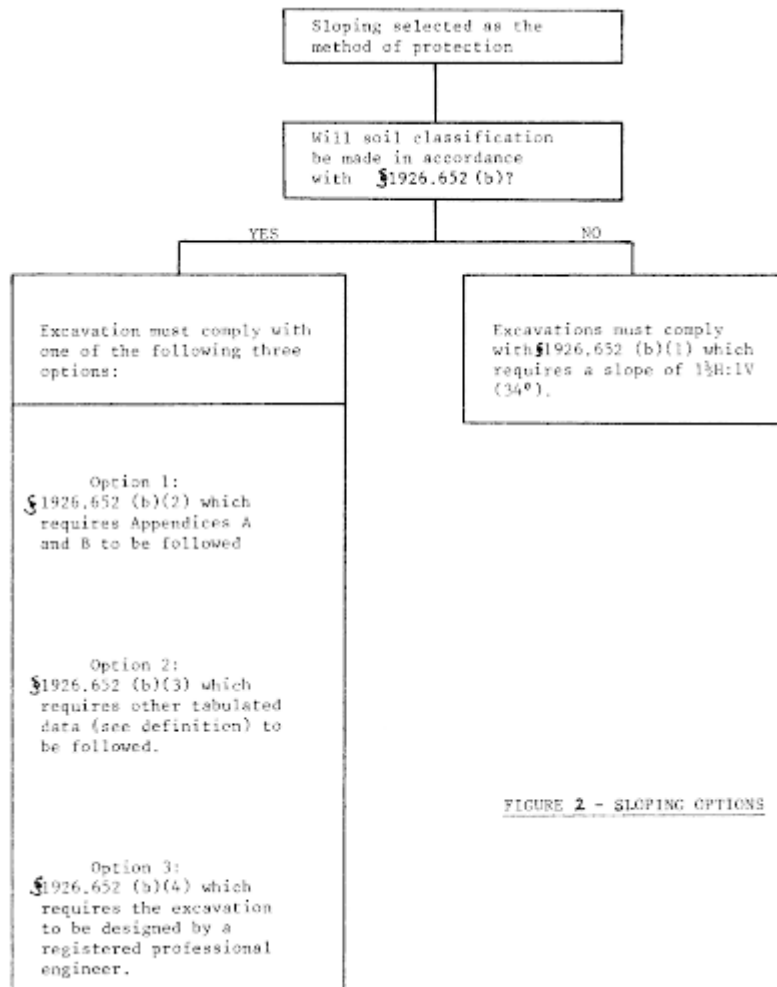


FIGURE 2 - SLOPING OPTIONS

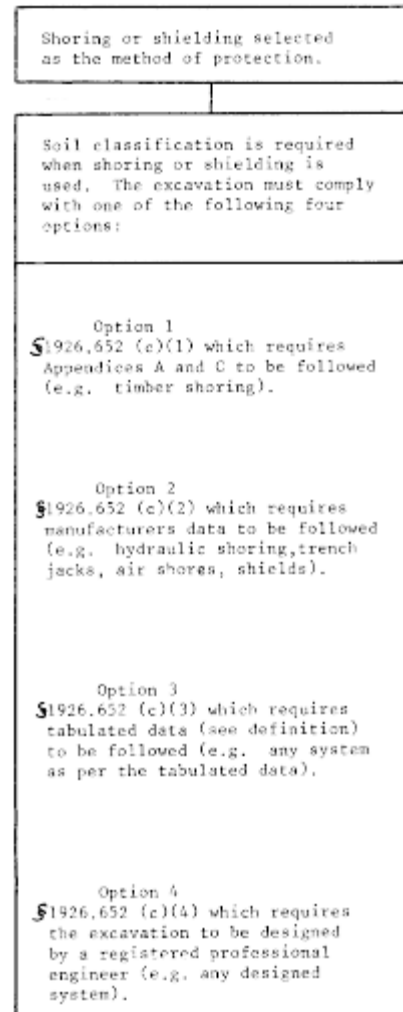


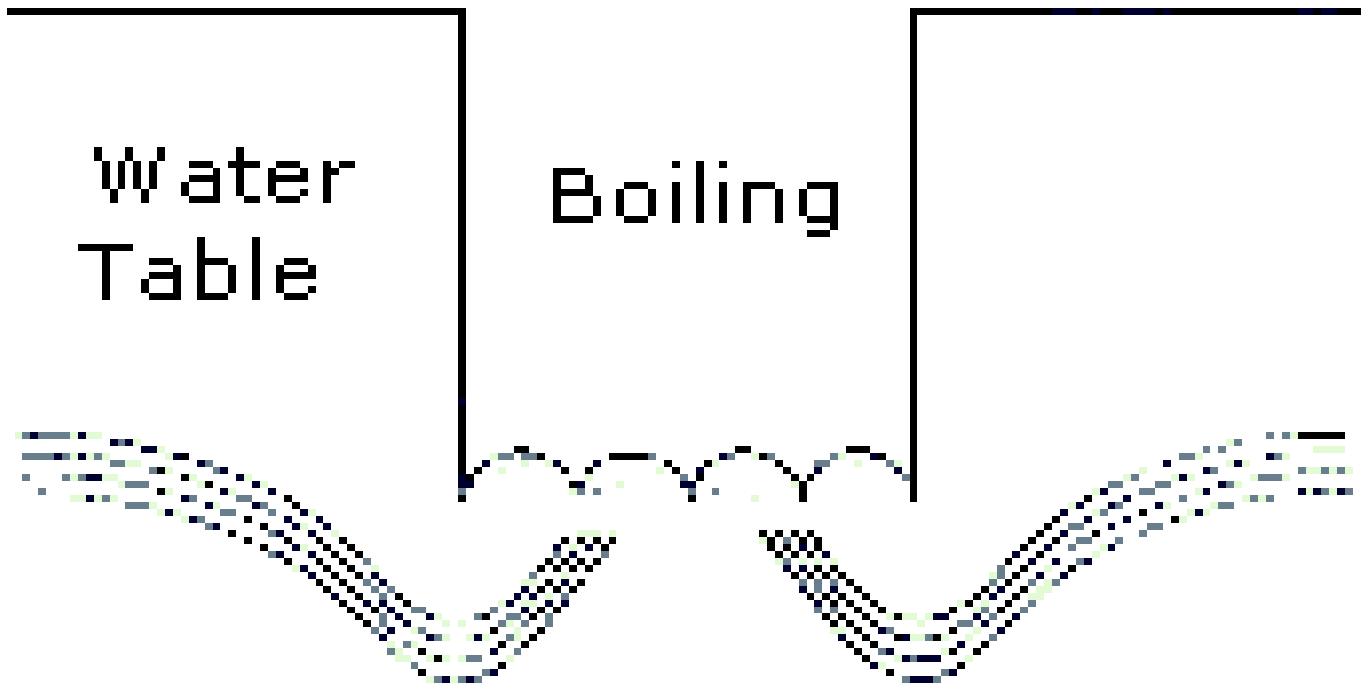
FIGURE 3 - SHORING AND SHIELDING OPTIONS

Appendix E

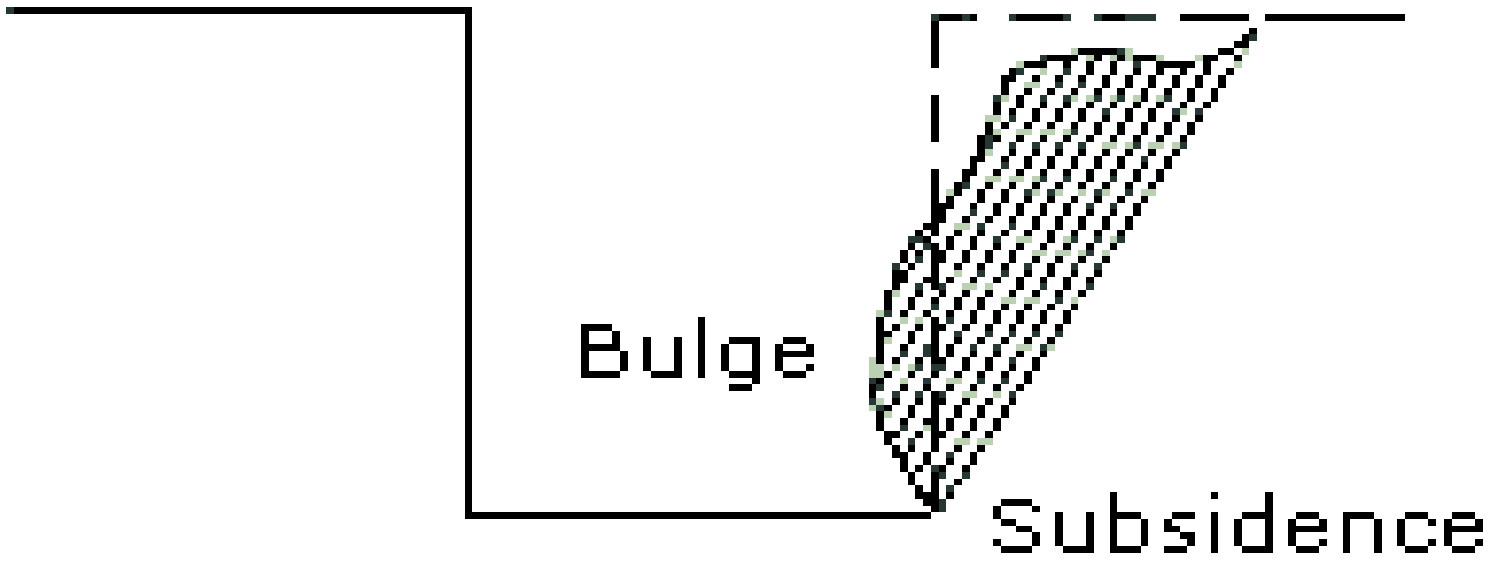
Figures

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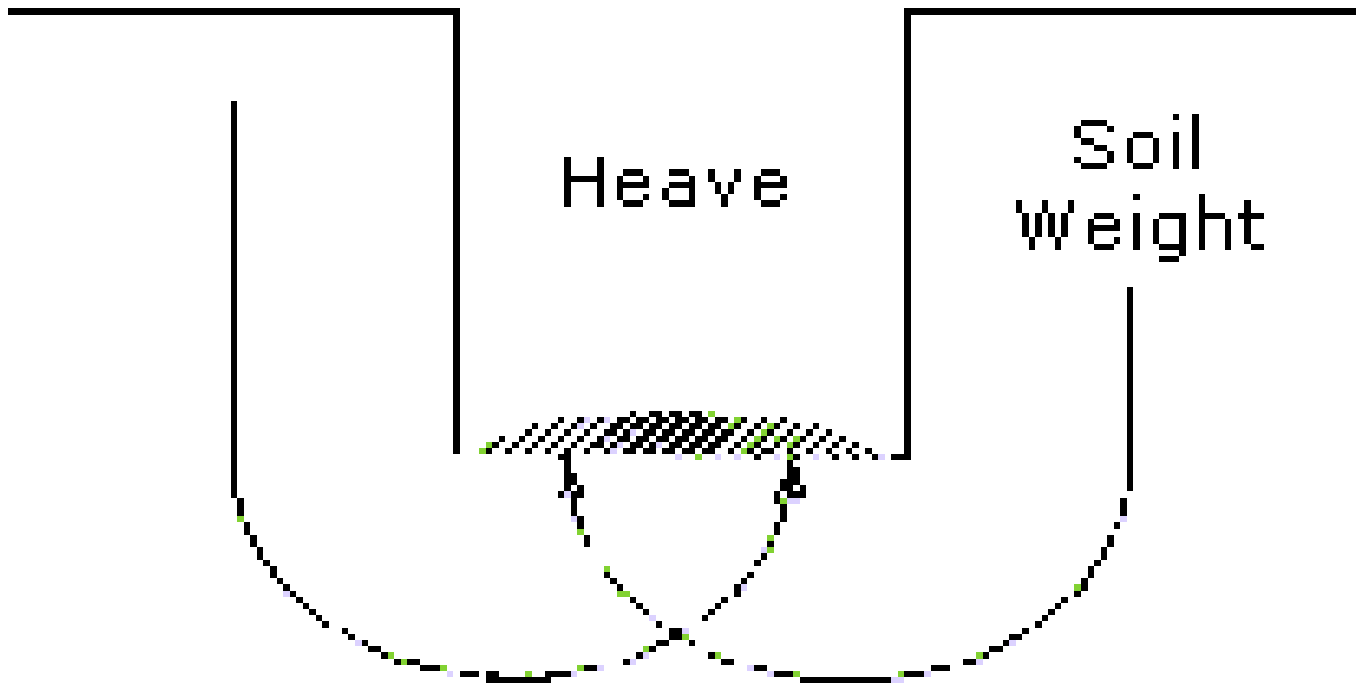
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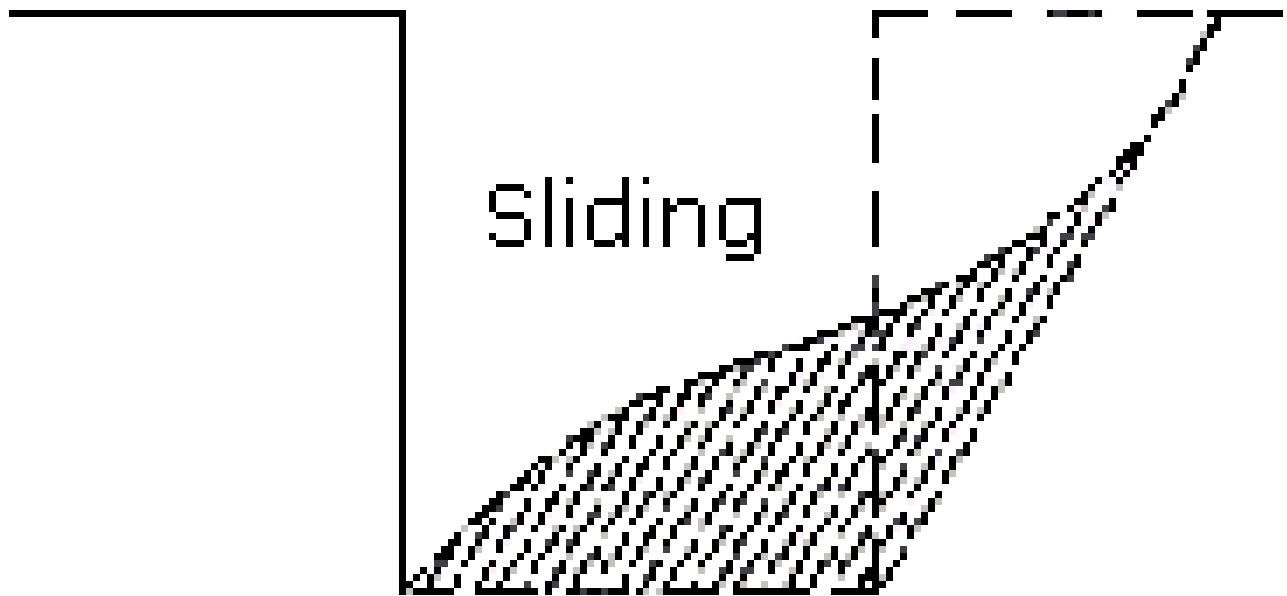
BULGE AND SUBSIDENCE



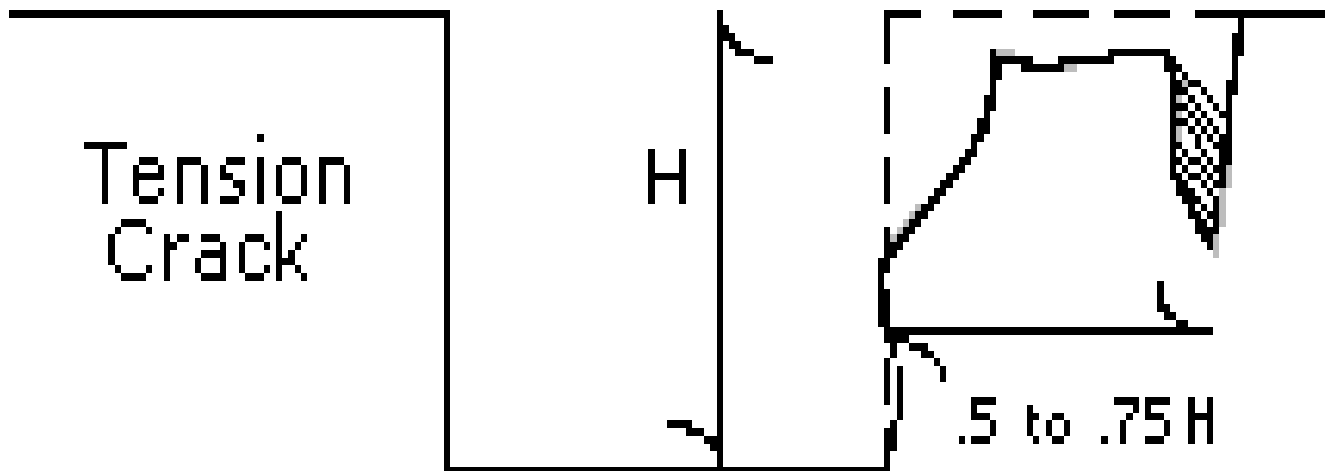
HEAVE AND SOIL WEIGHT



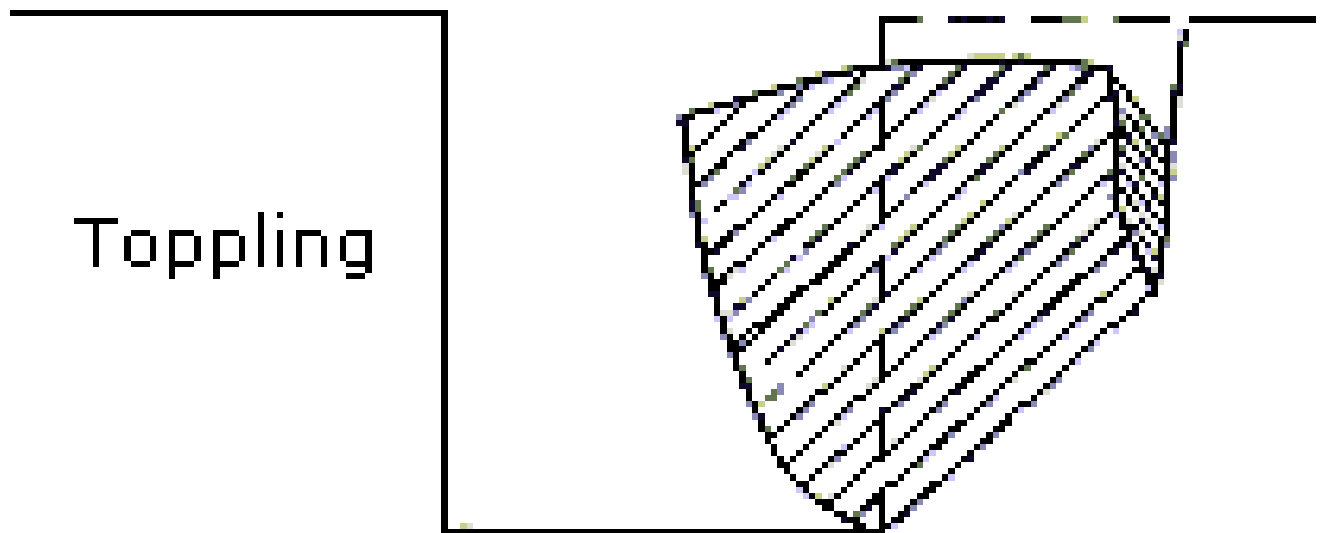
SLIDING



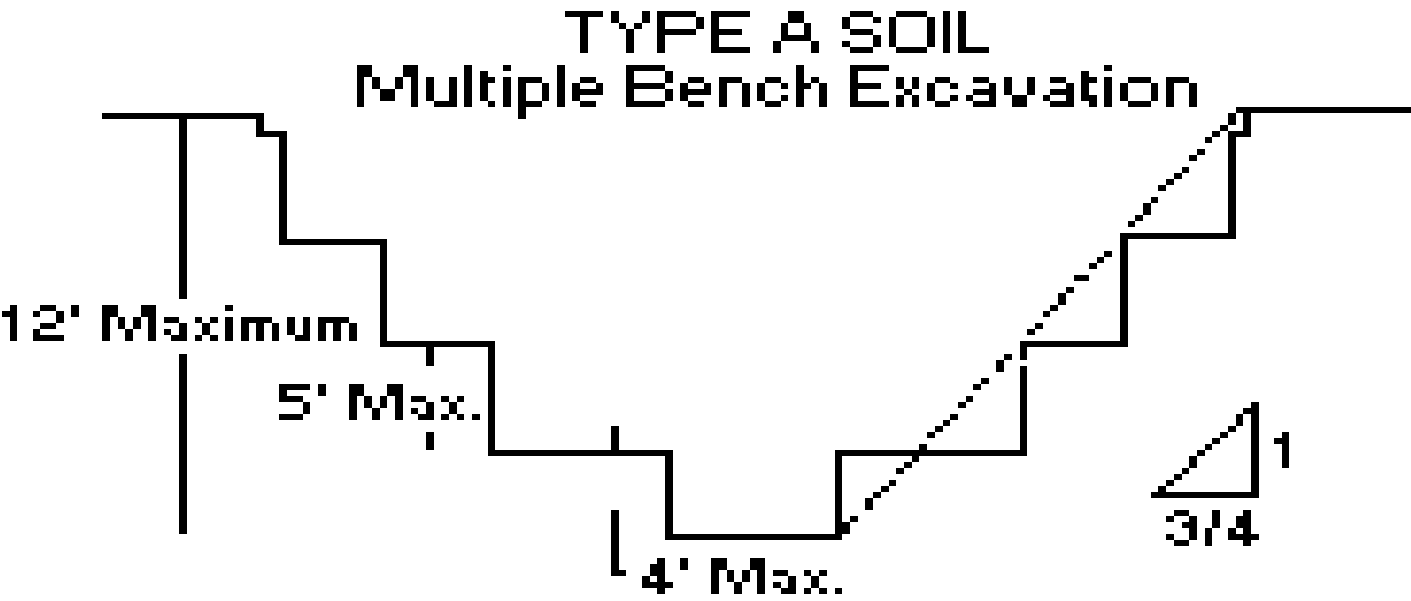
TENSION CRACK



TOPPLING

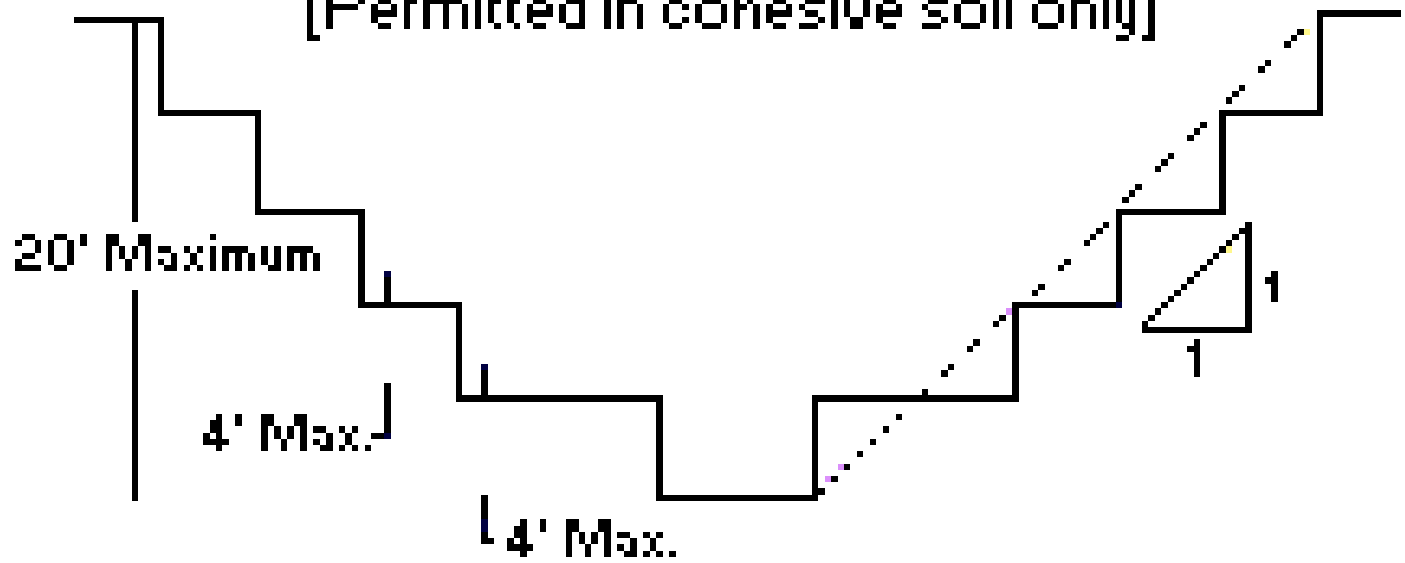


MULTIPLE BENCH EXCAVATION TYPE A SOIL



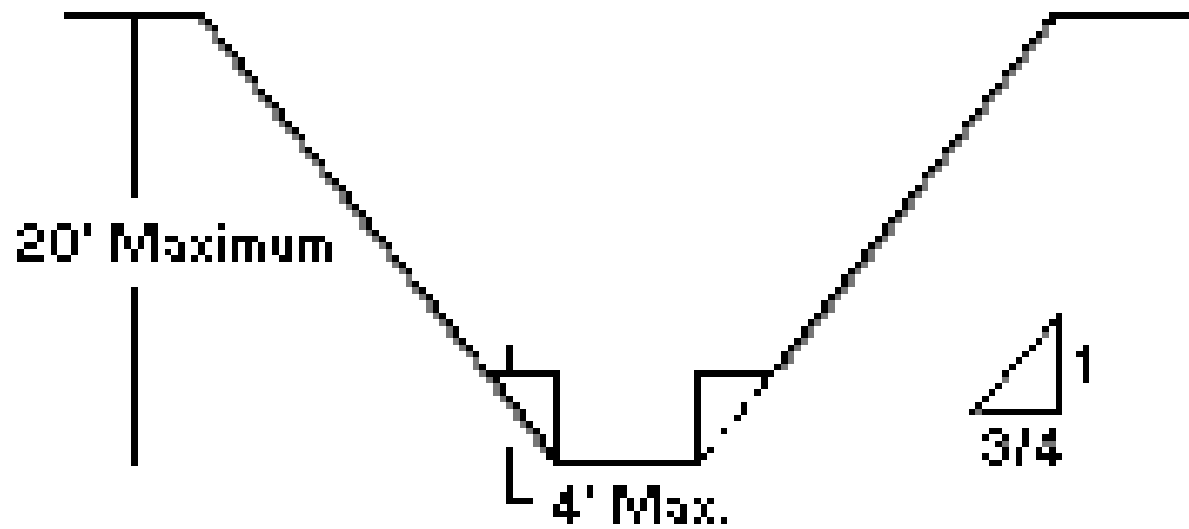
MULTIPLE BENCH TYPE B SOIL

TYPE B SOIL
Multiple Bench Excavation
[Permitted in cohesive soil only]



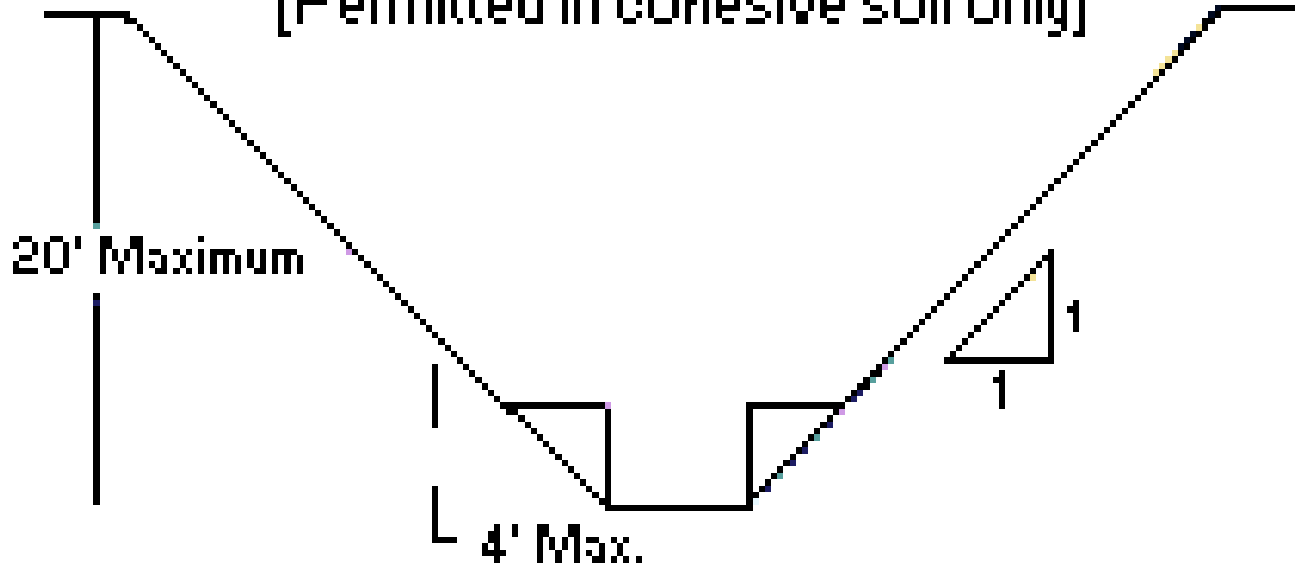
SIMPLE BENCH EXCAVATION TYPE A SOIL

TYPE A SOIL Simple Bench Excavation



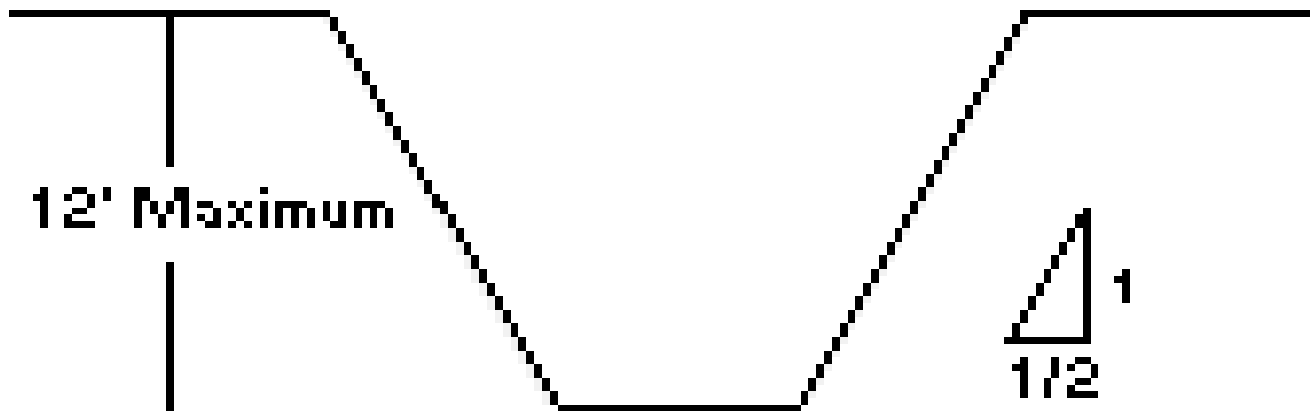
SIMPLE BENCH TYPE B SOIL

TYPE B SOIL
Single Bench Excavation
[Permitted in cohesive soil only]

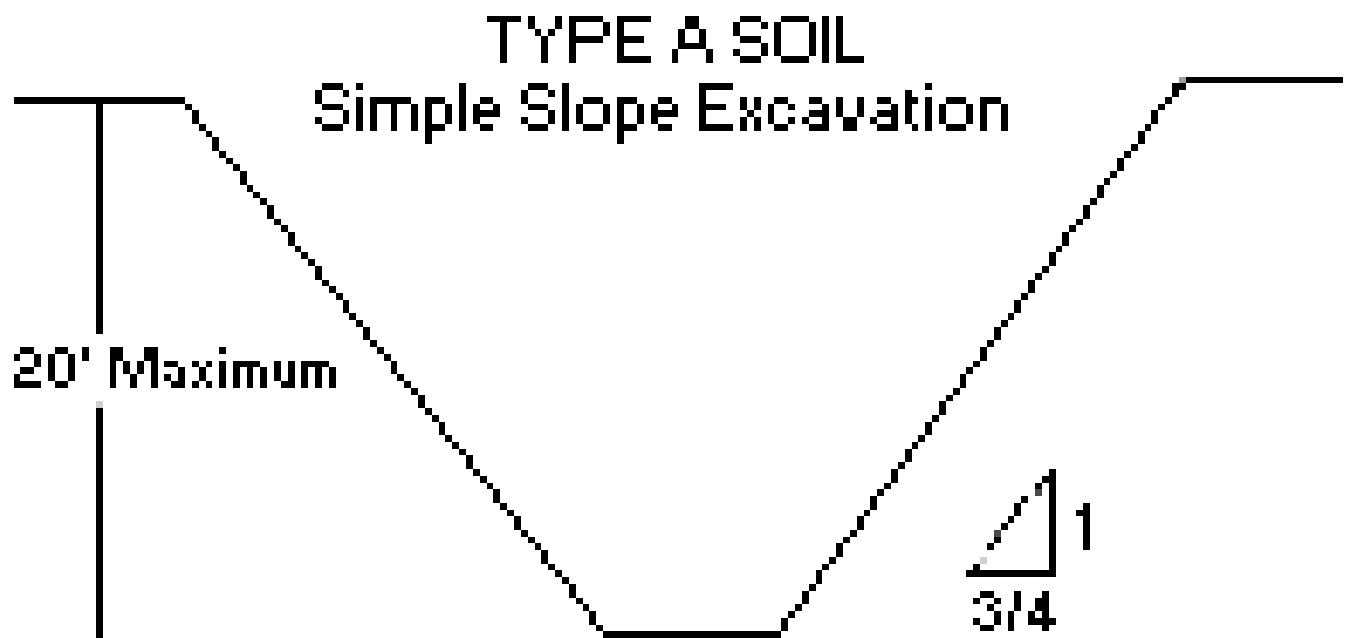


SIMPLE SLOPE SHORT TERM TYPE A SOIL

TYPE A SOIL
Simple Slope -- Short Term

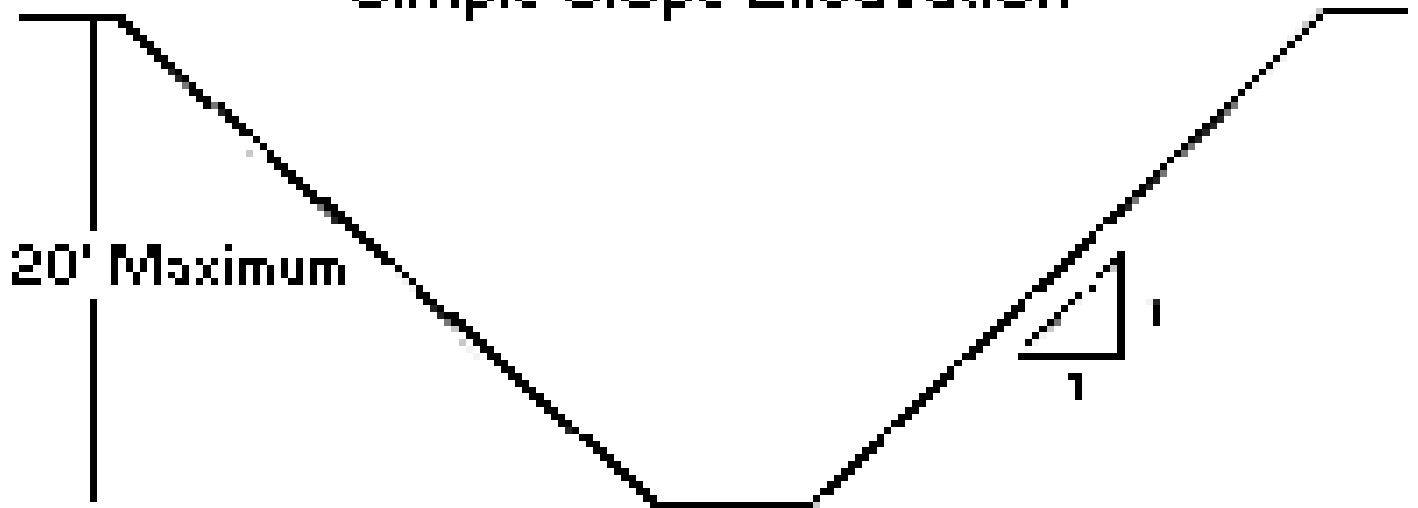


SIMPLE SLOPE TYPE A SOIL



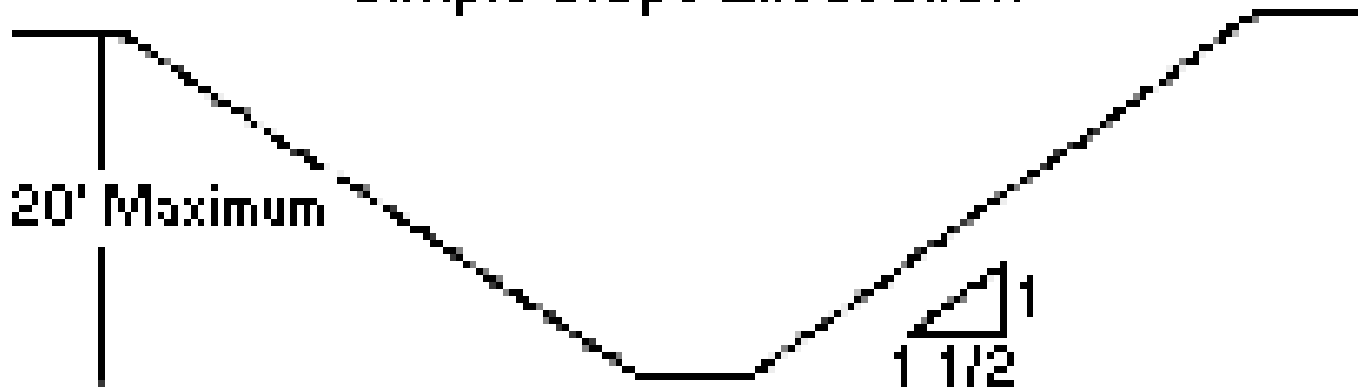
SIMPLE SLOPE TYPE B SOIL

TYPE B SOIL Simple Slope Excavation

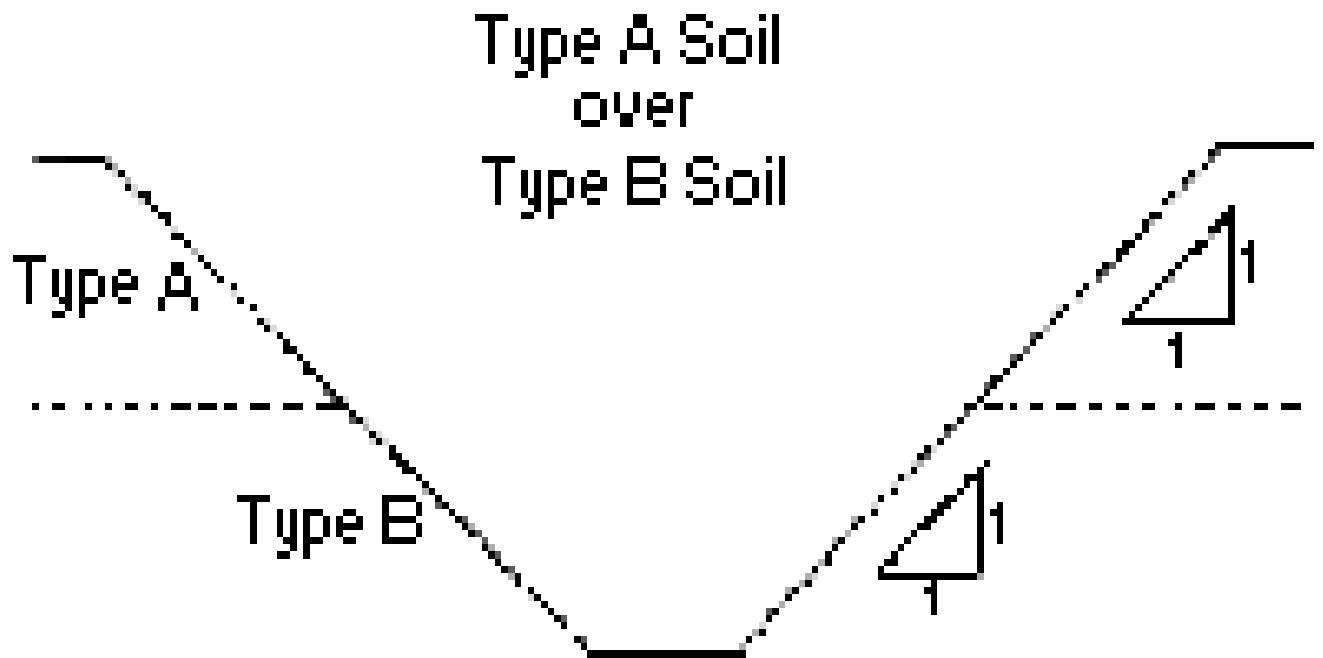


SIMPLE SLOPE TYPE C SOIL

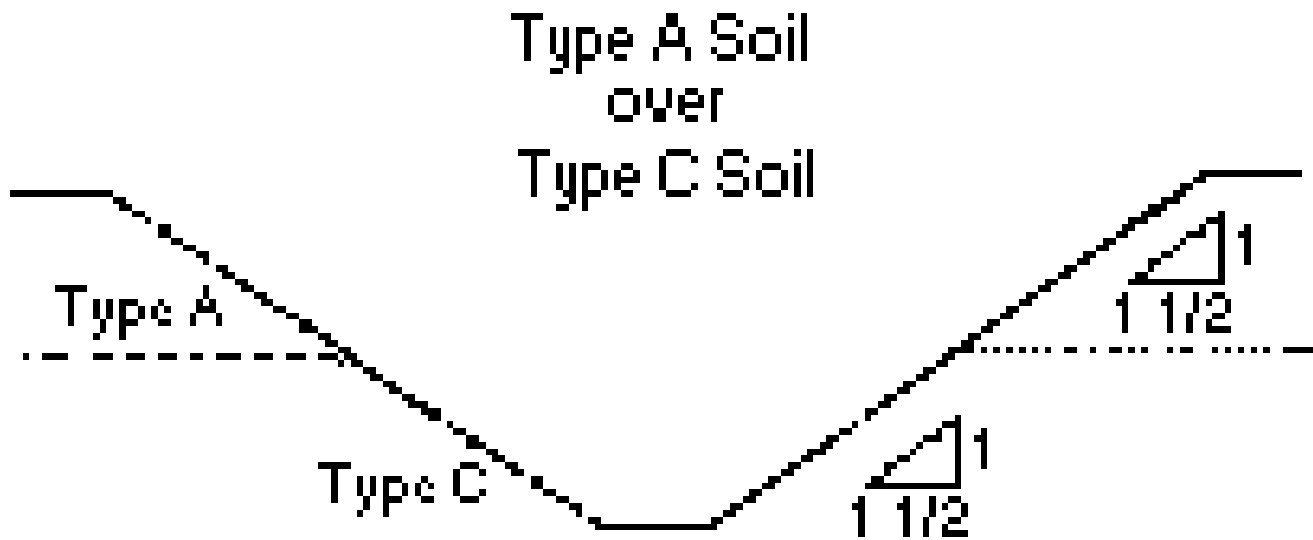
TYPE C SOIL Simple Slope Excavation



TYPE A OVER TYPE B RATIO

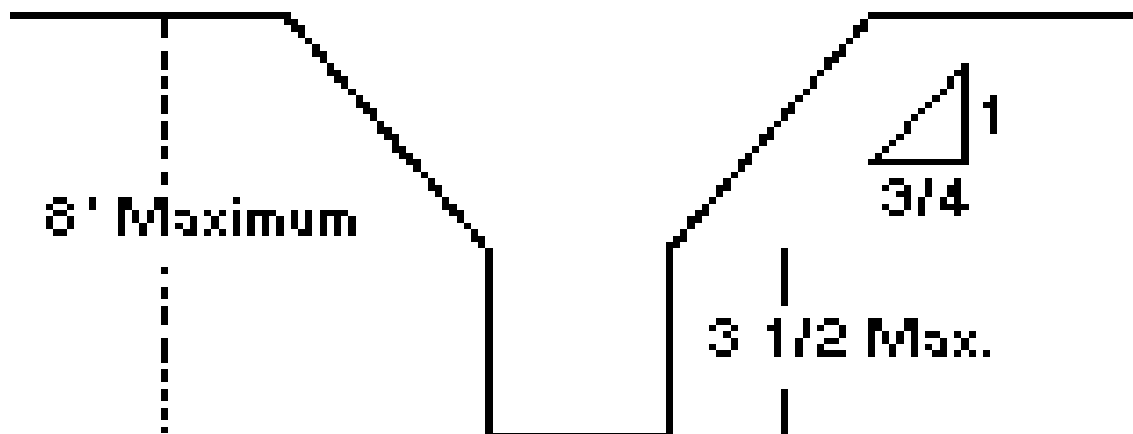


TYPE A OVER TYPE C SLOPE



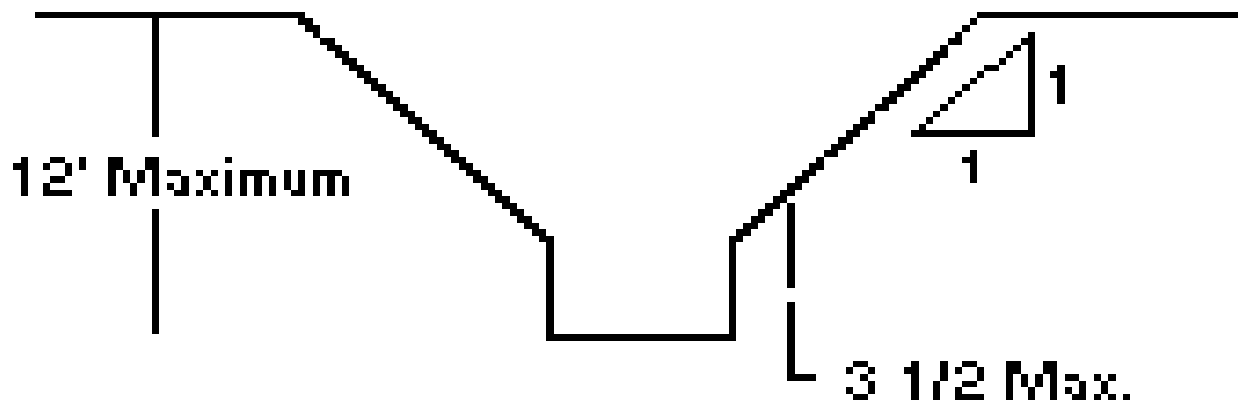
TYPE A SOIL 8' MAXIMUM UNSUPPORTED

TYPE A SOIL
Unsupported vertically sided lower portion
Maximum 8 Feet in depth



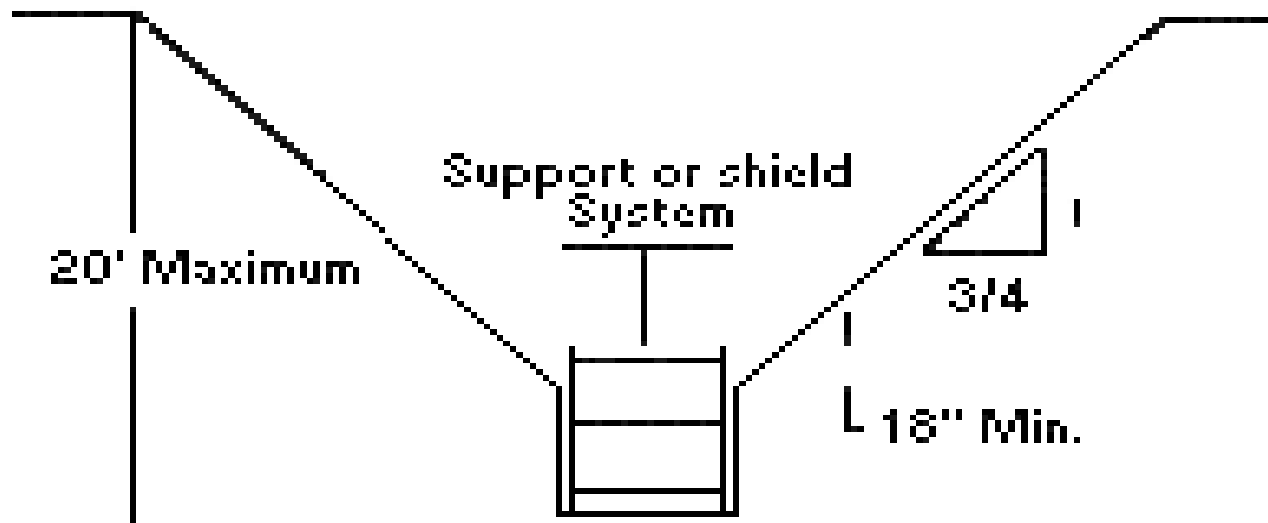
TYPE A SOIL 12' DEEP VERTICAL UNSUPPORTED

TYPE A SOIL
Unsupported vertically sided lower portion
Maximum 12 Feet in depth

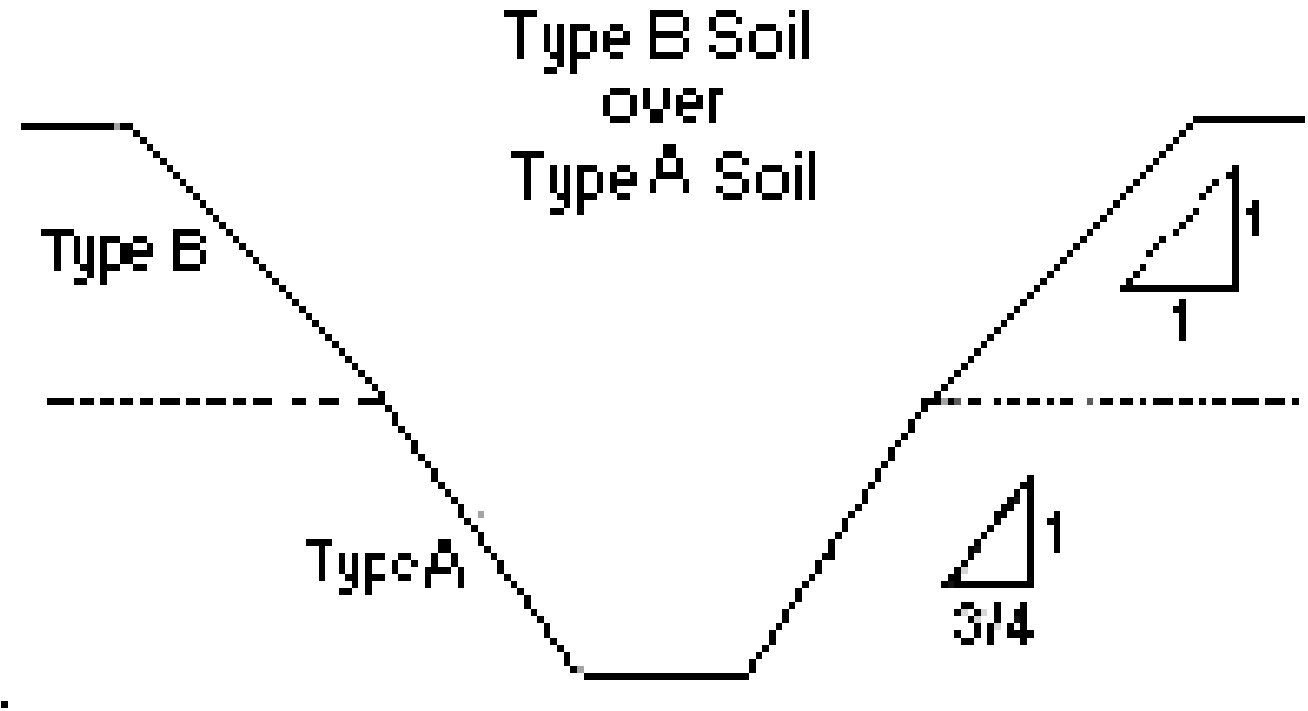


TYPE A SOIL VERTICALLY SHEILDDED

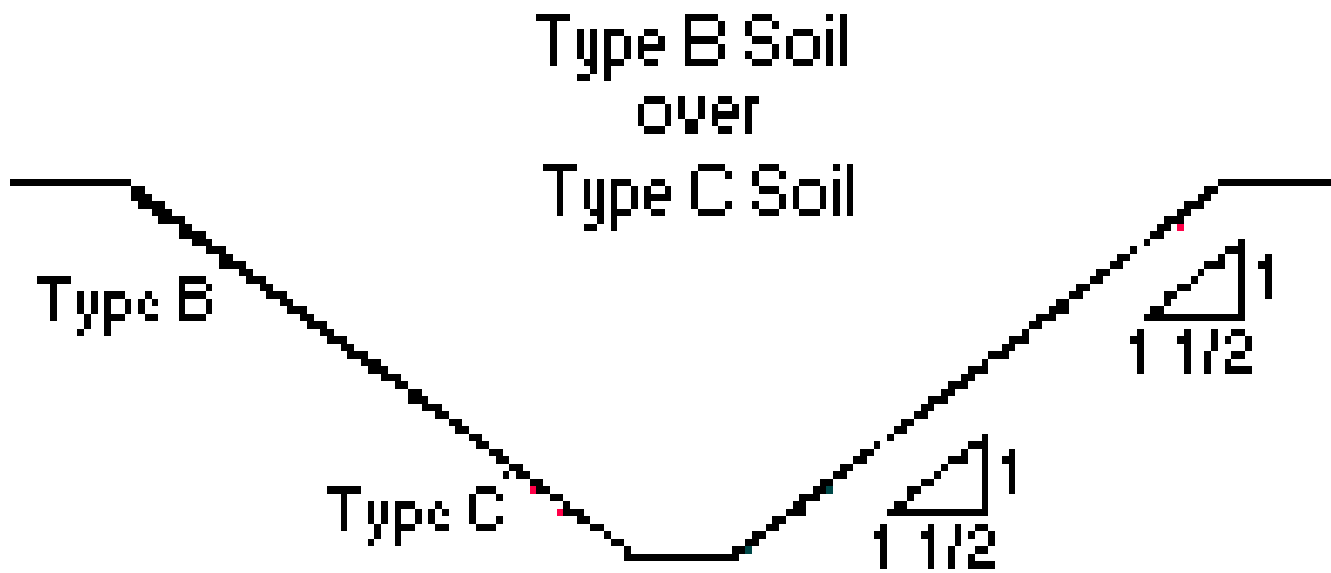
TYPE A SOIL
Supported or shielded
Vertically sided lower portion



TYPE B OVER TYPE A SOIL RATIO

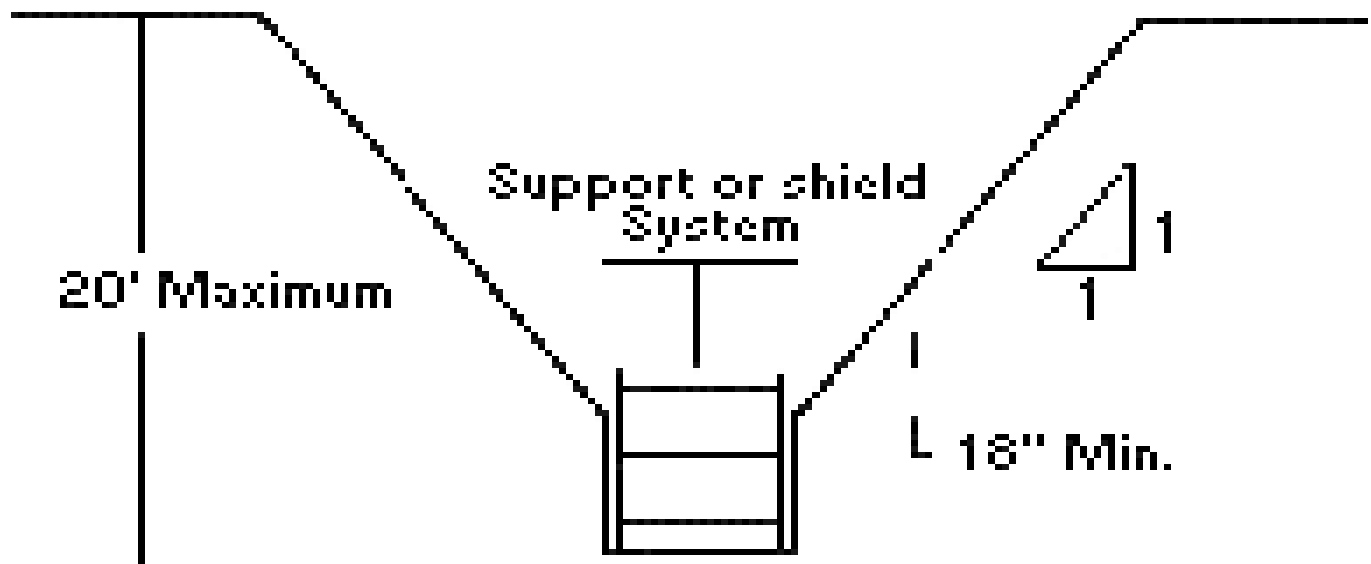


TYPE B OVER TYPE C SOIL SLOPE RATIO

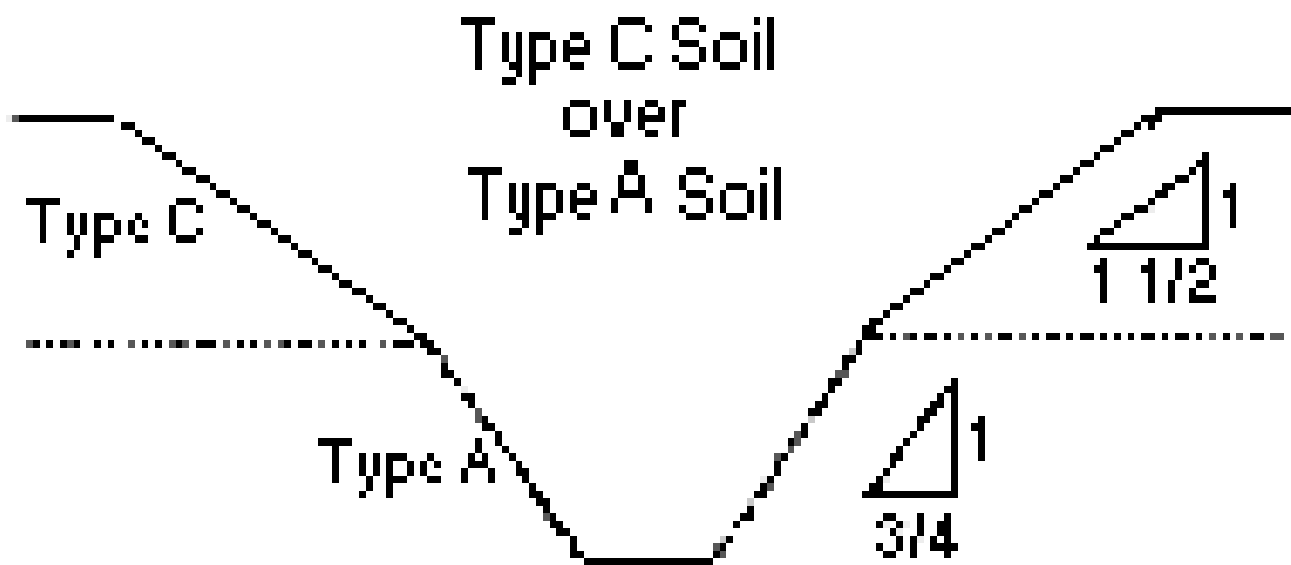


TYPE B SOIL VERTICALLY SHEILDED

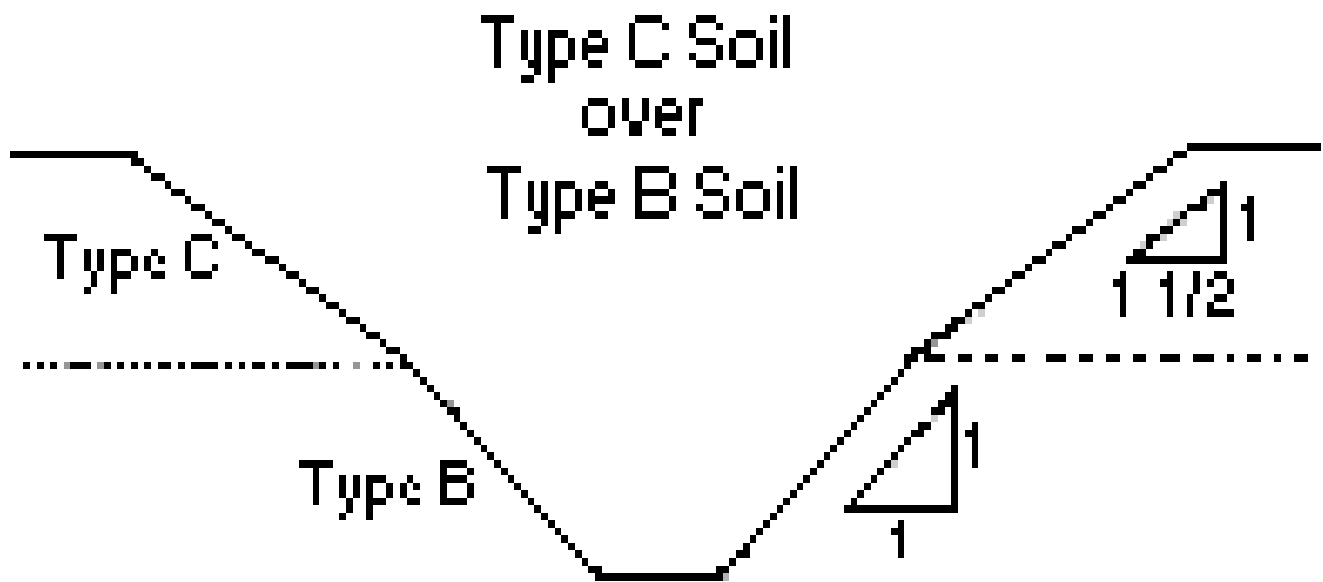
TYPE B SOIL
Supported or shielded
Vertically sided lower portion



TYPE C OVER TYPE A SOIL SLOPE RATIO

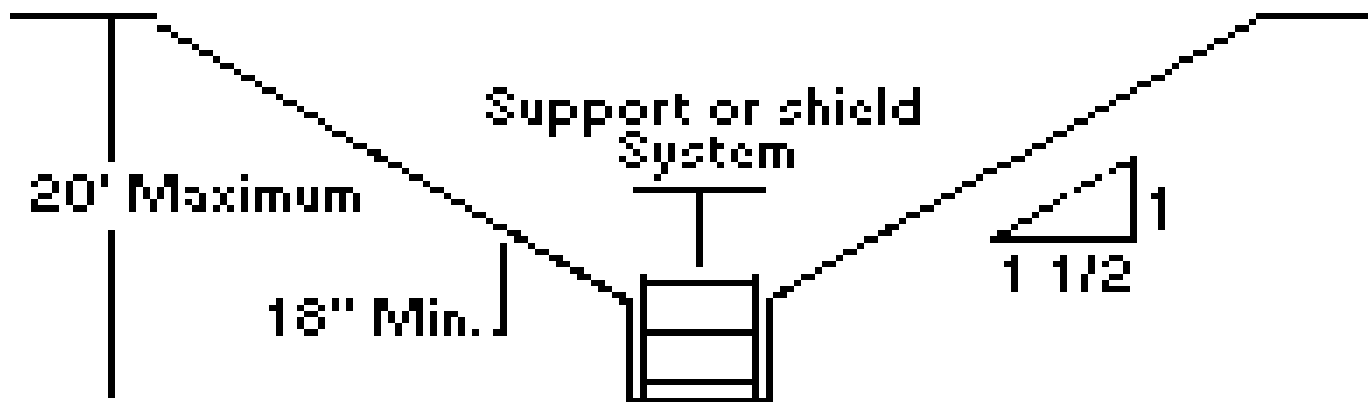


TYPE C OVER TYPE B SOIL SLOPE RATIO

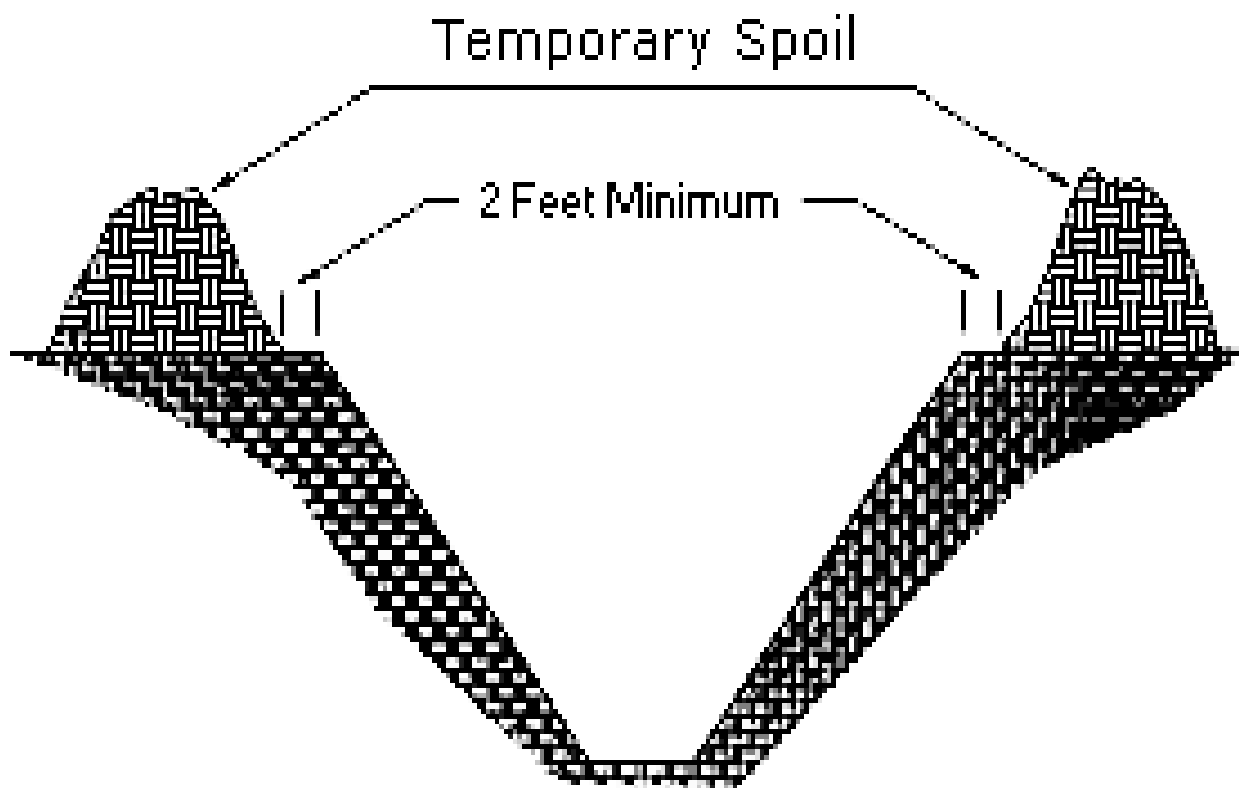


TYPE C SOIL SUPPORT RATIO

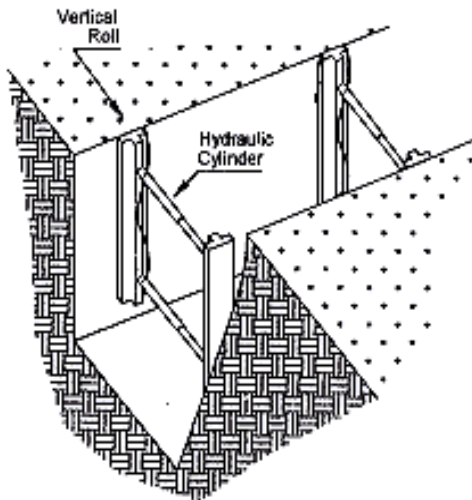
TYPE C SOIL
Supported of shielded
Vertically sided lower portion



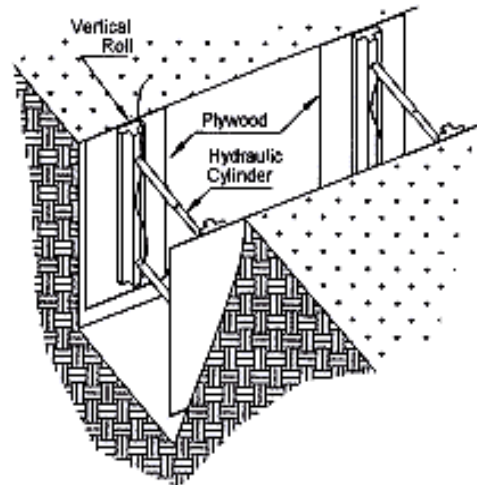
TEMPORARY SOIL PILE



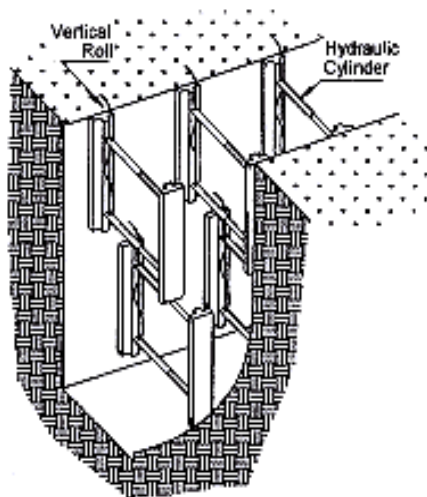
ALUMINIM HYDROLIC SHORING



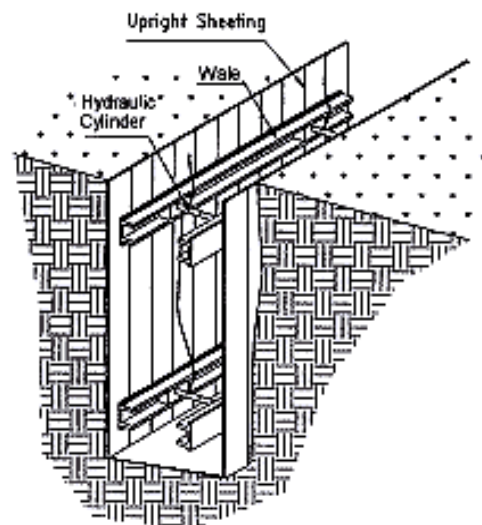
Vertical Aluminum Hydraulic Shoring
(Spot Bracing)



Vertical Aluminum Hydraulic Shoring
(With Plywood)

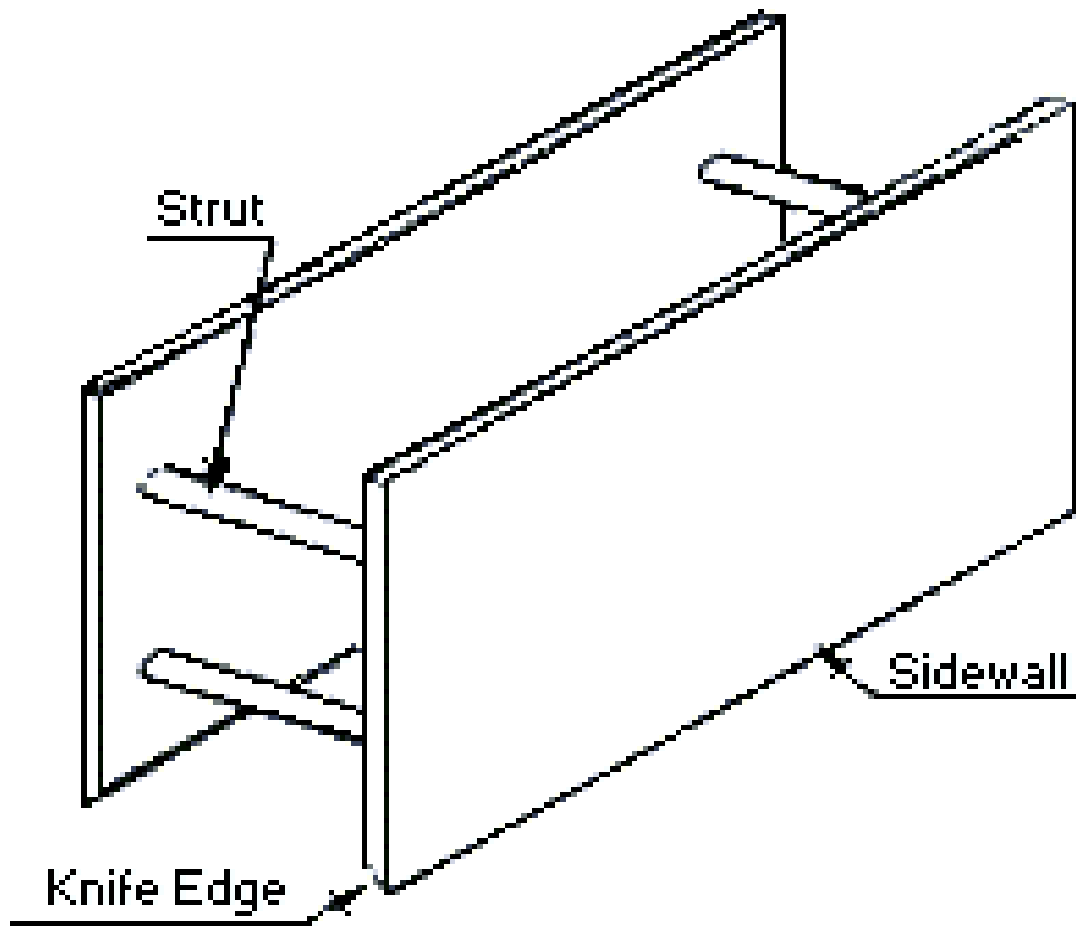


Vertical Aluminum Hydraulic Shoring
(Stacked)

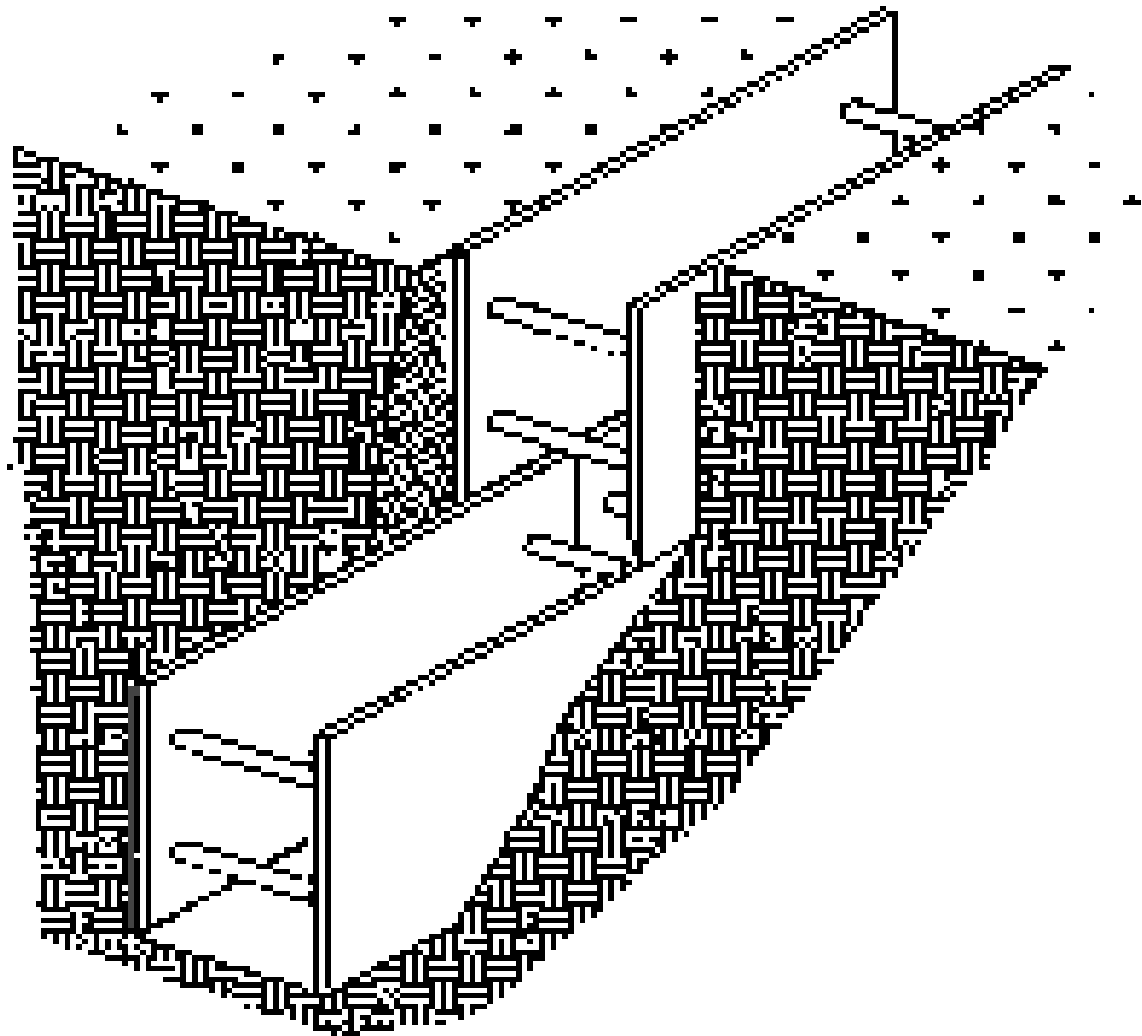


Aluminum Hydraulic Shoring Waler System
(Typical)

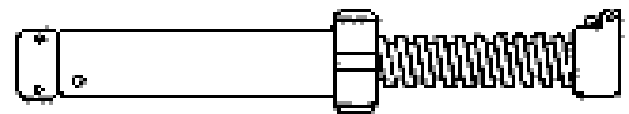
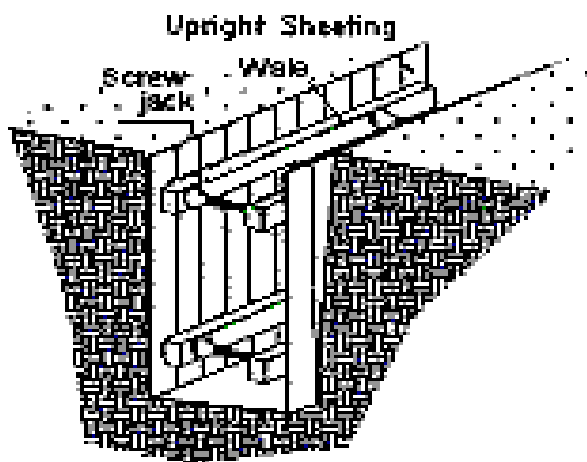
TRENCH BOX



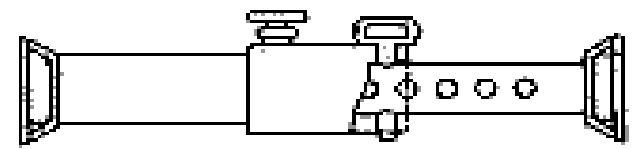
TRENCH BOX STEP DOWN



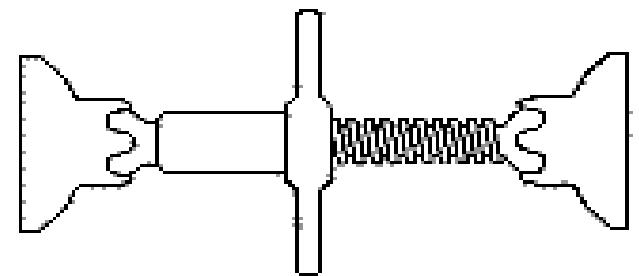
SHEETING JACKS



Pneumatic / hydraulic jacks



Screw jack



SHEETING WALE

