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044. SAFETY REQUIREMENTS FOR EXCAVATIONS. (7-1-97)

01. Scope: (7-1-97)

a. Excavations shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. (7-1-97)

b. This section applies to all open excavations made in the earth's surface. Excavations shall include trenches. (7-1-97)
02. Definitions. For other definitions of terms used in this section, see sub-section 010 of this standard. (7-1-97)

a. Accepted Engineering Practices are those requirements which are compatible with standards required by a licensed professional engineer. (7-1-97)

b. Aluminum Hydraulic Shoring is a pre-engineered shoring system comprised of aluminum hydraulic cylinders (cross braces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such a system is designed specifically to support the sidewalls of an excavation and prevent cave-ins. See Figure 044.02-A. (7-1-97)

c. Bell Bottom Pier Hole is a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape. (7-1-97)

d. Benching (Benching System) is 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. (7-1-97)

e. Cave-In is 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. (7-1-97)

f. Cemented Soil is 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. (7-1-97)

g. Cohesive Soil is 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, clay, and organic clay. (7-1-97)

h. Competent Person is 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 action to eliminate them. (7-1-00)

i. Cross Braces are 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. See Figure 044.02-A. (7-1-97)

j. Dry Soil is soil that does not exhibit visible of moisture content. (7-1-97)

k. Excavation is any man made cut, cavity, trench, or depression in the earth's surface, formed by earth removal. (7-1-97)
l. Faces or Sides are the vertical or inclined earth surfaces formed as a result of excavation work. (7-1-97)

m. Failure is the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities. (7-1-97)

n. Fissured is 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. (7-1-97)

o. Granular soil is 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. (7-1-97)

p. Hazardous Atmosphere is 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. (7-1-97)

q. Kick-out is the accidental release or failure of a cross brace. (7-1-97)

r. Layered System is two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered. (7-1-97)

s. Moist Soil is 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. (7-1-97)

t. Plastic is a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change. (7-1-97)

u. Protective System is 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. (7-1-97)

v. Protective Systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection. (7-1-97)

w. Ramp is 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. (7-1-97)

x. Saturated Soil is a soil in which the voids are filled with water. saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane. (7-1-97)
y. Sheeting is the members of a shoring system that retaining the earth in position and in turn are supported by other members of the shoring system. See Figure 044.02-A. (7-1-97)

z. Shield (Shield System) is 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 pre-manufactured or job built. (7-1-97)

aa. Shoring (Shoring System) is 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. (7-1-97)

bb. Sloping (Sloping System) is 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. (7-1-97)

c. Soil Classification System is, for the purpose of this Section, a method of categorizing soil and rock deposits in a hierarchy as follows: 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 characteristics of the deposits and the environmental conditions of exposure. (7-1-97)

d. Stable Rock is natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. (7-1-97)

ee. Structural Ramp is a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps. (7-1-97)

ff. Submerged Soil is soil which is underwater or is free seeping. (7-1-97)

gg. Support System is a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation. (7-1-97)

hh. Tabulated Data is tables and charts approved by a licensed professional engineer and used to design and construct a protective system. (7-1-97)

ii. Trench (Trench Excavation) is 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 fifteen (15) feet or less (measured at the bottom of the excavation), the excavation is also considered to be a trench. (7-1-97)

jj. Unconfined Compressive Strength is 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. (7-1-97)
**kk.** Unstable Rock is considered to be stable when the rock material on the side or sides of the excavation is secured against cave-in or movement by rock bolts or by another protective system that has been designed by a licensed professional engineer. (7-1-97)

**ll.** Uprights are 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. See Figure 044.02-A. (7-1-97)

**mm.** Wales are 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. See Figure 044.02-A. (7-1-97)

**nn.** Wet Soil is soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to floe when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet. (7-1-97)

**FIGURE 044.02-A**

**03. General Requirements:** (7-1-97)

**a.** Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Guardrails shall be provided where walkways are thirty (30) inches or more above lower levels. (7-1-97)

**b.** Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc., shall be backfilled. (7-1-97)

**04. Surface Encumbrances:** (7-1-97)
a. All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees. (7-1-97)

05. Underground Installations: (7-1-97)

a. 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. (7-1-97)

b. 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 request to locate underground utility installations within twenty four (24) hours (unless a longer period is required by 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. (7-1-97)

c. When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means. (7-1-97)

d. While the excavation is open, underground installation shall be protected, supported or removed as necessary to safeguard employees. (7-1-97)

06. Access and Egress: (7-1-97)

a. 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. (7-1-97)

b. Ramps and runways constructed of two (2) or more structural members shall have the structural members connected together to prevent displacement. (7-1-97)

c. Structural members used for ramps and runways shall be of uniform thickness. (7-1-97)

d. 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. (7-1-97)

e. Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments to the top surface to prevent slipping. (7-1-97)

f. A stairway, ladder, ramp, or other safe means of egress shall be located in trench excavations that are four (4) feet or more in depth so as to require no more than twenty five (25) feet of lateral travel for employees. (7-1-97)
07. Exposure to Vehicular Traffic: (7-1-97)

a. 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. (7-1-97)

08. Exposure to Falling Loads: (7-1-97)

a. 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 to provide adequate protection for the operator during loading and unloading operations. (7-1-97)

09. Warning System for Mobile Equipment: (7-1-97)

a. 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. (7-1-97)

10. Hazardous Atmospheres: (7-1-97)

a. The atmosphere of the excavation shall be tested to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions. (7-1-97)

b. Where oxygen deficiency (atmospheres containing less than nineteen point five (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 excavation greater than four (4) feet in depth. (7-1-97)

c. Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than nineteen point five (19.5) percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation. (7-1-97)

d. Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in access of twenty (20) percent of the lower flammable limit of the gas. (7-1-97)

e. 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. (7-1-97)

11. Emergency Rescue Equipment: (7-1-97)
a. 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. (7-1-97)

b. 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 attached at all times while the employee(s) wearing lifeline is in the excavation. (7-1-97)

12. Protection from Hazards Associated with Water Accumulation: (7-1-97)

a. 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. (7-1-97)

b. 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. (7-1-97)

c. 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 sub-section 044.12 a. & b. of this standard. (7-1-97)

13. Stability of Adjacent Structures: (7-1-97)

a. 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. (7-1-97)

b. 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 ensuring the safety of employees and the stability of the structure; or the excavation is in stable rock; or a licensed 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 licensed professional engineer has approved the determination that such excavation work will not pose a hazard to employees. (7-1-97)

c. Sidewalks, pavements, and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from possible collapse of such structures. (7-1-97)
14. Protecting Employees from Loose Rock or Soil: (7-1-97)

a. 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. (7-1-97)

b. 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 two (2) feet 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. (7-1-97)

c. Employees on excavations four (4) feet or deeper shall wear head protection. (7-1-97)

15. Inspections: (7-1-97)

a. 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. (7-1-97)

b. 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. (7-1-97)

16. Protection of Employees in Excavations: (7-1-97)

a. Each employee in an excavation shall be protected from cave ins by an adequate protective system designed in accordance with sub-sections 044.17. and 044.18 of this standard except when: excavations are made entirely in stable rock; or excavations are less than five (5) feet in depth and examination of the ground by a competent person provides no indication of a potential cave-in. (7-1-97)

b. 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. (7-1-97)

17. Design of Sloping and Benching Systems: (7-1-97)
a. Employees shall not be permitted to work on 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. (7-1-97)

b. The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or designee and shall be in accordance with the requirements of one of the following alternatives. (7-1-97)

c. Option One (1) - Excavations shall be sloped at an angle not steeper than one and one-half (1 1/2) horizontal to one (1) vertical (thirty four (34) degrees measured from the horizontal), unless the employer uses one of the other options listed below. This sloping shall be excavated to form configurations that are in accordance with slopes shown for type C soil in Figure 044.17-A. (7-1-97)

**FIGURE 044.17-A**

![Figure 044.17-A showing sloping and benching configurations]

- **Sloping**
  - Stable Rock
    - 90 degrees
  - Type B
    - 45 degrees
  - Type A
    - 53 degrees
  - Type C
    - 34 degrees

- **Benching**

**d.** Option Two (2) - Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with conditions and requirements of subsection 044.22. of this section and 29CFR1926 Subpart P Appendix B, Sloping and Breaching. (7-1-97)

e. Option Three (3) - Designs of sloping or benching systems shall be selected from and 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 parameters that affect the selection of a sloping or benching system drawn from such data; identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe; and explanatory information as may be necessary to aid the user in making a correct selection of a...
protective system from the data. At least one (1) copy of the tabulated data which identifies the licensed professional engineer who approved the data, shall be maintained at the job site baring construction of the protective system. After that time the data may be stored off the job site, but a copy of the data shall be made available to representatives of the Department upon request. (7-1-97)

f. Option Four (4) - Sloping and benching systems not utilizing options one (1), two (2), or three (3) shall be approved by a licensed professional engineer. (7-1-97)

g. Designs shall be in written form and shall include at least the following: the magnitude of the slopes that were determined to be safe for the particular project; the configurations that were determined to be safe for the particular project; and the identity of the registered licensed engineer approving the design. (7-1-97)

h. At least one (1) copy of the design shall be maintained at the job site while the slope is being constructed. After that time the design need not be at the job site, but a copy shall be made available to Department representatives upon request. (7-1-97)

18. Design of Support Systems: (7-1-97)

a. Designs of support systems, shield systems, and other protective systems shall be selected and constructed by the employer or designee and shall be in accordance with the requirements of this subsection. (7-1-97)

b. Option One (1) - Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in sub-section 044.22 of this standard and 29CFR1926 Subpart P Appendix C, Timber Shoring for Trenches. Designs for aluminum hydraulic shoring in trenches shall be determined in accordance with the conditions and requirements set forth in sub-standard 044.22 of this standard and 29CFR1926 Subpart P Appendix D, Aluminum Hydraulic Shoring for Trenches. (7-1-97)

c. Option Two (2) - Designs 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. Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval. 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 job site during construction of the protective system. After that time this data may be stored off the job site, but a copy shall be made available to representatives of the Department upon request. (7-1-97)

d. Option Three (3) - 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. The tabulated data shall be in written form and shall include all the following: identification of the parameters that affect the selection of a protective system drawn from such data; identification of the limits of use of the data; explanatory information as may be necessary to aid the user in
making a correct selection of a protective system from the data. At least one (1) copy of the
tabulated data, which identifies the licensed professional engineer who approved the data, shall
be maintained at the job site during construction of the protective system. after that time the data
may be stored off the job site, but a copy of the data shall be made available to representatives of
the Department upon request. (7-1-97)

e. Option Four (4) - Sloping and benching systems not utilizing options one (1), two (2), or three
(3) shall be approved by a licensed professional engineer. Designs shall be in written form and
shall include the following: a plan indicating the size, types, and configurations of the materials
to be used in the protective system; and the identity of the licensed registered professional
engineer approving the design. At least one (1) copy of the design shall be maintained at the job
site during construction of the protective system. After that time, the design may be stored off the
job site, but a copy of the design shall be made available to representatives of the Department
upon request. (7-1-97)

19. Materials and Equipment: (7-1-97)

a. Materials and equipment used for protective systems shall be free from damage or defects that
might impair their proper function. (7-1-97)

b. 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. (7-1-97)

c. 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 licensed professional engineer before
being returned to service. (7-1-97)

20. Installation and Removal of Support: (7-1-97)

a. Members of support systems shall be securely connected together to prevent sliding, falling,
kick-outs, or other predictable failure. (7-1-97)

b. 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. (7-1-97)

c. 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. (7-1-97)

d. 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. (7-1-97)
e. Backfilling shall progress with the removal of support systems from excavations. (7-1-97)

f. Excavation of material to a level no greater than two (2) feet 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. (7-1-97)

g. Installation of a support system shall be closely coordinated with the excavation of trenches. (7-1-97)

21. **Shield Systems**: (7-1-97)

a. Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand. (7-1-97)

b. 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. (7-1-97)

c. Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields. (7-1-97)

d. Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically. (7-1-97)

e. Shields shall project at least eighteen (18) inches above the lowest point where the excavation face begins to slope. See Figure 044.21-A. (7-1-97)

**FIGURE 044.21-A**
Excavations of earth material to a level not greater than two (2) feet 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 where there are no indications while the trench is open of a possible
loss of soil from behind or below the bottom of the shield. (7-1-97)

22. Soil Classification: (7-1-97)

a. This subsection 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. (7-1-97)

b. Each soil and rock deposits shall be classified by a competent person as Stable Rock, Type A,
Type B, or Type C in accordance with the requirements of sub-section 044.22.c., 044.22.d., and
044.22.e. of this standard. (7-1-97)

c. Type A soils are cohesive soils with an unconfined, compressive strength of one point five
(1.5) tons per square foot 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
caleche and hard pan are also considered Type A soil. However, no soil is type A if: the soil is
fissured; or the soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
the soil has been previously disturbed; or the soil is part of a sloped, layered system where the
layers dip into the excavation on a slope of four (4) horizontal to one (1) vertical or greater; or
the material is subject to other factors that would require it to be classified as less stable material.
See Figure 044.22-A. (7-1-97)

d. Type B soils are cohesive soils with an unconfined, compressive strength greater than point
five (0.5) tons per square foot but less than one point five (1.5) tons per square foot or 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. Type B soils shall also include
previously disturbed soils (except those which would otherwise be classified as Type C soil); soil
that meets the unconfined compressive strength or cementation requirements for Type A, but is
fissured or subject to vibration; dry rock that is not stable; or material that is part of a slope,
layered system where the layers dip into the excavation on a slope less steep than four (4)
horizontal to one (1) vertical, but only if the material would otherwise be classified as Type B.
See Figure 044.22-A. (7-1-97)

e. Type C soils are cohesive soils with an unconfined, compressive strength of point five (0.5)
tons per square foot or less; or granular soils including gravel, sand, and loamy sand; or
submerged soil or soil from which water is freely seeping; submerged rock that is not stable; or
material in a sloped, layered system where the layers dip into the excavation or a slope of four
(4) horizontal to (1) vertical or steeper. See Figure 044.22-A. (7-1-97)

FIGURE 044.22-A
f. The classification of the deposits shall be made based on the results of at least one (1) visual and at least one (1) manual analysis. Such analyses shall be conducted by a competent person using tests described in sub-section 044.22.k. and 044.22.m. of this standard, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system. (7-1-97)

g. The visual and manual analyses, such as those as being acceptable in sub-section 044.22.f. of this standard, 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. (7-1-97)

h. 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. (7-1-97)
i. 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. (7-1-97)

j. 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. (7-1-97)

k. The following observations and determinations shall be made: observe samples of soil that are excavated and soil in the sides of the excavation and estimate the range of particle sizes and relative amounts of the particle sizes, (Soil that is primarily composed of fine grained material is cohesive material and soil composed primarily of coarse grained sand or gravel is granular material.); observe soil as it is excavated, soil that remains in clumps is cohesive, (Soil that breaks up easily and does not stay in clumps is granular material.); observe the side of the opened excavation and the surface area adjacent to the excavation for crack like openings such as tension cracks that 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.); 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; observe the open 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.); 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; and 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. (7-1-97)

l. 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. (7-1-97)

m. The following tests and determinations shall be made: plasticity test - mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as one-eighth (1/8) inch in diameter, (Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two (2) inch length of one-eighth (1/8) inch thread can be held on one end without tearing, the soil is cohesive.); dry strength test - 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.); thumb penetration test - can be used to estimate the unconfined compressive strength of cohesive soils, (This test is based on the thumb penetration test on ASTM D2488.) (Type A soils can be penetrated by the thumb only with very great effort. Type C soils can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test shall 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 such as rain or flooding, the classification of the soil must be changed accordingly.); 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; drying test - is to differentiate between cohesive material with fissures, unfissured cohesive material, (The procedure for the drying test involves drying a sample of soil that is approximately one (1) inch thick and six (6) inches in diameter until it is thoroughly dry; if the sample develops cracks as it dries, significant fissures are indicated; samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material and the unconfined compressive strength shall be determined. If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two (2), 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. (7-1-97)

045-049. (RESERVED)