

# LD DOCSA

## ASSOCIATES, INC.

### GENERAL CONTRACTORS

---



Updated:

3/21/2017

Excavation, Trenching & Shoring Policy and Procedures

This Excavation Safety Program has been developed to protect employees from safety hazards that may be encountered during work in trenches and excavations. This program is intended to assure that employees who perform work in excavations are aware of their responsibilities and know how to perform the work safely.

# EXCAVATION, TRENCHING & SHORING POLICY AND PROCEDURES

## Table of Contents

<b>RESPONSIBILITIES</b> .....	<b>3</b>
SAFETY MANAGER .....	3
SUPERINTENDENT .....	3
WORKER .....	3
<b>EXCAVATION REQUIREMENTS</b> .....	<b>3</b>
UTILITIES AND PRE-WORK SITE INSPECTION .....	3
SURFACE ENCUMBRANCES .....	3
SOIL TYPES, WATER, SLIDE HAZARDS.....	3
UNDERGROUND INSTALLATIONS.....	4
OBSTRUCTIONS, RETAINING MATERIALS, EGRESS, GUARDING, HEAVY EQUIPMENT .....	5
HAZARDOUS ATMOSPHERES; TESTING AND CONTROLS .....	6
EXCAVATION, ANGLE OF REPOSE.....	6
<b>SUPPORTING SYSTEMS</b> .....	<b>7</b>
ANGLE OF REPOSE, TIE BACKS, TIGHT SHEETING, ADDITIONAL BRACING.....	7
ADDITIONAL REQUIREMENTS FOR TRENCH SUPPORT SYSTEMS .....	8
BENCHING AND SLOPING .....	8
TRENCHING BOXES AND SHIELDS .....	8
STRUCTURAL RAMPS.....	9
LADDERS .....	9
EXPOSURE.....	9
Walkways, sidewalks and roadways.....	9
Openings in roadways .....	10
Vehicular Traffic.....	10
Falling Loads.....	10
Walkways and Guardrails.....	10
WARNING SYSTEM FOR MOBILE EQUIPMENT.....	10
HAZARDOUS ATMOSPHERES .....	10

PERSONAL PROTECTIVE EQUIPMENT ..... 11

PROTECTION FROM WATER ACCUMULATION HAZARDS..... 12

**ADJACENT STRUCTURES ..... 13**

    PROTECTION, DESIGN, INSPECTION OF SHORING, BRACING AND UNDERPINNING ..... 13

    STABILITY ..... 13

    PROTECTION FROM FALLING OBJECTS AND LOOSE ROCKS OR SOIL..... 14

    INSPECTION BY PROGRAM MANAGER..... 15

**PROTECTIVE SYSTEM REQUIREMENTS..... 15**

    PUBLIC ..... 15

    EMPLOYEES ..... 16

    DESIGN FOR SLOPING & BENCHING SYSTEMS ..... 16

        Sloping and Benching Systems..... 16

        Other tabulated data..... 16

    SUPPORT, SHIELD, AND OTHER PROTECTIVE SYSTEMS ..... 17

        Data..... 17

    DESIGN BY A REGISTERED PROFESSIONAL ENGINEER ..... 18

    MATERIALS AND EQUIPMENT..... 19

**INSTALLATION AND REMOVAL OF SUPPORTS ..... 19**

    ADDITIONAL REQUIREMENTS..... 19

    SHIELD SYSTEMS ..... 20

    ADDITIONAL REQUIREMENTS..... 20

**ACCIDENT INVESTIGATIONS ..... 20**

**CHANGES TO PROGRAM ..... 20**

**GLOSSARY ..... 21**

**EXAMPLES ..... 23**

    DEPTH CHART ..... 23

    DEPTH..... 24

    DIFFERENT TEXTURED SOILS..... 27

    TRENCHES ..... 27

    FILL AREAS ..... 29

## **RESPONSIBILITIES**

L.D. Docsa Associates, Inc. has appointed one or more individuals within the company, as well as the safety committee, to assure compliance with the requirements of this program. The responsibilities are clearly detailed. All persons involved in excavation and trenching work have received appropriate training in the safe work practices that must be followed when performing this type of work.

### **SAFETY MANAGER**

The safety manager is responsible for ensuring this program is in compliance with MIOSHA standards, and procedures are being followed by employees.

### **SUPERINTENDENT**

The superintendent is responsible for site compliance with this written manual.

### **WORKER**

The worker/employee is responsible for ensuring the working environment is safe and in compliance with this manual.

## **EXCAVATION REQUIREMENTS**

### **UTILITIES AND PRE-WORK SITE INSPECTION**

Prior to excavation, the site shall be thoroughly inspected by Site Superintendent determine if special safety measures must be taken.

### **SURFACE ENCUMBRANCES**

All equipment, materials, supplies, permanent installations (i.e., buildings or roadways), trees, brush, boulders, and other objects at the surface that could present a hazard to employees working in the excavation shall be removed or supported as necessary to protect employees.

### **SOIL TYPES, WATER, SLIDE HAZARDS**

If different textured soils are encountered in the side of an excavation, each soil type of the excavation shall be cut to the proper angle of repose, except that the slope shall not steepen between the toe of the slope and the ground level where soft clay or running soil is encountered in the lower cut.

If the excavation is a trench, a trench shoring system shall be used or the sides shall be properly sloped to protect against a cave-in.

An employee shall not work in an excavation in which there is accumulated water or in which water is accumulating unless 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 may include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or the use of a safety harness and lifeline.

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operation shall be monitored by a qualified person or a monitoring system to ensure that the equipment is properly operated.

An ongoing inspection of an excavation or trench shall be made by a qualified person. After every rainstorm or other hazard-producing occurrence, an inspection shall be made by a qualified employee for evidence of possible slides or cave-ins. Where these conditions are found, all work shall cease until additional precautions, such as additional shoring or reducing the slope, have been accomplished.

An excavation that is cut into a rock formation shall be scaled to remove loose material.

When installed forms, walls, or similar structures create a trench between the form, wall, or structure and the side of the excavation, an employer shall comply with the provisions of **Excavation; angle of repose, Supporting systems, angle of repose, tie backs, tight sheeting, additional bracing, Additional Requirements for trench support systems and Benching and sloping.**

## **UNDERGROUND INSTALLATIONS**

The location of sewer, telephone, fuel, electric, water, or any other underground installations or wires that may be encountered during excavation work shall be determined and marked prior to opening an excavation. Arrangements shall be made as necessary by Site Superintendent with the appropriate utility entity for the protection, removal, shutdown, or relocation of underground installations.

If it is not possible to establish the exact location of these installations, the work may proceed with caution if detection equipment or other safe and acceptable means are used to locate the utility.

Excavation shall be done in a manner that does not endanger the underground installations or the employees engaged in the work. Utilities left in place shall be protected by barricades, shoring, suspension, or other means as necessary to protect employees.

An employer shall not excavate in a street, highway, public place, a private easement of a public utility, or near the location of a public utility facility owned, maintained, or installed on a customer's premises, without having first ascertained the location of all underground facilities of a public utility in the proposed area of excavation.

Upon receiving the information from the public utility, an employer shall exercise reasonable care when working in close proximity to the underground facilities of any public utility. If the facilities are to be exposed, or are likely to be exposed, only hand digging shall be employed in such circumstances and such support, as may be reasonably necessary for protection of the facilities, shall be provided in and near the construction area.

When any contact with or damage to any pipe, cable or its protective coating, or any other underground facility of a public utility occurs, the public utility shall be notified immediately by the employer responsible for operations causing the damage. If an energized electrical cable is severed, an energized conductor is exposed, or dangerous fluids or gasses are escaping from a broken line, the employer shall evacuate the employees from the immediate area while awaiting the arrival of the public utility personnel.

#### **OBSTRUCTIONS, RETAINING MATERIALS, EGRESS, GUARDING, HEAVY EQUIPMENT**

A tree, boulder, rock fragments, or other obstructions whose movement could cause injury to an employee shall be removed or supported.

An excavation that an employee is required to enter shall have excavated and other material stored and retained not less than 2 feet from the excavation edge.

When a shoring system is used, the system shall be designed and used to resist the added pressure when heavy equipment, material handling equipment, or material is located near an excavation.

When mobile equipment is utilized or permitted adjacent to an excavation where the operator's vision is restricted, stop logs or barricades shall be utilized or a signal person shall be used.

An excavation 48 or more inches in depth and occupied by an employee shall be provided with either a ladder extending not less than 3 feet above the top as a means of access or with

a ramp meeting the requirements noted in this document. Lateral travel along the wall of a trench to a ladder or other means of egress shall not exceed 25 feet.

An earth ramp may be used in place of a ladder if it meets all of the following requirements:

- The ramp material shall be stable.
- The sides of the excavation above the ramp shall be maintained to the angle of repose or sheeted or shored along the means of egress.
- The degree of angle of the ramp shall not be more than 45 degrees.
- Vertical height between the floor of the trench and the toe of the ramp shall not exceed 30 inches.

### **HAZARDOUS ATMOSPHERES; TESTING AND CONTROLS**

To prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, all of the following requirements shall apply:

- Where an oxygen deficiency (an atmosphere that contains less than 19.5% oxygen) or a hazardous atmosphere exists, such as in excavations in areas where hazardous substances are stored nearby, the atmosphere in the excavation shall be tested before employees enter excavations that are more than 4 feet (1.22 m) deep.
- Precautions shall be taken to prevent employee exposure to atmospheres that contain less than 19.5% oxygen and any other hazardous atmosphere. These precautions include providing proper respiratory protection or ventilation in accordance with the requirements of this part.
- Precautions shall be taken, such as providing ventilation, to prevent employee exposure to an atmosphere that contains a concentration of a flammable gas in excess of 20% of the lower flammable limit of the gas.
- When controls are used that is 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.

### **EXCAVATION, ANGLE OF REPOSE**

The side of an excavation more than 5 feet deep shall be sloped as prescribed in depth chart, unless supported as prescribed in this part. Chart can be found in the appendices of this manual.

An excavation less than 5 feet in depth shall also be effectively protected when examination of the ground indicates hazardous earth movement may be expected.

If 1 side of a trench is 5 feet or less in depth and the other side is deeper than 5 feet, the side deeper than 5 feet shall be protected as provided in this part. All excavating material shall be placed on the low side if possible.

Special attention shall be given to a side that may be adversely affected by weather or moisture content.

## SUPPORTING SYSTEMS

### ANGLE OF REPOSE, TIE BACKS, TIGHT SHEETING, ADDITIONAL BRACING

The angle of repose and the design of the supporting system for a side of an excavation shall be based on the evaluation of all of the following factors:

- Depth of cut and type of soil.
- Possible variation in the water content of the material while the excavation is open.
- Anticipated changes in the material due to exposure to air, sun, water, or freezing.
- Load imposed by structures, equipment, overlying material, or stored material.
- Vibration from traffic, equipment, or blasting.

A support system shall be designed by a qualified person, and reviewed by project manager and/or safety committee. The design of the supporting system shall be maintained at the jobsite. Changes from the design of the support system shall be approved by a qualified employee.

Tie rods and other forms of tie backs used to restrain the top of sheeting shall be anchored a minimum of 10 feet. The measurement to the anchor point shall start at the intersection of an angle of repose with the surface of the soil retained. The tie back and anchor shall be capable of restraining any pressure exerted on the system.

When tight sheeting or sheet piling is used, pressures due to existing ground water conditions shall be considered in the design. Sheet piling shall be driven to the predetermined depth set forth in the required design. Changes from the design shall be approved by the designer of the support system.

Materials used for a supporting system shall be in good serviceable condition. When timbers are used, they shall be sound and free of large or loose knots.

A supporting system shall include additional bracing approved by the designer of the support system when the sides of excavations are cut adjacent to a previous known excavation or a



known fill, particularly when the separation between the previous excavation and the new excavation is less than the depth of the excavation.

Tight sheeting shall be braced or anchored at the bottom and along the vertical plane to prevent lateral movement.

### **ADDITIONAL REQUIREMENTS FOR TRENCH SUPPORT SYSTEMS**

A brace or trench jack that is used for a support system for a trench shall be spaced as designed and shall be secured to prevent sliding, failing, or kickout. The backfilling and the removal of a support system for a trench shall progress together from the bottom of the trench. In unstable or running soil, the jacks and braces shall be removed from above the trench after employees have cleared the trench.

The excavation of material to a level that is not more 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 if 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. The installation of a support system shall be closely coordinated with the excavation of trenches.

### **BENCHING AND SLOPING**

The angle of repose shall be flattened when an excavation has water conditions, silty materials, loose boulders, or areas where erosion, deep frost action, or slide planes appear.

When benching the side of an excavation, the vertical rise shall not be more than 5 feet and the step back shall extend at least to the angle of repose as required by depth chart.

When benching a side of a trench, the height of the lower bench shall not be more than the lesser of 5 feet or width of the trench measured at the bottom.

An employee shall not be permitted to work on sloped or benched excavations at levels above another employee, except when an employee at the lower level is protected from the hazard of falling, rolling, or sliding material or equipment.

### **TRENCHING BOXES AND SHIELDS**

Portable trench boxes or sliding trench shields may be used for the protection of personnel in place of a shoring system or sloping. Where such trench boxes or shields are used, they shall be designed, constructed, and maintained in a manner that provides protection equal to or greater than the sheeting or shoring required for the trench.

The use of benching in conjunction with a portable trench box is permitted when the toe of the trench box is not more than 2 feet above the trench bottom, but only if the trench box is designed to resist the forces calculated for the full depth of the trench and if there are no indications, while the trench is open, of a possible cave-in below the bottom of the trench box.

An employee shall not be allowed in shields when shields are being installed, removed, or moved.

### **STRUCTURAL RAMPS**

Structural ramps used solely by employees as a means of access or egress from excavations shall be designed by a competent person, and reviewed by project manager and/or safety committee. Structural ramps used for access or egress of equipment shall be designed by a person qualified in structural design, and shall be constructed in accordance with the design.

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

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

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.

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

### **LADDERS**

When portable ladders are used, guidelines from the Fall Protection Plan and Procedures must be followed.

### **EXPOSURE**

#### **Walkways, sidewalks and roadways**

A walkway or sidewalk shall be kept clear of excavated material and other obstructions. The walkways and sidewalks shall be lighted if used during hours of darkness. A sidewalk shall not be undermined unless it is shored to support a live load of not less than 125 pounds per square foot. A walkway or sidewalk that is adjacent to an excavation shall be separated from the excavation and protected by a guardrail as prescribed in the Fall Protection written manual.

### Openings in roadways

An open cut into a roadway shall be provided with a barricade on all sides as prescribed in rule 2223 of Part 22. Signals, Signs, Tags, and Barricades. Warning lights shall be provided during hours of darkness.

### Vehicular Traffic

Employees exposed to 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. Warning vests worn by flagmen shall be red or orange, and shall be reflectorized material if worn during night work. Emergency lighting, such as spotlights or portable lights, shall be provided as needed to perform work safely.

### Falling Loads

No employee is permitted underneath loads being handled by lifting or digging equipment. Employees are being 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 provide adequate protection for the operator during loading and unloading operations.

### Walkways and Guardrails

Walkways shall be provided where employees or equipment are permitted to cross over excavations. Guardrails shall be provided where walkways, accessible only to on-site project personnel, are six (6) feet or more above lower levels.

## **WARNING SYSTEM FOR MOBILE EQUIPMENT**

A warning system shall be used when mobile equipment is operated adjacent to the edge of an excavation if the operator does not have a clear and direct view of the edge of the excavation. The warning system shall consist of barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

## **HAZARDOUS ATMOSPHERES**

Site Superintendent will test the atmosphere in excavations over four (4) feet deep if a hazardous atmosphere exists or could reasonably be expected to exist. A hazardous atmosphere could be expected, for example, in excavations in landfill areas, areas where hazardous substances are stored nearby, or near or containing gas pipelines. Also, whenever working on sanitary sewers.

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 forced ventilation of the workspace.

Forced ventilation or other effective means shall be used to prevent employee exposure to an atmosphere containing a flammable gas in excess of ten (10) percent of the lower flammability limit of the gas.

When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, continuous air monitoring will be performed by Site Superintendent or designated responsible employee. The device used for atmospheric monitoring shall be equipped with an audible and visual alarm.

Atmospheric testing will be performed using a properly calibrated direct reading gas monitor. Direct reading gas detector tubes or other acceptable means may also be used to test potentially toxic atmospheres.

Each atmospheric testing instrument shall be calibrated by Site Superintendent or designated responsible employee on a schedule and in the manner recommended by the manufacturer. In addition:

Any atmospheric testing instrument that has not been used within 30 days shall be recalibrated prior to use.

Each atmospheric testing instrument shall be calibrated at least every six (6) months.

Each atmospheric testing instrument will be field checked immediately prior to use to ensure that it is operating properly.

## **PERSONAL PROTECTIVE EQUIPMENT**

All employees working in trenches or excavations shall wear approved hardhats and steel-toed shoes or boots.

Employees exposed to flying fragments, dust or other materials produced by drilling, sawing, sanding, grinding, and similar operations shall wear approved safety glasses with side shields.

Employees performing welding, cutting, or brazing operations, or are exposed to the hazards produced by these tasks, shall wear approved spectacles or a welding face shield or helmet, as determined by Job Site PPE requirements and/or Safety Manager.

**L.D. Docsa Associates, Inc.**

---

Employees entering bell-bottom pier holes or other similar deep and confined footing excavations shall wear a harness with a lifeline 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.

Employees shall wear, as determined by Jobsite PPE requirements, approved gloves or other suitable hand protection.

Employees using or working in the immediate vicinity of hammer drills, masonry saws, jackhammers, or similar high-noise producing equipment shall wear suitable hearing protection, as determined by Job Site PPE requirements.

Each employee working at the edge of an excavation six (6) feet or more deep shall be protected from falling. Fall protection shall include guardrail systems, fences, barricades, covers, or a tie-back system meeting OSHA requirements, as determined by Job Site PPE requirements, and/or Site Superintendent.

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, and a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may develop during work in an excavation. This equipment shall be attended when in use. Only personnel who have received approved training and have appropriate equipment shall attempt retrieval that would require entry into a hazardous atmosphere. If entry into a known hazardous atmosphere must be performed, then Site Superintendent shall give advance notice so that the hazards can be evaluated and rescue personnel placed on standby if necessary.

**PROTECTION FROM WATER ACCUMULATION HAZARDS**

Employees are not permitted to work in excavations that contain or are accumulating water unless precautions have been taken to protect them from the hazards posed by water accumulation. Precautions may include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of safety harnesses and lifelines.

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operation shall be monitored by a person trained in the use of that equipment.

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. Precautions shall also be taken to provide adequate drainage of the area

adjacent to the excavation. Excavations subject to runoff from heavy rains shall be re inspected by Site Superintendent after each rain incident to determine if additional precautions, such as special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of safety harnesses and lifelines, should be used.

Site Superintendent shall inform affected workers of the precautions or procedures that are to be followed if water accumulates or is accumulating in an excavation.

## **ADJACENT STRUCTURES**

### **PROTECTION, DESIGN, INSPECTION OF SHORING, BRACING AND UNDERPINNING**

A structure that is adjacent to an excavation or trench below the level of the base or footing of any foundation or retaining wall shall be protected against settlement, lateral movement, undermining, or washout.

Before the excavation begins, the design of the protection used shall be set forth by a qualified person who is knowledgeable in the subject area.

The shoring, bracing, and underpinning shall be inspected daily or more often, as conditions warrant, by a qualified employee.

### **STABILITY**

Site Superintendent and/or project manager/safety committee will determine if the excavation work could affect the stability of adjoining buildings, walls, sidewalks, or other structures.

Support systems (such as shoring, bracing, or underpinning) shall be used to assure the stability of structures and the protection of employees where excavation operations could affect the stability of adjoining buildings, walls, or other structures.

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:

- A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure;
- The excavation is in stable rock;

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

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

Where review or approval of a support system by a registered professional engineer is required, Site Superintendent shall secure this review and approval in writing before the work begins.

### **PROTECTION FROM FALLING OBJECTS AND LOOSE ROCKS OR SOIL**

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, such as wire mesh or timber, at appropriate intervals on the face of the slope to stop and contain falling material; or
- Benching sufficient to contain falling material.

Excavation personnel shall not be permitted to work above one another where the danger of falling rock or earth exists.

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

Protection shall be provided by keeping such materials or equipment at least two (2) feet from the edge of excavations, by use of restraining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

Materials and equipment may, as determined by Site Superintendent, need to be stored further than two (2) feet from the edge of the excavation if a hazardous loading condition is created on the face of the excavation.

Materials piled, grouped, or stacked near the edge of an excavation must be stable and self-supporting.

---

## **INSPECTION BY PROGRAM MANAGER**

The Site Superintendent shall conduct daily inspections of excavations, adjacent areas, and protective systems for evidence of a situation that could result in possible cave-ins, failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by Site Superintendent or designated responsible employee 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 the trench will be or is occupied by employees.

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

Site Superintendent or designated responsible employee shall maintain a written log of all inspections conducted. This log shall include the date, work site location, results of the inspection, and a summary of any action taken to correct existing hazards.

## **PROTECTIVE SYSTEM REQUIREMENTS**

### **PUBLIC**

Barricades, walkways, lighting, and posting shall be provided as necessary for the protection of the public prior to the start of excavation operations.

Guardrails, fences, or barricades shall be provided on excavations adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares. Warning lights or other illumination shall be maintained as necessary for the safety of the public and employees from sunset to sunrise.

Wells, holes, pits, shafts, and all similar hazardous excavations shall be effectively barricaded or covered and posted as necessary to prevent unauthorized access. All temporary excavations of this type shall be backfilled as soon as possible.

Walkways or bridges protected by standard guardrails shall be provided where employees and the general public are permitted to cross over excavations. Where workers in the excavation may pass under these walkways or bridges, a standard guardrail and toeboard shall be used to prevent the hazard of falling objects. Information on the requirements for guardrails and toeboards may be obtained by contacting the Safety Manager or Site Superintendent.



**EMPLOYEES**

Stairs, ladders, or ramps shall be provided at excavation sites where employees are required to enter trench excavations over four (4) feet deep. The maximum distance of lateral travel (along the length of the trench) necessary to reach the means of egress shall not exceed 25 feet.

Employees in an excavation shall be protected from cave-ins by using either an adequate sloping and benching system or an adequate support or protective system. The only exceptions are:

- Excavations made entirely in stable rock; or
- Excavations less than four (4) feet in depth where examination of the ground by Site Superintendent provides no indication of a potential cave-in.

Protective systems shall be capable of resisting all loads that could reasonably be expected to be applied to the system.

**DESIGN FOR SLOPING & BENCHING SYSTEMS**

Sloping and Benching Systems

The slope and configuration of sloping and benching systems shall be selected and constructed by Site Superintendent in accordance with the following options (examples shown in the appendices of this manual). Allowable configurations and slopes:

- Excavations shall be sloped at an angle no steeper than one and one-half (1 ½) horizontal to one (1) vertical (34 degrees measured from the horizontal), unless one of the options listed below is used.
- Slopes shall be properly excavated depending on soil type as shown in 29 CFR 1926, Subpart P, and Appendix B.
- Determination of slopes and configurations using 29 CFR 1926, Subpart P. (See appendices)

The maximum allowable slopes and allowable configurations for sloping and benching systems shall meet the requirements set forth in these appendices.

Other tabulated data

The design of sloping or benching systems may be selected from, and shall be constructed in accordance with, other tabulated data, such as tables and charts. The tabulated data used must be in written form and include the following:

- Identification of the factors that affect the selection of a sloping or benching system.
- Identification of the limits of the use of the data, including the maximum height and angle of the slopes determined to be safe.
- Other information needed by the user to make correct selection of a protective system.
- At least one copy of the tabulated data that 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, and shall be maintained by Safety Manager.
- Design by a registered professional engineer

Sloping or benching systems designed in a manner other than those described in the preceding three options shall be approved by a registered professional engineer.

Designs shall be in written form and shall include at least the following information:

- The maximum height and angle of the slopes that were determined to be safe for a particular project; and
- The identity of the registered professional engineers who approved the design.

At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time, the design may be stored off the jobsite, and shall be maintained by the Safety Manager.

## **SUPPORT, SHIELD, AND OTHER PROTECTIVE SYSTEMS**

The design of support systems, shield systems, and other protective systems shall be selected and constructed by Site Superintendent in accordance with the following requirements:

- Designs using 29 CFR 1926, Subpart P, Appendices A, C and D
- Timber shoring in trenches shall be designed in accordance with the requirements of the OSHA guidelines.
- Aluminum hydraulic shoring shall be designed in accordance with the manufacturer's tabulated data or the requirements of the OSHA guidelines.

## **Data**

### **MANUFACTURER'S TABULATED DATA**

Support systems, shield systems, and other protective systems designed from manufacturer's tabulated data shall be constructed and used in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

## **L.D. Docsa Associates, Inc.**

---

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

Manufacturer's specifications, recommendations, and limitations, as well as the manufacturer's written approval to deviate from the specifications, recommendations, and limitations, shall be kept in written form at the jobsite during construction of the protective system(s). After that time, the information may be stored off the jobsite, and shall be maintained by Safety Manager and/or Project Manager.

### **OTHER TABULATED DATA**

Designs of support systems, shield systems, and other protective systems shall be selected from and constructed in accordance with tabulated data, such as tables and charts.

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

- Identification of the factors that affect the selection of a protective system drawn from such data;
- Identification of the limits of the use of such data; and
- Information needed by the user to make a correct selection of a protective system from the data.

At least one written 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, and shall be maintained by Safety Manager and/or Project Manager.

### **DESIGN BY A REGISTERED PROFESSIONAL ENGINEER**

Support systems, shield systems, and other protective systems designed in a manner other than the preceding three options shall be approved by a registered professional engineer.

Designs shall be in written form and shall include:

- A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and
- The identity of the registered professional engineer who approved the design.

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, and shall be maintained by Safety Manager and/or Project Manager.

---

## **MATERIALS AND EQUIPMENT**

Materials and equipment used for protective systems shall be free from damage or defects that might affect their proper function.

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

When materials or equipment used for protective systems are damaged, the Site Superintendent will ensure that these systems are examined by a competent person to evaluate suitability for continued use. If the competent person cannot assure that 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. The material or equipment shall then be evaluated and approved by a registered professional engineer before being returned to service.

## **INSTALLATION AND REMOVAL OF SUPPORTS**

Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other potential hazards.

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 systems. Individual members of the support systems shall not be subjected to loads exceeding those that they were designed to support.

Before temporary removal of individual support members begins, additional precautions shall be taken as directed by Site Superintendent to ensure the safety of employees (i.e., the installation of other structural members to carry the loads imposed on the support system). Removal of support systems shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly. If there is any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation, the work shall be halted until it can be examined by the Site Superintendent. Backfilling shall progress in conjunction with the removal of support systems from excavations.

## **ADDITIONAL REQUIREMENTS**

Excavation of material to a level no greater than two (2) feet below the bottom of the members of a support system is allowed, but only if the system is designed to resist the forces calculated for the full depth of the trench. There shall be no indications of a possible loss of

soil from behind or below the bottom of the support system while the trench is open. Installation of a support system shall be closely coordinated with the excavation of trenches.

### **SHIELD SYSTEMS**

Shield systems shall not be subjected to loads that are greater than those they are designed to withstand. Shields shall be installed in a manner that will restrict lateral or other hazardous movement of the shield and could occur during cave-in or unexpected soil movement.

Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields. Employees are not permitted in trenches when shields are being installed, removed, or moved vertically.

Employees are not be permitted to work above other employees in the faces of sloped or benched systems, except when employees at lower levels are protected from the hazards of falling, rolling, or sliding material or equipment.

### **ADDITIONAL REQUIREMENTS**

Excavation of material to a level no greater than two (2) feet below the bottom of the shield system is allowed, but only if the system is designed to resist the forces calculated for the full depth of the trench.

There shall be no indications of a possible loss of soil from behind or below the bottom of the shield system while the trench is open.

### **ACCIDENT INVESTIGATIONS**

All incidents that result in injury to workers, as well as near misses, regardless of their nature, shall be reported and investigated. Investigations shall be conducted by the Site Superintendent with assistance from witness to the accident, soon after an incident as possible to identify the cause and means of prevention to eliminate the risk of reoccurrence.

In the event of such an incident, the Excavation Safety Program shall be reevaluated by Safety Manager and Safety Committee, to determine if additional practices, procedures, or training are necessary to prevent similar future incidents.

### **CHANGES TO PROGRAM**

Any changes to the Excavation Safety Program shall be approved by the Safety Manager, along with the Safety Committee, and shall be reviewed by a qualified person as the job

progresses to determine additional practices, procedures, or training needs necessary to prevent injuries. Affected employees shall be notified of procedure changes, and trained if necessary. A copy of this program shall be maintained at the jobsite.

## GLOSSARY

**Accepted engineering practices:** the 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 (wales). This system is designed to support the sidewalls of an excavation and prevent cave-ins.

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

**Benching system:** 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 an excavation, or the loss of soil from under a trench shield or support system, in amounts large enough to trap, bury, or injure and immobilize a person.

**Competent person:** a person who has been trained to identify hazards in the workplace, or working conditions that are unsafe for employees, and who has the authority to have these hazards corrected.

**Cross braces:** the horizontal members of a shoring system installed from side to side of the excavation. The cross braces bear against either uprights or wales.

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

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

**Failure:** the movement or damage of a structural member or connection that makes it unable to support loads.

**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.

**Kickout:** the accidental movement or failure of a cross brace.

**Program Manager:** the individual within the company who oversees excavation work and is responsible for assuring compliance with this program.

**Protective system:** a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face 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:** an inclined walking or working surface that is used to gain access to one point from another. A ramp may be constructed from earth or from structural materials such as steel or wood.

**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 system:** a structure used in an excavation to withstand cave-ins and which will protect employees working within the shield system. Shields can be permanent structures or portable units moved along as work progresses. Shields used in trenches are usually referred to as trench boxes or trench shields.

**Shoring system:** a structure that is built or put in place to support the sides of an excavation to prevent cave-ins.

**Sides:** see faces.

**Sloping system:** sloping the sides of an excavation away from the excavation to protect employees from cave-ins. The required slope will vary with soil type, weather, and surface or near surface loads that may affect the soil in the area of the trench (such as adjacent buildings, vehicles near the edge of the trench, etc.).

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

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

**Support system:** a structure used 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 height) made below the surface of the ground.

**Trench box or trench shield:** see shield.

**Uprights:** the vertical members of a trench shoring system placed in contact with the earth and usually positioned so the 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:** horizontal members of a shoring system placed in the direction of the excavation face whose sides bear against the vertical members of the shoring system or earth (the uprights or sheeting).

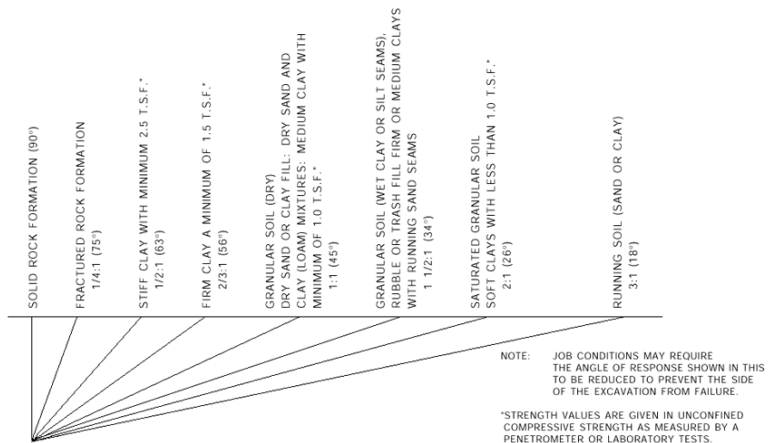
## EXAMPLES

### DEPTH CHART

Maximum allowable angle of repose for the side of an excavation in excess of 5' depth.

Note: Job conditions may require the angle of response shown in this to be reduced to prevent the side of the excavation from failure.

\*Strength values are given in unconfined compressive strength as measured by a penetrometer or laboratory tests.



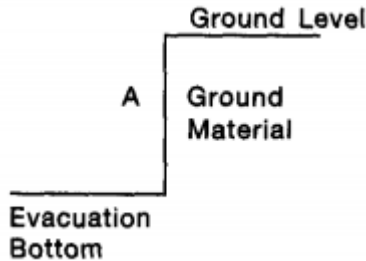


**DEPTH**

*Excavation & Trench Protection*

0-5' Deep

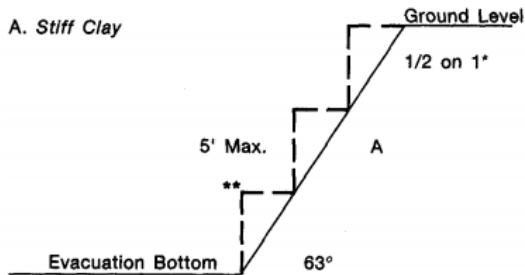
Side A: If examination of the ground indicated hazardous ground movement may be expected, side A shall be cut to the angle of repose and a supporting system shall be provided.



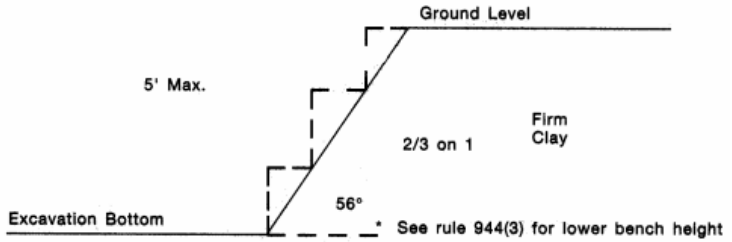
More than 5' Deep

\*1/2 Horizontal: 1 Vertical

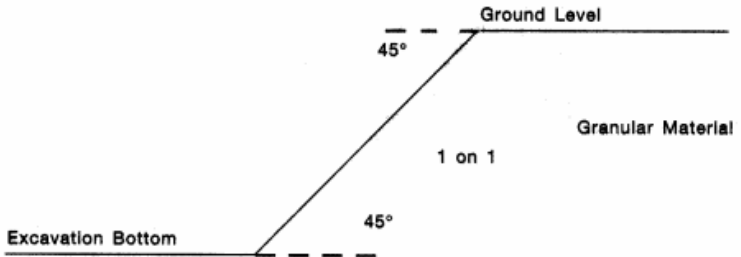
\*\*See rule 944(3) for lower bench height.



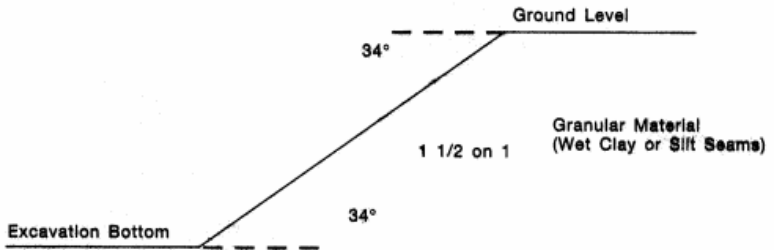
**B. Firm Clay**



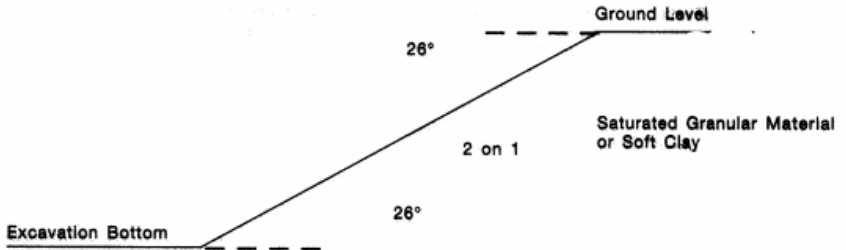
**C. Granular Material**



**D. Granular Material (Wet Clay or Silt Seams)**



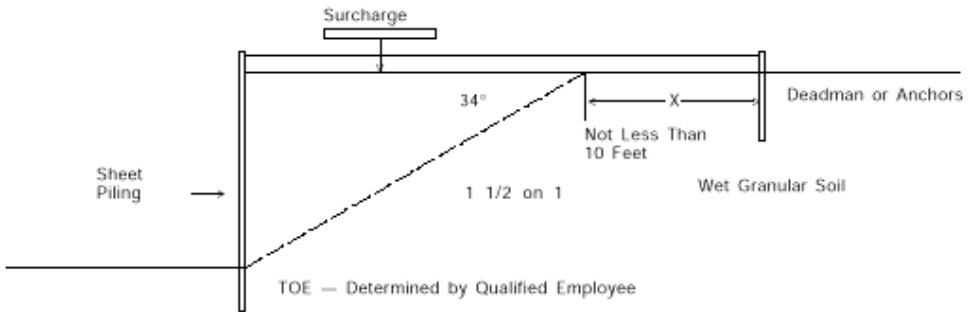
**E. Saturated Granular Material or Soft Clay**



**SUPPORT SYSTEM**

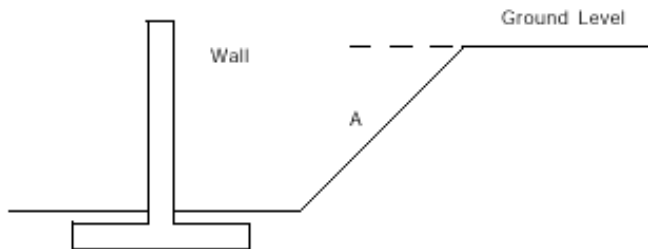
**Sheet Piling**

The design of the supporting system should take into consideration any surcharge, such as, stockpiled material, equipment, or hydrostatic pressure that must be supported by the system. (X=Not less than 10')



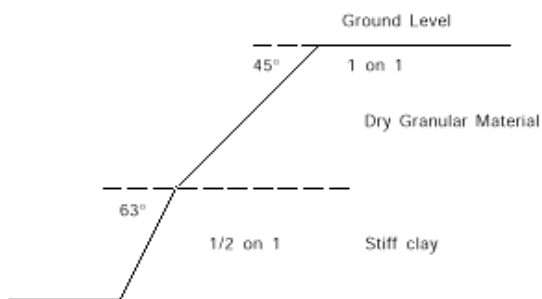
**Wall in Place**

Side A: Side A should be cut to the angle of repose or a supporting system provided. If a support system is designed for Side A, no braces or members should bear against the wall unless the wall is designed to withstand bracing loads.

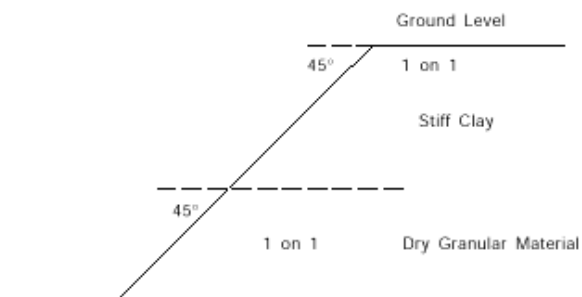


**DIFFERENT TEXTURED SOILS**

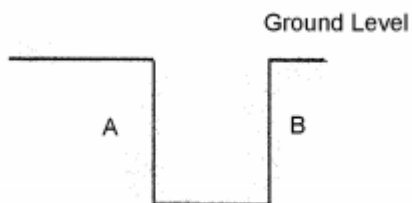
Case 1



Case 2

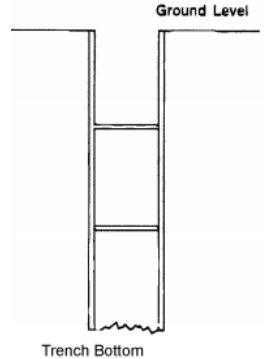
**TRENCHES**

Sides A&B: If examination of the ground indicates ground movement may be expected, sides A&B shall be cut to the angle of repose or a supporting system shall be provided.

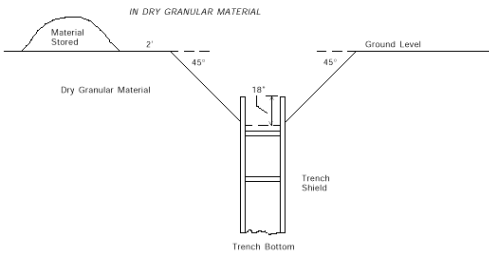


**Trench Shoring System**

If trench support system shall be designed by a qualified employee knowledgeable in the field, this arrangement of stringers, struts, and braces should be designated by the plans.

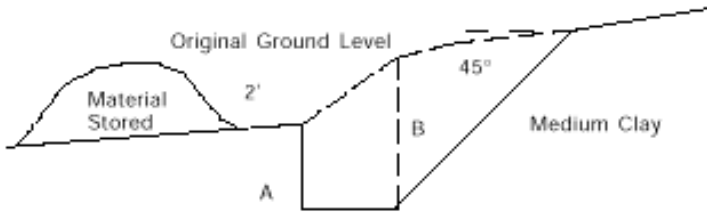


**Trench Supporting System**



**Trench Cut In Sloping Ground**

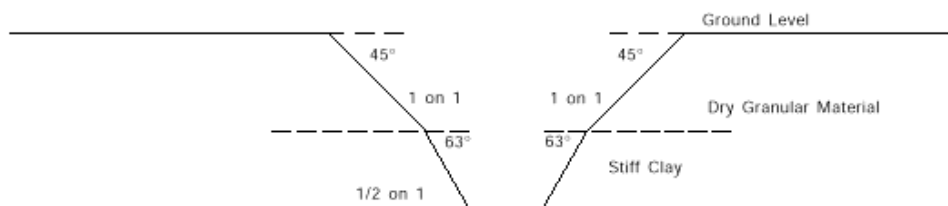
MEDIUM CLAY



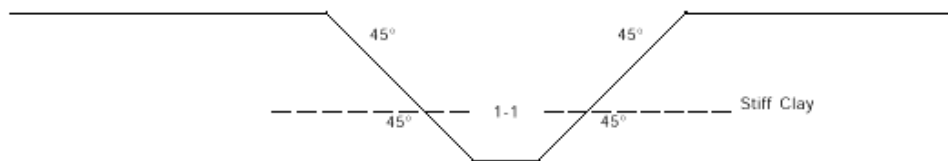
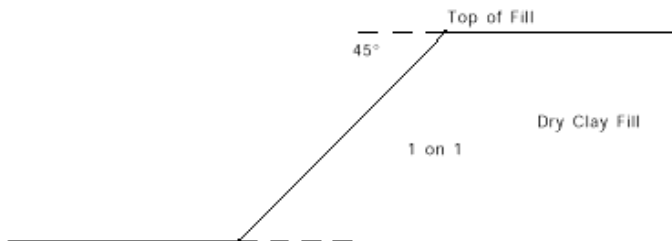
- If Side A is 5' or less and Side B is more than 5'
- (1) Side A should be sloped as provided for in Example 6.
  - (2) Side B should be cut to the correct angle of repose.
  - (3) All excavated material should be stored on the low side of the trench, if possible.

**Trench Cut in Different Textured Materials**

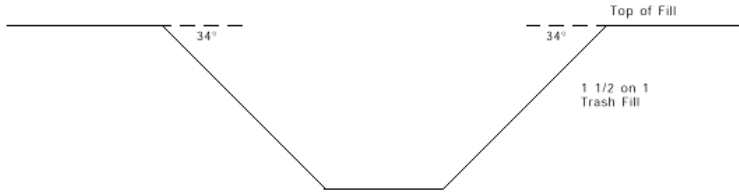
Case 1



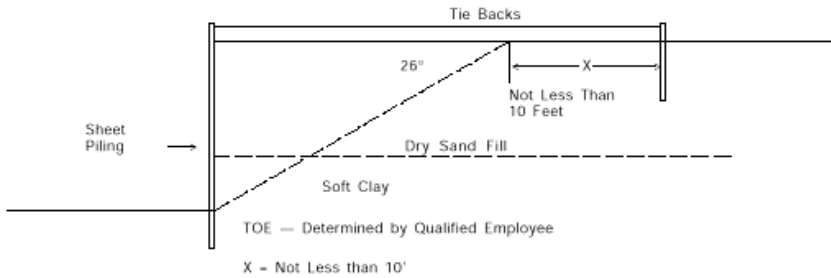
Case 2

**FILL AREAS****Dry Clay or Sand Fill**

**Wet soil, Rubble, Trash or Organic Material Fill**



**Saturated sand, soft clay or organic soil encountered at depth under fill area**



**Saturated Sand, Soft Clay, or Organic Soil encountered at depth under a fill**

If the bottom of the trench extends into saturated sand, soft clay, or organic soil under a fill, a trench supporting system should be used to provide protection below the fill.

