

# CITY OF LINCOLN

## EXCAVATION SAFETY POLICY

### PURPOSE:

The purpose of this policy is to prevent personal injury and illness to City of Lincoln employees and contractors, while performing excavation duties as per 29 CFR 1926.650 to 1926.652, the Occupational Safety and Health Administration's (OSHA) Excavation and Trenching Standard.

### OBJECTIVES:

The objectives of this policy are to establish a written program outlining general guidelines governing excavations and trenches.

This written program will address the following:

1. Definitions
2. Hazards
3. Pre-Planning
4. Soil Classification
5. Testing of Soil
6. Protective Support Systems
7. Backfilling
8. Excavating Near Utilities
9. Emergencies, Rescue Policy

### RESPONSIBILITY:

#### Department Heads Have the Responsibility to:

- I. Implement this excavation policy by:
  - A. Directing all supervisors to assess the hazards of each excavation and to identify the employees this may affect.
  - B. Providing all employees with information, training, and the equipment they need to protect themselves and others from excavation hazards.
  - C. Ensuring that all necessary equipment is available to comply with this policy.
- II. Enforce compliance with this policy. All appropriate employees, presently employed and all new employees, must be trained and responsible for the purpose and the use of this excavation safety policy.

**Supervisors Have the Responsibility to:**

- I. Identify and assess the hazards of each excavation area.
- II. Ensure that all employees receive the appropriate training and equipment they need to protect themselves and others.
- III. Enforce compliance with this policy.

**Employees Have the Responsibility to:**

- I. Understand their assigned tasks relating to excavation safety.
- II. Apply the proper training and equipment to safely work in excavations and trenches.
- III. Assist with the assessment and the identification of excavation hazards.
- IV. Comply with the directives of this policy.

**Fire Has the Responsibility to:**

- I. Rescue all employees who are trapped in an excavation or trench due to cave-ins or other hazardous situations (falls and equipment, water accumulation, hazardous atmospheres) within the City of Lincoln. Outside the City of Lincoln, the local fire department will act as the authorized rescue agency, unless a specifically trained rescue team is identified as a necessity.
- II. Assist any department, upon request, with the identification of hazardous chemicals that may be found in an excavated area or trench.

**Risk Management Has the Responsibility to:**

- I. Train appropriate supervisors and assist in the training of employees in the City's excavation safety policy.
- II. Audit and evaluate each department's compliance with this policy on an annual basis. The effectiveness of the policy shall be evaluated annually and corrective action taken to eliminate defects found in the policy.
- III. Provide Competent Person training.

**1. Definitions**

An excavation is any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal. Excavations produce unsupported soil conditions.

A trench is a narrow excavation made below the surface of the ground in which the depth is greater than the width. The width does not exceed 15 feet.

A sloping system means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins

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

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

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

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

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

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

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

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a “registered professional engineer” with the meaning of this standard when approving designs for “manufactured protective systems” or “tabulated data” to be used in interstate commerce.

## 2. Hazards

The most common hazards that should be recognized and associated with work in excavations can be categorized as follows:

- A. Cave-ins -- Cave-ins are the most common excavation hazard. They occur when a mass of soil or rock material separates from the side of an excavation or when soil is lost from under a trench shield or support system. The mass of soil or rock material then moves suddenly into the excavation either by falling or sliding. Cave-ins can entrap, bury, or otherwise injure and immobilize a worker. Protective Support Systems such as sloping, benching, shielding, and shoring should be used to protect workers from cave-ins.
- B. Falls -- Use warning systems such as mobile equipment, barricades, hand or mechanical signals, or stop logs to alert operators of the edge of an excavation. Don't let employees work on faces of sloped or benched excavations at levels above other employees unless the employees at lower levels are adequately protected.
- C. Equipment Accidents -- Keep all equipment that might fall into an excavation at least 2 feet from the edge of the excavation. Also, keep excavated soil at least 2 feet from the edge of the excavation.
- D. Water Accumulation -- Employees are not to work in excavation areas where water has accumulated unless water removal equipment is being used. Diversion ditches, dikes, or other means should be used to prevent surface water from entering an excavation and to provide drainage.
- E. Hazardous Atmospheres -- Any excavation deeper than four feet or where an oxygen deficiency or a hazardous atmosphere exists or could exist needs to be checked by a competent person. If hazardous conditions exist, respirators must be worn or ventilation must be provided and the atmosphere need to be monitored.
- F. Access and Egress -- **If an excavation is deeper than four feet**, adequate means of exit, such as ladders, steps, ramps or other safe means of egress must be provided and be within 25 feet of the worker. They must extend three feet above the ground.

## 3. Pre-planning:

- A. An excavation Competent person shall be on site at each excavation
- B. Before beginning any excavation, identify and evaluate specific job hazards. These can include traffic, nearness of structures and their conditions, soil, surface and ground water, the water table, overhead and underground utilities, and weather.
- C. Call the Digger's hotline 48 hours before digging (1-800-331-5666) for the exact location of all utilities including: electric, gas, telephone, sewer, water, and cable television lines.

- D. Pick the correct type of personal protective equipment for the job. If you are to be working near vehicular traffic, wear a warning vest or other suitable garments marked with or made of reflectorized or high-visibility material. Also wear hard hats, goggles, adequate foot wear, and respirators as necessary.

#### **4. Soil Classification:**

Every soil and rock deposit needs to be classified by a competent person as stable rock, type A, type B, or type C before excavation can begin. In a layered system, the system is classified according to its weakest layer. Any time the properties, factors, or conditions affecting the soil type change in any way, the area needs to be reevaluated and reclassified to reflect the changed circumstances.

1. Stable rock is natural solid mineral matter.
2. Type A soil is cohesive soil with an unconfined, compressive strength of 1.5 tons per square foot or greater. Examples of Type A soils are: clay, silty clay, sandy clay, clay loam, caliche, hardpan and, in some cases, silty loam and sandy clay loam. No soil is Type A if:
  - a. The soil is fissured.
  - b. The soil is subject to vibration from heavy traffic, pile driving, or similar effects.
  - c. The soil has been previously disturbed.
  - d. The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical or greater.
  - e. The material is subject to other factors that would require it to be classified as a less stable material.
3. Type B soil is:
  - a. Cohesive soil with an unconfined compressive strength greater than 0.5 tons per square foot, but less than 1.5 tons per square foot.
  - b. Granular cohesionless soil including: angular gravel, silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.
  - c. Previously disturbed soil except that which would otherwise be classed as Type C soil.
  - d. Soil that meets the unconfined compressible strength or cementation requirements for Type A, but is fissured or subject to vibration.
  - e. Dry rock that is not stable.

- f. Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical, but only if the material would otherwise be classified as Type B.

4. Type C soil is:

- a. Cohesive soil with an unconfined compressive strength of 0.5 tons per square foot or less.
- b. Granular soil including gravel sand and loamy sand.
- c. Submerged soil or soil from which water is freely seeping.
- d. Submerged rock that is not stable.
- e. Material in a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical or steeper.

**5. Testing of Soil:**

Classification tests of soil shall be performed by a competent person using at least one visual test and one manual test.

- A. Visual tests provide qualitative information on 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 the excavated material. To perform a visual test:
  - 1. Observe samples of soil and estimate the range of particle sizes and their relative amounts. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.
  - 2. Observe soil as it is excavated. Soil that remains in clumps is cohesive and soil that breaks up easily is granular.
  - 3. Observe the side of the opened excavation and the adjacent surface. Crack-like openings, tension cracks, and chunks of soil that spall off a vertical side could indicate fissured material. Small spalls are evidence of moving ground and are potentially hazardous.
  - 4. Observe the surrounding area and the excavation area itself for existing utility and other underground structures, and to identify previously disturbed soil.
  - 5. Observe the sides of the excavation for layered systems.
  - 6. Observe the excavation area for evidence of surface water, water seeping from the sides of the excavation, or the level of the water table.

7. Observe the excavation area for sources of vibration that may affect the stability of the excavation face.
- B. Manual tests provide quantitative as well as qualitative properties of soil. They provide more information in order to classify the soil properly. Some examples of manual tests include:
1. Plasticity
  2. Dry strength
  3. Thumb penetration
  4. Other strength tests: pocket penetrometer, hand-operated sheervane
  5. Drying test

## 6. Protective Support Systems:

The excavation competent person shall determine the type of protection required from 29 CFR 1926.650 to 29 CFR 1926.652 subpart P

Appendix A (Soil Classification) summarized on pages 5,6 & 7

Appendix C (Timber Shoring for Trenches)

Plywood used in shoring shall be 1.125 (1 1/8) in. thick softwood or 0.75 (3/4) inch. thick 14 ply arctic white birch (finland form). Please note that plywood is not intended as structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

Appendix D (Aluminum Hydraulic Shoring for Trenches)

Appendix E (Alternatives to Timber Shoring)

Appendix F (Selection of Protective Systems)

The Trench Protective system for trenches 20 or more feet in depth must be designed and approved by a Registered Professional Engineer.

The designs should include the sizes, types and configuration of materials to be used and the engineer's identity. A copy of the design should be kept at the jobsite.

**Protective support systems are required to protect City of Lincoln employees from cave-ins while working in any excavation unless:**

1. The excavation is made entirely in stable rock, or
2. The excavation is less than 5 feet deep and a competent person has examined the ground and found no indication of a potential cave-in. When soil conditions are unstable, excavations less than 5 feet deep must also be protected from cave-ins.

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.

#### A. Sloping and Benching Systems

1. A sloping system means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins.
2. 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. Use charts and tables to determine the angle of incline.
3. The maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V). This varies according to the soil type which can be classified by a competent person. See Table 2 for the maximum allowable slopes.
4. The actual slope shall never be steeper than the maximum allowable slope. When there are signs of distress, the slope shall be cut back to an actual slope which is at least  $\frac{1}{2}$  horizontal to one vertical (1/2H:1V) less steep than the maximum allowable slope.
5. A benching system means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.
6. The length of the vertical sides of a benching system and the maximum allowable slope 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. Use charts and tables to determine the length of the sides and the maximum allowable slope.
7. It is always better to over-compensate and make the angle flatter.

#### B. Shielding Systems

1. A shield system means a pre-constructed structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields used in trenches are usually referred to as trench boxes or trench shields.
2. Shields can be permanent structures or can be designed to be portable and moved along as work progresses.
3. Shielding must extend above the ground level or the trench walls above the top of the box must be sloped.

### C. Shoring Systems

1. A shoring system means a structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.
2. Shoring systems shall be installed from the top down and removed from the bottom up. Unless they are installed and removed from outside the trench.

### 7. Backfilling:

Use machines to fill the excavated area as soon as you are done working in that area. Backfill materials shall not be pushed or dumped into an excavation while an employee is still in it. At the completion of a backfill operation, excess fill and other debris should be completely cleaned up, especially on paved roads.

### 8. Excavating Near Utilities:

When excavating near utility lines, always follow all excavation safety rules, as well as, these special situation rules.

- A. If you are digging within eighteen inches of a utility line, ask the utility company to expose and protect the line.
- B. A Material Safety Data Sheet (MSDS) should be obtained for all chemicals that may be contained in pipelines and vessels. The warnings on the MSDS should be followed.
- C. Mechanical digging is not allowed near the utility lines.
- D. Power tools and mechanical equipment such as concrete breakers, drills, and backhoes should be effectively grounded with a 2/0 ground lead.
- E. Be careful not to drop large rocks, roots, or clumps of soil directly on to the exposed utility line while backfilling.
- F. When utilities are exposed in a trench and are unsupported, supports shall be installed as needed to prevent damage or creating a hazardous situation.

## **9. Emergencies:**

If you are about to be buried in a cave-in:

1. Yell to get attention.
2. Cover your face with your arms.
3. Do not struggle to free yourself, just wait calmly for rescue.

If you are watching someone be buried in a cave-in:

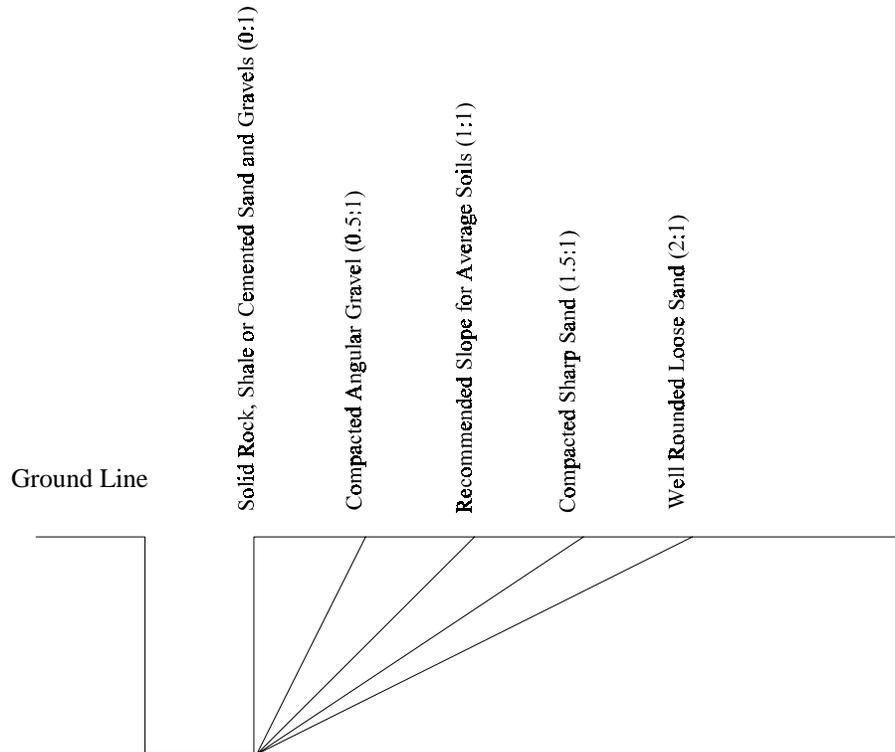
1. Do not attempt to rescue them yourself. Never enter the excavation.
2. Notify the Fire Department by calling 911 on your radio or phone. Give the emergency personal information about the exact location of the accident, the number of victims involved, the trench measurements, and special hazard information.
3. Shut down all heavy equipment and move other workers away from the area.
4. Monitor the situation until LFD rescue personnel arrive.

**Questions concerning this policy will be addressed by:**

**Risk Management Division  
Department of Personnel  
555 South 10th Street  
Lincoln, NE 68508  
441-7671**

**TABLE 2**  
**APPROXIMATE ANGLE OF REPOSE**  
**For Sloping of Sides of Excavations<sup>1</sup>**

Note: Clays, silts, loams or non-homogeneous soils require shoring and bracing.  
 The presence of ground water requires special treatment.



Maximum Allowable Slopes for Excavations	
Soil or Rock Type	Maximum Allowable Slopes (H:V) <sup>2</sup>
Stable Rock	Vertical (90°)
Type A <sup>3</sup>	3/4:1 (53°)
Type B	1:1 (45°)
Type C	1 1/2:1 (34°)

Notes:

<sup>1</sup> Sloping or benching for excavations greater than 20-feet deep shall be designed by a registered professional engineer.

<sup>2</sup> Numbers in parentheses are angles expressed in degrees from the horizontal. Angles have been rounded off.

<sup>3</sup> A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12-feet or less in depth. Short-term maximum allowable slopes for excavations greater than 12-feet in depth shall be 3/4H:1V (53°)