Purpose

This program outlines procedures and guidelines for the protection of employees working in and around trenches and excavations. This program requires compliance with OSHA Standards described in 29CFR 1926.650, 651 and 652.

Compliance is mandatory to ensure employee protection when working in or around excavations. The program in this manual on confined space, hazard communication, lockout/tagout, respiratory protection, and any other safety programs or procedures deemed essential for employee protection, are to be used in conjunction with this program.

Introduction

It is the Town of Collierville's policy that the first consideration of work shall be the protection of the safety and health of all employees. We have developed this trenching and excavation safety program to ensure that all employees are properly trained on trenching and excavation operations.

Definitions

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

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

Competent Person: One who has been trained to identify existing and predictable hazards in the workplace, or working conditions that are unsafe for workers, and who has the authority to have these hazards corrected, stopping the work if necessary. The Designated Supervisor of an excavation is chosen by the department and serves as the Competent Person for the purposes of this program.

Duration of Exposure: The longer an excavation is open, the longer the other factors have to work on causing it to collapse.

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

Fissured: 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.

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

Protective System: A method of protecting workers from cave-ins, from material that could fall or roll

from an excavation face into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems and other systems that provide the necessary protection.

Soil Types:

Type A: Most stable: clay, silty clay, and hardpan. No soil is Type A if is fissured, is subject to vibration, has previously been disturbed or has seeping water.

Type B: Medium stability: silt, sandy loam, medium clay, and unstable dry rock. Previously disturbed soils, except those that would be classified as Type C. Soil that meets Type A soil but is fissured or subject to vibration.

Type C: Least stable: gravel, sand, loamy sand, soft clay, submerged soil or dense unstable rock, or soil from which water is freely seeping.

Shield (Shield System): A structure that is capable of withstanding the forces imposed on it by a cave-in and thereby protects the employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses.

Shoring (Shoring System): A structure that is build or put in place to support the sides of an excavation and designed to prevent cave-ins.

Sloping (Sloping System): Sloping the sides of the excavation away from the excavation to protect employees from cave-ins. The required slope or angle of incline vary with soil type, weather and surface near surface loads that may affect the soil in the area of the trench (Such as adjacent building, vehicles near the edge of a trench).

Surcharge Loads: Generated by the weight of anything in proximity to the excavation, push starts for a cave-in (anything up top pushing down).

- Weight of spoil pile
- Weight of nearby buildings, poles, pavement, or other structural objects.
- Weight of material and equipment.

Trench: A narrow excavation below the surface of the ground, less than 15ft wide, with a depth no greater than the width.

Undermining: Undermining can be caused by such things as leaking, leaching, caving, or over-digging. Underminded walls can be very dangerous.

Vibration: A force that is present on construction sites and must be considered. The vibrations caused by backhoes, dump trucks, compactors, and traffic on job sites can be substantial.

Hazards

The Town of Collierville requires a competent person on-site during excavation and trenching due to the numerous potential hazards that may be encountered or created. Hazards include:

- Electrocution
- Gas Explosion
- Entrapment
- Struck by Equipment
- Suffocation

Hazard Controls

Before any work is performed and before any employees enter the excavation, a number of items must be check and insured:

- Before any excavation, underground installations must be determined. This can be accomplished by either contacting the local utility companies or the local "one-call" center for the area. All underground utility locations must be documented on the proper forms. All overhead hazards (surface encumbrances) that create a hazard to employees must be removed or supported to eliminate the hazard.
- If the excavation is to be over 20 feet deep, it must be designed by a registered professional engineer who is registered in the state where work will be performed.
- Adequate protective systems will be utilized to protect employees. This can be accomplished through sloping, shoring, or shielding.
- The worksite must be analyzed to design adequate protection systems and prevent cave-ins.
- Workers must be supplied with and wear any personal protective equipment deemed necessary to assure their protection.
- All spoil piles will be stored a minimum of four (4) feet from the sides of the excavation. The spoil pile must not block the safe means of egress.
- If a trench or excavation is 4 ft or deeper, stairways, ramps, or ladders will be used as a safe means of access and egress. For trenches, the employee must not have to travel any more than 25 feet of lateral travel to reach the stairway, ramp, or ladder.
- No employees will work in an excavation where water is accumulating.
- A competent person will inspect all excavations and trenches daily, prior to employee exposure or entry, and after any rainfall, soil change, or any other time needed during the shift. The competent person must take prompt measures to eliminate any and all hazards.
- Excavations and trenches 4 feet or deeper that have the potential for toxic substances or hazardous atmospheres will be tested at least daily. If the atmosphere is inadequate, protective systems will

be utilized.
- If work is in or around traffic, employees must be supplied with and wear reflective vests. Signs and barricades must be utilized to ensure the safety of employees, vehicular traffic, and pedestrians.

Competent Person Responsibilities

The OSHA Standards require that the competent person must be capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and have authorization to take prompt corrective measures to eliminate them and, if necessary, to stop the work.

A competent person is required to:

- Have a complete understanding of the applicable safety standards and any other data provided.
- Assure the proper locations of underground installations or utilities, and that the proper utility companies have been contacted.
- Conduct soil classification tests and reclassify soil after any condition changes.
- Determine adequate protective systems (sloping, shoring, or shielding systems) for employee's protection.
- Conduct all air monitoring for potential hazardous atmospheres.
- Conduct daily inspections of excavation and trenches.
- Approve design of structural ramps, if used.

Trenching and Excavation Safety Plan

A trenching and excavation safety plan is required in written form. This plan is to be developed to the level necessary to ensure complete compliance with the OSHA Excavation Safety Standard.

Excavation safety plan factors:

- Utilization of the local one-call system.
- Determination of locations of all underground utilities.
- Consideration of confined space atmosphere potential.
- Proper soil protection systems and personal protective equipment and clothing.
- Determination of soil composition and classification.
- Determination of surface and subsurface water.
- Depth of excavation and length of time it will remain open.
- Proper adherence to all OSHA Standards, this trenching and excavation safety program, and any other coinciding safety programs.

Soil Classification and Identification

The OSHA Standards define soil classifications within the Simplified Soil Classification Systems, which consists of four categories: Stable rock, Type A, Type B, and Type C. Stability is greatest in stable rock and decreases through Type A and Type B to Type C, which is the least stable. Appendix A of the 1926 Subpart P Standard provides soil mechanics terms and types of field tests used to determine soil

classifications.

Stable rock is defined as natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Type A soil is defined as:

- Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (TSF) or greater.
- Cemented soils like caliche and hardpan are considered Type A.

Soil is NOT Type A if:

- It is fissured.
- The soil is subject to vibration from heavy traffic, pile driving or similar effects.
- The soil has been previously disturbed.
- The material is subject to other factors that would require it to be classified as a less stable material.
- The exclusions for Type A most generally eliminate it from most construction situations.

Type B soil is defined as:

- Cohesive soil with an unconfined compressive strength greater than .5 TSF, but less than 1.5 TSF.
- Granular cohesionless soil including angular gravel, silt, silt loam, and sandy loam.
- Soil that meets the unconfined compressive strength requirements of Type A soil, but is fissured or subject to vibration
- Dry rock that is unstable.

Type C soil is defined as:

- Cohesive soil with an unconfined compressive strength of .5 TSF or less.
- Granular soils including gravel, sand, and loamy sand.
- Submerged soil or soil from which water is freely seeping.
- Submerged rock that is not stable.

Soil Test and Identification

The competent person will classify the soil type on the basis of at least one visual and one manual analysis. These tests should be run on freshly excavated samples from the excavation and are designed to determine the stability based on a number of criteria: the cohesiveness, the presence of fissures, the presence of the amount of water, the unconfined compressive strength, the duration of exposure, undermining, and the presence of layering, prior excavation, and vibration.

The cohesion tests are based on methods to determine the presence of clay. Clay, silt, and sand are size classifications, with clay being the smallest sized particles, silt intermediate, and sand the largest. Clay minerals exhibit good cohesion and plasticity (can be molded). Sand exhibits no elasticity and virtually no cohesion unless surface wetting is present. The degree of cohesiveness and plasticity depend on the amounts of all three types and water.

When examining the soil, three questions must be asked: Is the sample granular or cohesive? Fissured or non-fissured? What is the unconfined compressive strength measured in TSF?

Methods of testing soils:

- Visual test: If the excavated soil is in clumps, it is cohesive. If it breaks up easily, not staying in clumps, it is granular.
- Wet manual test: Wet your fingers and work the soil between them. Clay is a slick paste when wet, meaning it is cohesive. If the clump falls apart in grains, it is granular.
- Dry strength test: Try to crumble the sample in your hands with your fingers. If it crumbles into grains, it is granular. Clay will not crumble into grains, only into smaller chunks.
- Pocket penetrometer test: This instrument is most accurate when soil is nearly saturated. This instrument will give unconfined compressive strength in tons per square foot. The spring-operated device uses a piston that is pushed into a coil up to a calibration groove. An indicator sleeve marks and retains the reading until it is read. The reading is calibrated in tons per square foot (TSF) or kilograms per cubic centimeter.
- Thumb penetration test: The competent person attempts to penetrate a fresh sample with thumb pressure. If the sample can be dented, but penetrated only with great effort, it is Type A. Type B can be penetrated with effort and molded. If it can be penetrated several inches and molded by light pressure, it is Type C.

The competent person will perform several tests of the excavation to obtain consistent, supporting data along its depth and length. The soil is subject to change several times within the scope of an excavation and the moisture content will vary with weather and job conditions. The competent person must also determine the level of protection based on what conditions exist at the time of the test and allow for changing conditions.

Excavation Protection Systems

The three basic protective systems for excavations and trenches are sloping and benching systems, shoring, and shields.

The protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied to or transmitted to the system. Every employee in an excavation shall be protected from cave-ins by an adequate protective system.

Exceptions to using protective systems:

- Excavations made entirely of stable rock
- Excavations are less than 5 feet deep and declared safe by a competent person

Sloping and Benching Systems

There are four options for sloping:

1. Slope to the angle required by the Standard for Type C, which is the most unstable soil type.
2. The table below provided in Appendix B of the Standard may be used to determine the maximum allowable angle (after determining soil type).

Soil or Rock Type	Height/Depth Ratio	Slope Angle
Stable Rock	Vertical	90°
Type A	¾:1	53°
Type B	1:1	45°
Type C	1 ½ : 1	34°

3. Tabulated data prepared by a registered professional engineer can be utilized.
4. A registered professional engineer can design a sloping plan for a specific job.

Sloping and benching systems for five (5) to twenty (20) feet in depth must be constructed under the instruction of a designated competent person.

Sloping and benching systems for excavations greater than twenty (20) feet must be designed and stamped by a registered professional engineer.

Sloping and benching specifications can be found in Appendix B of the OSHA Standard (Subpart P).

Shoring Systems

Shoring is another protective system or support system. Shoring utilizes a framework of vertical members (uprights), horizontal members (whales) and cross braces to support the sides of the excavation to prevent a cave-in. Metal hydraulic, mechanical, or timber shoring is common examples.

The different examples of shoring are found in the OSHA Standard under these appendices:

- **Appendix C –** Timber Shoring for Trenches
- **Appendix D –** Aluminium Hydraulic Shoring for Trenches
- **Appendix E –** Alternatives to Timber Shoring

Shield Systems (Trench Boxes)

Shielding is the third method of providing a safe workplace. Unlike sloping and shoring, shielding does not prevent a cave-in. Shields are designed to withstand the soil forces caused by a cave-in and protect the employees inside the structure. Most shields consist of two flat, parallel metal walls that are held apart by metal cross braces.

Shielding design and construction is not covered in the OSHA Standards. Shields must be certified in design by a registered professional engineer and must have either a registration plate on the shield or registration papers from the manufacturer on file. **ANY REPAIRS OR MODIFICATIONS MUST BE APPROVED BY THE MANUFACTURER.**

Safety Precautions for Shield Systems

- Shields must not have any lateral movement when installed.
- Employees will be protected from cave-ins when entering and exiting the shield (examples – ladder within the shield or a properly sloped ramp at the end).
- Employees are not allowed in the shield during installation, removal, or during vertical movement.

- Shields can be 2ft. above the bottom of an excavation if they are designed to resist loads at the full depth and if there are no indications of caving under or behind the shield.
- The shield must extend at least 18 inches above the point where proper sloping begins (the height of the shield must be greater than the depth of the excavation).
- The open end of the shield must be protected from the exposed excavation wall. The wall must be sloped, shored, or shielded.

Personal Protective Equipment

The Designated Supervisor will ensure that all workers wear required personal protective equipment (PPE) as detailed below. Hardhats, safety eyewear, gloves, hearing protection, and fall protection devises will be furnished by the department.

- Personnel working in the trenches or excavations will wear approved steel-toed shoes or boots.
- Where there is potential for exposure to flying fragments, dust or other materials produced by drilling, sawing, sanding, grinding and similar operations will wear approved safety glasses.
- Where fall hazards exist; or where rescue operations may be necessary, personnel must wear a full body harness and be tied off at all times to an approved lifeline or anchor point.
- Hand protection must be made available to employees based on the hazards of the work being performed.
- To determine the appropriate PPE to be utilized, the supervisor should conduct a pre-work hazard assessment and ensure all hazards are addressed prior to personnel entering a trench.

Inspections

Daily inspection of excavations, the adjacent areas and protective systems shall be made by the competent person for evidence of a situation that could result in a cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.

- All inspections shall be conducted by the competent person prior to the start of work and as needed throughout the shift.
- Inspections will be made after every rainstorm or any other increasing hazard.
- All documented inspections will be kept on file with the department and forwarded to the Risk Management and Safety Program Coordinator weekly.
- A copy of the Daily Excavation Inspection form is attached to this program.

Training

Training on the purpose, content and function of the Trenching and Excavation Safety Program is required for all employees who participate in or are affected by trenching/excavation operations.

The competent person(s) must be trained in accordance with OSHA Excavation Standard, and all other programs that may apply (examples: Hazard Communication, Confined Space, and Respiratory Protection), and must demonstrate a thorough understanding and knowledge of the programs and the hazards associated.

All other employees working in and around the excavation must be trained in the recognition of hazards associated with trenching and excavating.

All new personnel must be trained in trenching and excavation work before an employee is assigned duties in excavations.

Retraining

Retraining or additional training is required whenever:

- There is a new or revised trenching/excavating procedure.
- An authorized employee's job duties change regarding trenching/excavating.
- The Trenching and Excavation Program changes.
- Additional unique hazards arise, such as new equipment or modified processes.
- Refresher training is recommended annually.

Daily Worksite Checklist for Trenching/Excavation Sites

Project:		Date:	Weather:	Soil Type:
Trench Depth:	Length:	Width:	Type of Protective System:	

Signature of Competent Person:

Yes	No	N/A	Excavation
			Trench box extends at least 18 inches above the vertical wall of the excavation and to within 2 feet of the bottom of the trench (or less if soil collapsing behind or below trench box).
			Trench box installed in accordance with manufacturers specific instructions and use limitations.
			Trench box inspected for damage or defects and pins and spreaders are securely installed.
			If other soil protective systems are used, they are installed in accordance with manufacturers Instructions OR are approved by a Registered Professional Engineer.
			All employees at worksite trained in trenching safety procedures.
			Surface encumbrances such as utility poles, heavy equipment supported or removed.
			Heavy equipment safety zone at least 1½ times depth of trench for if not supported.
			Employees protected from loose rock or soil.
			Spoils, materials, and equipment set back a minimum of 2' from edge of excavation.
			Walkways and bridges over excavations 6' or more in depth are at least 20 inches wide and are equipped with required guardrails.
			Ladders placed no more than 25 feet apart.
			Employees prohibited from working or walking under suspended loads.
			Employees prohibited from working on faces of sloped or benched excavations above other employees.
			Warning system established and used when mobile equipment is operating near edge of excavation.
			Barriers provided if trench opening is not readily apparent.
			Barriers, fences available to secure area if left overnight.

Yes	No	N/A	Personal Protective Equipment
			Hard hats worn by all employees.
			Work boots or safety shoes worn by all employees.
			Eye protection worn by all employees (if applicable).
			Hearing protection worn by all employees (if applicable).
			Warning vests, or other highly visible PPE provided and worn by all employees exposed to vehicular traffic.

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Yes	No	N/A	Utilities
			Utility companies contacted and/or utilities located.
			Exact location of utilities marked when near excavation.
			Underground installations protected, supported, or removed when excavation is open.

Yes	No	N/A	Wet Conditions
			Precautions taken to protect employees from accumulation of water.
			Water removal equipment monitored by Competent Person.
			Surface water controlled or diverted.
			Inspection made after each rainstorm.

Yes	No	N/A	Hazardous Atmosphere
			Atmosphere tested when there is a possibility of oxygen deficiency or build-up of hazardous gases. If yes, atmosphere will be tested every_____.
			Oxygen content is between 19.5% and 21%.
			Flammable gas build-up to 20% of lower explosive limit (LEL).
			Toxic Levels of gases are below limits set on gas monitor.
			Ventilation blowing into space and air intake placed away from vehicle exhaust.
			Program Manager contacted if atmosphere is above established limits. Source of contaminant to be determined and eliminated prior to entry or Program Manager will establish special procedures for entry.

Emergency Procedures for Trench Cave-Ins

- **GET ALL OTHER EMPLOYEES OUT OF THE TRENCH!!**
- **CALL 911**
- **NOTIFY COMPETENT PERSON**

Note time
Note location of trapped worker(s)
Leave all victims hand tools in place
Shut down all heavy equipment
Stop nearby traffic that may cause vibration
Keep everyone back from trench at least 50 feet
Gather information for rescue team
WAIT for rescue team. Do not attempt to rescue.

Note-Do not attempt to dig the person out using hand tools or heavy equipment. This could cause the trench to collapse further and could cause further injuries!!!!