structures with wheel guards, fender logs, or curbs not less than 8 inches (20.3 cm) high and place them parallel with and secured to the sides of the runway.

(3) When used in lieu of steps, provide ramps with cleats to ensure safe access.

j. Personnel Hoists and Elevators. (24-8.j)

(1) Design, construction, installation or erection, operation, inspection, testing, and maintenance of personnel hoists and elevators must be according to the manufacturer's instructions, ANSI/ASSP A10.4, ANSI A10.22, ASME A17 and the applicable OSHA standards (for example, 29 CFR 1926.552).

(2) Keep a copy of the manufacturer's manual covering construction, installation or erection, operation, inspection, testing, and maintenance, and a copy of the applicable ANSI and/or ASME standards available onsite.

24-9. Figures and Tables.
Not Applicable.

24-10. Checklists and Forms.
Not Applicable.

Chapter 25
Excavation and Trenching

25-1. References.

a. ER 385-1-95, Safety and Health Requirements for Operations and Activities Involving Munitions and Explosives of Concern (MEC) (https://www.publications.usace.army.mil/USACE-Publications/Engineer-Regulations/) (25-1.a)

b. 29 CFR 1926 Subpart P, Excavations (https://www.govinfo.gov/content/pkg/CFR-2020-title29-vol8/pdf/CFR-2020-title29-vol8-part1926-subpartP.pdf) (25-1.b)

25-2. Definitions.

a. Barricade. A physical obstruction (for example, tape, screens, cones) intended to warn of and limit access to a hazardous area. (25-2.a)

b. Benching. A method of protecting employees from cave-ins by cutting the sides of the excavation in the arrangement of one or more horizontal levels, usually with vertical or near-vertical walls between steps. (25-2.b)

c. Cofferdam. A temporary structure used to keep water (and earth) out of an excavation during construction of the permanent structure. (25-2.c)

d. Competent Person (CP), Excavations. A person designated in writing by the employer to be responsible for the immediate supervision, implementation, and monitoring of the Excavation and Trenching Plan. Must have training, knowledge, and experience in excavation and trenching to be capable of identifying, evaluating, and addressing existing and potential hazards. This individual must have the authority to take prompt corrective measures with regard to such hazards. The term "Competent Person (CP)" as used in this chapter, refers to "Competent Person, Excavations." (25-2.d)

e. Perimeter Protection. Measures taken to prevent personnel, vehicles, and materials from falling into an excavation. (25-2.e)

f. Protective System. Methods used to protect employees from cave-ins, from material falling into an excavation, or from the collapse of adjacent structures. Systems include benching, sloping, shoring, trench shields, underpinning, rock bolting, and similar. (25-2.f)

g. Scaling. The removal of loose, overhanging, protruding, or otherwise precariously positioned material from above or along the sides of an excavation. (25-2.g)

h. Sloping. A method of protecting employees from cave-ins by cutting the sides of the excavation in the arrangement of slopes. The angle of the slope needed to prevent cave-in is a function of the soil type, environmental factors such as moisture and freezing weather, and the magnitude and location of any loads and vibration surcharged upon the slopes. (25-2.h)

i. Stable Rock. Natural, solid, mineral material that can be excavated with vertical sides and remain intact while exposed. (25-2.i)

j. Support System. A structural means of supporting the walls of an excavation to prevent cave-ins. Systems include shields, shoring, underpinning, rock bolts, and similar. (25-2.j)

25-3. Personnel Required Qualification/Training.

a. Competent Person (CP). (25-3.a)

(1) CPs must have training, knowledge, and experience in soil analysis, use of protective systems, and the requirements of this chapter and 29 CFR 1926 Subpart P.

(2) CPs must be able to demonstrate the ability to detect conditions that could result in cave-ins, failures in protective systems, hazardous atmospheres, and other hazards including those associated with confined spaces.

(3) CPs must have the authority to stop work and take prompt corrective measures to eliminate existing and predictable hazards if it is determined to be unsafe.

b. Rescue Personnel. Personnel conducting rescue operations must be trained on rescue procedures identified in the Excavation and Trenching Plan (see para 25-7.i). (25-3.b)

25-4. Roles and Responsibilities.

a. Competent Person (CP). The CP is responsible for: (25-4.a)

(1) Developing the Excavation and Trenching Plan (see para 25-7) and AHA (see para 25-6).

(2) Conducting documented inspections of excavations to identify and control for any existing or potential hazards (see para 25-5.a).

(3) Immediately stopping the work if it is determined to be unsafe and take prompt corrective measures to mitigate the hazards.

(4) Performing soil classification testing (see paras 25-5.b and 25-8.i).

(5) Examining material or equipment used for protective systems when they are damaged to evaluate its suitability for continued use (see para 25-8.j).

(6) Determining exemptions for the use of fall protection for inspectors and supervisor (see para 25-8.h).

(7) Evaluating the need for air monitoring (see para 25-5.c).

(8) Monitoring water control equipment and operations to ensure proper operation (see para 25-8.c).

(9) The CP for excavations and trenching must always be onsite when such work is being performed.

b. Qualified Person (QP). The QP is responsible for: (25-4.b)

(1) Designing Class 1 perimeter protection to guard against vehicles or equipment from falling into an excavation (see para 25-8.h).

(2) Designing ramps used for equipment access into excavations (see para 25-8.h).

c. Registered Professional Engineer (RPE). The RPE is responsible for: (25-4.c)

(1) Evaluating and determining that adjacent structures are sufficiently removed from the excavation or supported prior to excavating below a footing (see para 25-8.b).

(2) Planning and directing any freezing, pumping, drainage, or similar control measures (see para 25-8.c).

(3) Designing tabulated data for use with support system (see para 25-8.i).

(4) Designing sloping or benching for excavation over 20 feet (6 m) in depth (see para 25-8.i).

d. Rescue Personnel. Rescue personnel must conduct rescue operations according to the written rescue procedures (see para 25-7.i). (25-4.d)

25-5. Inspection Requirements.

a. Excavations. When workers will be in or around an excavation, a CP must conduct documented inspections of each excavation, the adjacent areas, and protective systems at the following frequencies: (25-5.a)

(1) Before each work shift and throughout the work shift as dictated by the work being done.

(2) After every rainstorm or event that could increase hazards (for example, snowstorm, thunderstorm, thaw, earthquake).

(3) When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or similar conditions occur.

(4) When there is a change in size, a change in location, or creation of a spoil pile.

(5) Where there is any indication of change in adjacent structures.

b. Soil Conditions/Classification. The CP must inspect and test the soil conditions, at minimum, prior to the start of each work shift and as conditions warrant to determine the soil classification. Document and maintain the results for the life of the project (for example, in QC Daily Reports, excavation inspection logs). (See para 25-8.i) (25-5.b)

c. In excavations 4 feet (1.2 m) or greater in depth where oxygen deficiency or gaseous conditions are known or suspected, test the air prior to the start of each shift or more often if directed by the CP. Maintain a log of all test results at the work site. (25-5.c)

25-6. Activity Hazard Analysis (AHA) Requirements.
Develop AHAs according to paragraphs 1-6 or 2-6, as applicable. An AHA is required to be developed by a CP for all work in excavations and trenches. The AHA must include the following:

a. For all piping activities, include workers' increased exposure during connection activities (for example, bent over, kneeling). (25-6.a)

b. Methods and locations for egress. (25-6.b)

c. Identification and credentials of the CP, Excavation. (25-6.c)

d. Documentation that examination of the ground by the CP results in no indication of a potential cave-in. (25-6.d)

25-7. Minimum Plan Requirements.
Excavation and Trenching Plan. An Excavation and Trenching Plan is required when excavations or trenches are 5 feet (1.5 m) or more in depth. The plan must be developed by a CP, submitted, and approved by the USACE supervisor or accepted by the KO or COR prior to beginning work. The plan must include the following:

Note. For excavations or trenches less than 5 feet (1.5 m) in depth, or made entirely in stable rock, an Excavation and Trenching Plan is optional.

a. Activity Hazard Analysis (AHA) (see para 25-6). (25-7.a)

b. Detailed description of activity being performed to include a diagram or sketch of the work area with adjacent and nearby structures shown and locations of utility shut offs, if required. (25-7.b)

c. Description of the anticipated hazards or concerns and control measures that will be implemented to control to an acceptable level, to include: (25-7.c)

(1) Projected soil types and methods of testing to determine soil type (see table 25-2).

(2) Projected maximum depth of the excavation and planned method of shoring, sloping, or benching. Shoring, sloping, or benching for excavations over 20 feet (6.1 m) in depth must be designed by an RPE. (See para 25-4.c.)

(3) Plan for management of excavated materials (for example, soil, asphalt, concrete, stone).

(4) Methods to provide safe access (see para 25-8.h).

(5) Proposed methods for preventing damage to overhead utility lines, trees designated to remain, and other man-made facilities or natural features designated to remain within or adjacent to the limits of work.

(6) Plan for traffic control (see chapter 5).

(7) Atmospheric monitoring procedures and planned method for confined space entry as applicable (see chapter 34).

d. Assignment of personnel and their roles and responsibilities. Include necessary information/documentation to support qualification/training of such persons (see paras 18-3, 25-3, and 34-3). (25-7.d)

e. Inspection and oversight methods to ensure adherence to the plan. (25-7.e)

f. Process for obtaining dig permits (for example, excavation permits) according to paragraph 25-8.f. (25-7.f)

g. Certification of unexploded ordnance (UXO) disposal clearance as applicable (see para 25-8.g). (25-7.g)

h. For cofferdams. Prepare a Controlled Flooding Plan that includes fall protection, access and egress, and evacuation procedures (see para 25-8.k). (25-7.h)

i. Rescue Procedures. Employers must provide prompt rescue to all buried workers. (25-7.i)

(1) Site and task specific procedures for self-rescue and assisted rescue of any worker who is buried during a cave-in to include rescue equipment.

(2) Include any other planned methods of rescue (that is, by a jurisdictional, public or Government emergency rescue agencies) and include the point of contact information necessary to contact and summon the agency to the accident site.

(3) If using local emergency response services (for example, local fire/emergency medical services), include a Memorandum of Agreement or Memorandum of Understanding with local responders.

25-8. General Requirements.
The requirements of this chapter are applicable to all Government and contractor work forces when their employees are performing excavation or trenching activities.

a. Protective Systems. (25-8.a)

(1) Protective systems must 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.

(2) Guard the sides of all excavations in which employees are exposed to danger from moving ground by a support system, sloping or benching of the ground, or other equivalent means.

(3) A protective system is not required for excavations less than 5 feet (1.5 m) in depth and which a CP examines, determines, and documents that there is no potential for cave-in. However, a fixed means of egress must be still provided.

(4) Slope and bench according to paragraph 25-8.i.

(5) Use and install support systems according to paragraph 25-8.j.

(6) Shore unstable soil or excavations deeper than 5 feet (1.5 m) unless benching, sloping, or another acceptable plan is implemented and approved by the USACE supervisor or accepted by the KO or COR.

(7) If evidence of a situation that could result in possible cave-ins, slides, failure of protective systems, hazardous atmospheres, or other hazardous condition is identified, remove exposed workers from the hazard and stop all work in the excavation until all necessary safety precautions have been implemented.

b. Stability of Adjacent Structures. (25-8.b)

(1) Except in stable rock, do not excavate below the level of the base of footing of any foundation or retaining wall unless one of the following is met:

(a) A support system, such as underpinning, is provided to ensure the stability of the structure and to protect employees involved in or adjacent to the excavation work.

(b) An RPE has determined that the structure is sufficiently removed from the excavation so that it is not affected by the excavation and the excavation will not pose a hazard to employees.

(2) If the stability of adjoining buildings or walls is endangered by excavations, then an RPE must design the shoring, bracing, or underpinning to ensure the stability of the structure and to protect employees.

(3) Do not undermine sidewalks, pavements, and related structures unless a support system is provided to protect employees and the sidewalk, pavement, or related structure.

(4) Where it is necessary to undercut the side of an excavation, safely support the overhanging material.

c. Protection from Water. (25-8.c)

(1) Use diversion ditches, dikes, or other means to prevent surface water entering an excavation and to provide good drainage of the area adjacent to the excavation.

(2) Do not work in excavations in which there is accumulated water or in which water is accumulating unless the water hazards posed by accumulation is controlled.

(a) An RPE must plan and direct freezing, pumping, drainage, and similar control measures. Address existing moisture balances in surrounding soils and the effects on foundations and structures if it is disturbed.

(b) When continuous operation of ground water control equipment is necessary, provide an emergency power source. The CP must monitor water control equipment and operations to ensure proper operation.

d. Protection from Falling Material. (25-8.d)

(1) Protect employees from loose rock or soil that could create a hazard by falling from the excavation wall by scaling, ice removal, benching, barricading, rock bolting, wire mesh, or other means. Give special attention to slopes that may be adversely affected by weather, moisture content, or vibration.

(2) Remove or make safe materials (for example, boulders, stumps) that may slide or roll into the excavation.

(3) Place excavated material at least 2 feet (0.6 m) from the edge of an excavation or retain it using devices that are sufficient to prevent the materials from falling into the excavation. In any case, place material at a distance to prevent excessive loading on the face of the excavation.

(4) Do not work on the faces of sloped or benched excavations at levels above other employees except when employees at lower levels are adequately protected from the hazard of falling material or equipment.

e. Mobile Equipment and Motor Vehicle Precautions. (25-8.e)

(1) When vehicles or mobile equipment are used or allowed adjacent to an excavation, install substantial stop logs or barricades. The use of a ground guide is recommended.

(2) Workers must stand away from vehicles being loaded or unloaded to avoid being struck by spillage or falling materials.

(3) Do not allow excavating or hoisting equipment to raise, lower, or swing loads over or adjacent to personnel in the excavation without substantial overhead protection. Personnel must maintain a safe distance from hoisting operations until the load has been placed.

Note. Any equipment used to hoist loads, with the use of rigging attached to the equipment (to include excavators, forklifts) must be considered “LHE” or “hoisting equipment” and as such, must follow the requirements in chapter 16.

(4) Employees exposed to equipment or vehicular traffic must wear high visibility apparel according to chapter 5.

f. Underground Utilities. Locate all underground utilities (for example, communication, water, fuel, electric lines) and protect them from damage or displacement. (25-8.f)

(1) Obtain a dig permit (for example, excavation permits) from the local public works organization or other AHJ prior to starting any excavation work. Process the permit requests through the USACE supervisor/KO or COR.

(2) Contact utility companies and other responsible authorities to locate and mark the underground utilities and, if they so desire, direct or assist with protecting them.

(3) <u>If working within 3 feet (0.9 m) of underground utilities, physically verify utility location using non-destructive methods and neutralize the utility system</u>.

(4) When operations approach the location of underground utilities, excavate with caution until the exact location of the utility is found.

(5) Protect workers from the utility and protect the utility from damage or displacement.

g. Hazardous Conditions. (25-8.g)

(1) Employees entering excavations classified as confined spaces, or that otherwise present the potential for emergency rescue (for example, bell-bottom pier

holes), must follow confined space entry procedures to include wearing rescue equipment and maintaining communication with the (confined space) Attendant (see chapter 34).

(2) Where excavations are to be performed in areas known or suspected to contain explosives, unexploded munitions, or military ordnance, ensure that surface and subsurface UXO is surveyed, cleared, and disposed of by an explosive UXO disposal personnel prior to excavation work (see ER 385-1-95).

h. Safe Access. (25-8.h)

(1) Provide perimeter protection to prevent personnel, vehicles, and equipment from falling into excavations according to the following hierarchy:

(a) Class I perimeter protection is required if the excavation is exposed to members of the public or vehicles or equipment.

(a-1) Class I perimeter protection must meet the requirements of a guardrail system according to chapter 21.

(a-2) Class I perimeter protection guarding against traffic (for example, vehicles, equipment) falling into an excavation must be designed, by a QP, to withstand the potential forces due to impact by traffic.

(b) Class II perimeter protection, at minimum, is required if the excavation does not meet the requirements for Class I perimeter protection but is: routinely exposed to employees and is deeper than 6 feet (1.8 m) or contains hazards (for example, impalement, hazardous substances).

(b-1) Class II perimeter protection consists of warning barricades or flagging placed not closer than 6 feet (1.8 m) from the edge of the excavation.

(b-2) Warning barricades or flagging do not have to meet the requirements for Class I perimeter protection but do need to display an adequate warning at an elevation of 3 feet (0.9 m) to 4 feet (1.2 m) above ground level (AGL).

(b-3) When workers are in the zone between the warning barricades or flagging and the excavation, provide them with appropriate fall protection according to chapter 21.

(c) Class III perimeter protection, at minimum, is required if the excavation does not meet the requirements for either Class I or Class II perimeter protection.

(c-1) Class III. Perimeter protection consists of warning barricades or flagging placed not closer than 6 inches (15.2 cm) nor more than 6 feet (1.8 m) from the edge of the excavation.

(c-2) Warning barricades or flagging do not have to meet the requirements for Class I perimeter protection but do need to display an adequate warning at an elevation of 3 feet (0.9 m) to 4 feet (1.2 m) AGL.

(c-3) When workers are in the zone between the warning barricades or flagging and the excavation, provide them with appropriate fall protection according to chapter 21.

(2) Barricade or cover all wells, calyx holes, pits, shafts, and similar.

(3) Backfill excavations as soon as possible. Upon completion of exploration and similar operations, backfill test pits, temporary wells, calyx holes, and similar immediately.

(4) Provide walkways or bridges with standard guardrails according to chapter 21 where people or equipment are required or permitted to cross over excavations.

(5) Where personnel are required to enter excavations or trenches over 4 feet (1.2 m) in depth, provide sufficient stairs, ramps, or ladders. Such means of egress must be provided at intervals so that no more than 25 feet (7.6 m) of lateral travel is required in order to access.

(a) Provide at least two means of exit for personnel working in excavations. Where the width of the excavation exceeds 100 feet (30.5 m), provide two or more means of exit on each side of the excavation.

(b) When access to excavations more than 20 feet (6.1 m) in depth is required, provide ramps, stairs, or mechanical personnel hoists.

(6) Ramps. Install ramps according to chapter 24.

(a) Ramps used solely for personnel access must be a minimum width of 4 feet (1.2 m) and provided with standard guardrails according to chapter 21.

(b) Ramps used for equipment access must be a minimum width of 12 feet (3.7 m). Provide curbs not less than 8 inches x 8 inches (20.3 cm x 20.3 cm), timbers, or equivalent protection. Equipment ramps must be designed by a QP qualified in structural design.

(7) Ladders used as access ways must extend from the bottom of the excavation to not less than 3 feet (0.9 m) above the surface.

(8) Provide fall protection for persons when inspecting or testing in or around an excavation that is between 6 feet (1.8 m) and 20 feet (6.1 m) deep, that has a vertical

face leading edge fall exposure (that is, sides have not been laid back), or that contains hazards (for example, impalement hazards, hazardous substances) (see chapter 21).

Note. Exception. The designated CP for Excavation may exempt the use of fall protection for inspectors or supervisors provided those individuals are not exposed to hazards within 24 inches (61 cm) of edges, the excavation contains no additional hazards and the individual(s) stay a minimum of 24 inches (61 cm) from the excavation's edge.

i. Sloping and Benching. Sloping or benching of the ground must follow one of the systems outlined below (see figures 25-1 and 25-2). (25-8.i)

(1) Allowable configurations and slopes. For excavations 20 feet (6.1 m) or less in depth, do not exceed an angle of 34° measured from the horizontal (that is, 1-1/2 horizontal to 1 vertical). Excavate these slopes to form configurations according to the slopes shown for Type C soil in figure 25-1.

(2) Determination of slopes and configurations using classification of soil and rock deposits. For excavations 20 feet (6.1 m) or less in depth, use classification of soil and rock deposits to determine slope configurations according to 29 CFR 1926, Subpart P, Appendices A and B. (See figure 25-1)

(a) Soil classification must be conducted by a CP and include at least one visual and one manual test (for example, pocket penetrometer, plasticity/wet thread test, shear vane test).

(b) Classify layered soils based on the soil classification of the weakest layer. Each layer may be classified individually if a more stable layer lies below a less stable layer (that is, Type C over Type B) (see table 25-1).

(3) Designs using other tabulated data. Select the design from and according to written tabulated data, such as charts and tables approved by an RPE. Maintain at least one copy of the tabulated data at the jobsite during excavation. The tabulated data must include the following:

(a) Identification of the parameters that affect the selection of a sloping or benching system drawn from the 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 correctly selecting a protective system from the data.

(d) The identity of the RPE who approved the data.

(4) Design by an RPE. Slope or bench according to designs prepared by an RPE. Maintain at least one copy of the design at the jobsite during excavation. Designs must be in writing and include the following:

(a) The magnitudes and configurations of the slopes that were determined to be safe for the excavation.

(b) The identity of the RPE who approved the design, including name and contact information.

j. Support Systems, Shoring, and Shielding. Support systems, including shield systems and other protective systems, must follow one of the following systems: (25-8.j)

(1) Designs using manufacturer’s tabulated data. Implement designs based on manufacturer's tabulated data. Follow all specifications, limitations, and recommendations issued or made by the manufacturer.

(a) Deviation from the specifications, recommendations, and limitations are only allowed after the manufacturer issues specific written approval.

(b) Maintain a written copy of the manufacturer's specifications, recommendations, and limitations, and the manufacturer's approval to deviate from these, if required, at the jobsite during excavation.

(2) Designs using other tabulated data. Select the design from and according to written tabulated data, such as charts and tables approved by an RPE. Maintain at least one copy of the tabulated data at the jobsite during excavation. The tabulated data must include the following:

(a) Identification of the parameters that affect the selection of the 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 correctly selecting a protective system from the data.

(d) The identity of the RPE who approved the data to include name and contact information.

(3) Designed by an RPE. Implement support systems, shoring, or shielding based on designs prepared by an RPE. Maintain at least one copy of the designs at the jobsite during excavation. Designs must be in writing and include the following:

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

(b) The identity of the RPE who designed the support system to include name and contact information.

(4) Materials and Equipment Used for Support Systems.

(a) Materials and equipment must be free from damage or defects that might impair their proper function.

(b) Use and maintain manufactured materials and equipment in a manner consistent with the recommendations of the manufacturer and in a manner that will prevent employee exposure to hazards.

(c) When material or equipment is damaged, a CP must examine the material or equipment and evaluate its suitability for continued use.

(5) Installation and Removal of Support Systems.

(a) Support excavations less than 20 feet (6.1 m) in depth which have vertically lowered portions to a height at least 18 inches (45.7 cm) above the top of the vertical side (see figure 25-3).

(b) Do not excavate to a level more than 2 feet (0.6 m) below the bottom of the members of a support system. Excavation of material to a level of 2 feet (0.6 m) below the bottom of the members of a support system is only permitted 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.

(c) Closely coordinate the installation of support systems with the excavation of the trenches.

(d) Install and remove support systems in manners that protect employees from cave-ins, structural collapses, or from being struck by members of the support system.

(e) Do not subject individual members of a support system to loads exceeding those for which they were designed to withstand.

(f) Securely connect the support system members to prevent sliding, falling, kickouts, or other predicable failure.

(g) Before temporary removal of individual members, take additional precautions to ensure the safety of employees (for example, installing other structural members to carry the loads imposed on the support system).

(h) Begin removal at, and progress from, the bottom of the excavation. Slowly release members to allow notice of any indication of possible failure of the remaining members or possible cave-in of the sides of the excavation. In unstable soil, use ropes to pull out the jacks or braces from above after personnel have cleared the trench.

(i) Backfilling must progress together with the removal of support systems from excavations.

(j) Shield Systems.

(j-1) Install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(j-2) Protect employees from the hazard of cave-ins when entering or exiting the area protected by shields.

(j-3) Do not allow employees inside shields when shields are being installed, removed, or moved.

k. Cofferdams. (25-8.k)

(1) If overtopping of the cofferdams by high water is possible, design must include provisions for controlled flooding of the work area (see para 25-7.h).

(2) If personnel or equipment are required or permitted on cofferdams, provide standard guard railings, or equivalent protection according to chapter 21.

(3) Provide walkways, bridges, or ramps with at least two means of rapid exit for personnel and equipment working on cofferdams. Equip these means of egress with standard guardrails according to chapter 21.

(4) Develop evacuation procedures that includes warning signals for evacuation of personnel and equipment in case of emergency and for controlled flooding (see para 25-7.h). Post the procedures at the jobsite.

(5) Protect cofferdams located close to navigable shipping channels from vessels in transit.

25-9. Figures and Tables.

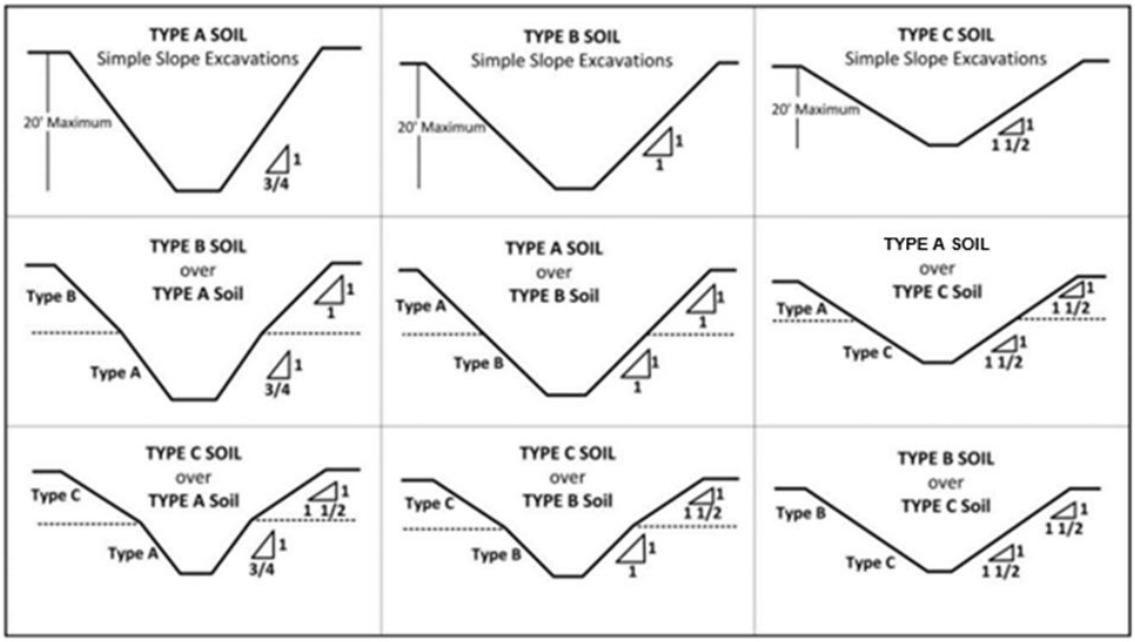


Figure 25-1. Allowable Sloping Configurations for Type A, Type B, and Type C Soils

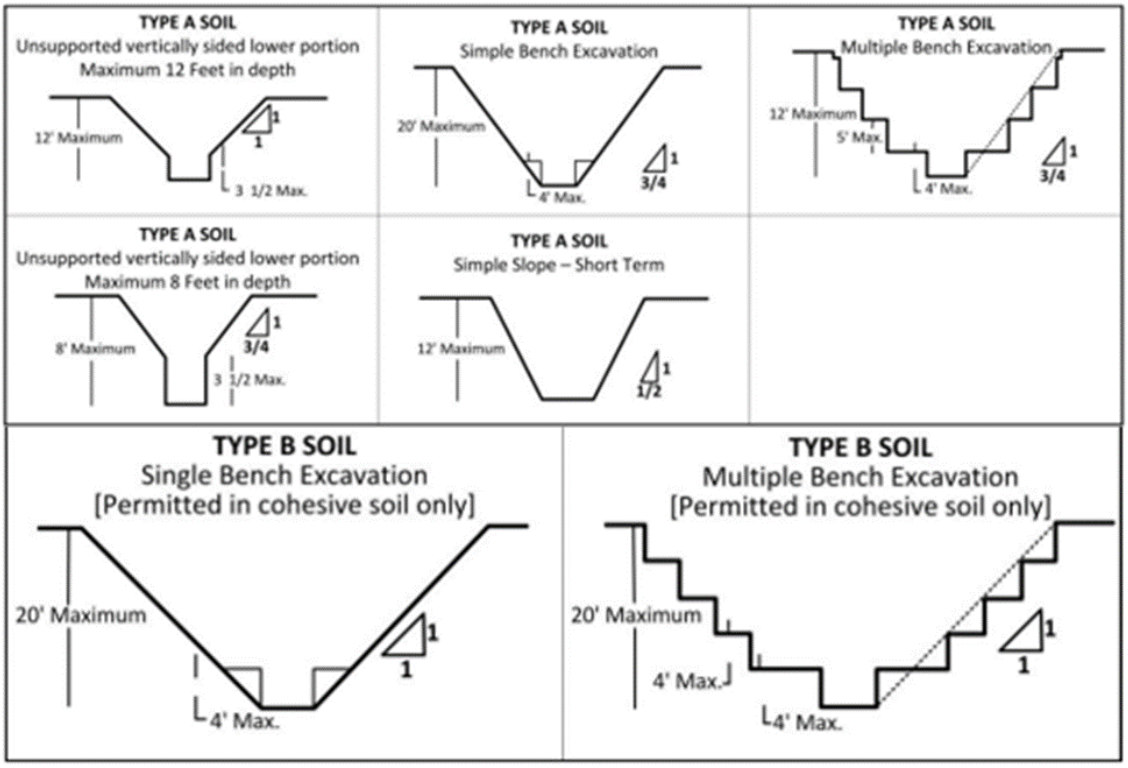
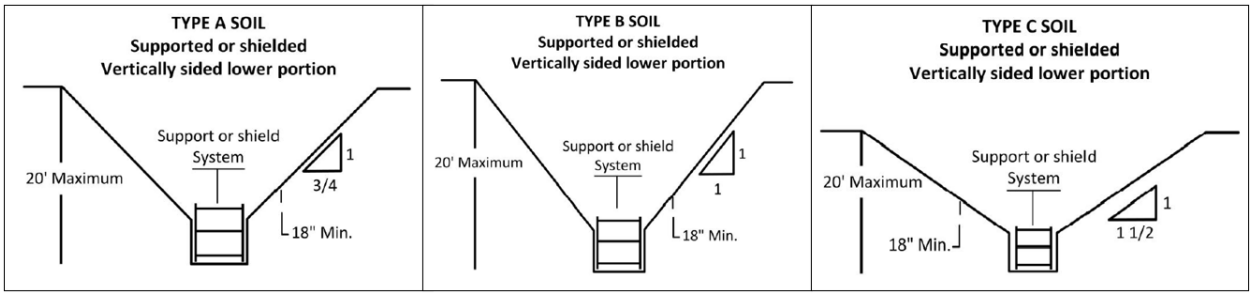


Figure 25-2. Allowable Benching and Sloping for Type A and Type B Soils



Note:
All excavations which have vertically sided lower portions must be shielded or supported to a height at least 18 inches (45.7 cm) above the top of the vertical side.

Figure 25-3. Excavations with Vertically Sided Lower Portions

Table 25-1
Soil classification

Soil Type	Criteria	Other Considerations
Stable Rock	Natural solid mineral that can be excavated with vertical sides and remain intact while exposed.	Not Applicable.
Type A	Cohesive soil with an unconfined compressive strength of 1.5 tons per square foot (tsf) (144 kPa) or greater.	Cannot be Type A if soil is: • Fissured; • Subject to vibration from heavy traffic, pile driving, etc.; • Previously disturbed; • Part of sloped, layered system where layers dip into excavation on a slope of 4H:1V or greater; or • Subject to other factors requiring it to be classified as less stable material.
Type B	Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)	Type B soil can also be: • Granular cohesionless soils such as angular gravel, silt, silt loam, sandy loam, and in some cases, silty clay loam and sandy clay loam; • Previously disturbed soils except those which would otherwise be classed as Type C soil; • Soil that meets the requirements of Type A, but is fissured or subject to vibration; • Dry rock that is not stable; or • Part of sloped, layered system where layers dip into excavation on a slope of 4H:1V, but only if the soil would otherwise be classed as Type A.