



UMBC OFFICE OF ENVIRONMENTAL SAFETY AND HEALTH (ESH) PROCEDURE	TITLE: Excavation, Trenching, and Earth-Moving Vehicles
DATE CREATED: 12/2023	Revision: 1.0

I. PURPOSE

The purpose of this procedure is to establish minimum requirements to protect people and property and minimize occupational exposure to hazards associated with excavating and trenching operations, as well as ensure the safe operation of heavy earth-moving equipment and vehicles.

This procedure was written to establish guidelines to ensure compliance with the following Occupational Safety and Health Administration (OSHA) regulations:

- 29 CFR 1926 Subpart P – Excavations
- 29 CFR 1926.602 – Material Handling Equipment
- 29 CFR 1926.651 - Specific Excavation Requirements
- 29 CFR 1926.652 - Requirements for Protective Systems

II. SCOPE

This procedure applies to all University of Maryland Baltimore County (UMBC) employees that are expected to perform tasks relating to excavation or trenching operations, or are assigned to operate earth-moving vehicles.

Requirements for Contractors

Contractors, utility company personnel, or any other third-party entity that performs excavation or trenching operations at the University are required to have an excavation and trenching policy, procedure, or program that complies with all applicable federal, state, and local regulations.

Contracted or third-party personnel are responsible for following the requirements of their employer's safety and health policies at all times when performing excavation or trenching operations.

Facilities Management shall approve and coordinate all excavation and trenching activity on University property that is performed by non-UMBC personnel, prior to beginning excavation or other similar operations.

III. DEFINITIONS

- *Aluminum Hydraulic Shoring*: manufactured shoring system consisting of aluminum hydraulic cylinders (cross braces) used with vertical or horizontal rails designed to support sidewalls of an excavation.
- *Bell-Bottom Pier Hole*: shaft or footing excavation, the bottom of which is made larger than the cross section above to form a bell shape.
- *Benching*: method of protecting workers from cave-in by excavating the sides of an excavation to form one or more horizontal steps, usually with vertical or near-vertical surfaces between levels.
- *Cave-in*: the movement of soil or rock into an excavation, or the loss of soil from under a trench shield or support system, in amounts large enough to 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.
- *Cross Braces*: the horizontal members of a shoring system installed from side to side of the excavation. The cross braces bear against either uprights or wales.
- *Designated Supervisor*: the individual within the department that will oversee excavation work and that is responsible for assuring compliance with all applicable safety policies, procedures, and regulations.
- *Excavation*: any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.
- *Faces or Sides*: the vertical or inclined earth surfaces formed as a result of excavation work
- *Failure*: the movement or damage through breakage, displacement or permanent deformation of a structural member or connection that makes it unable to support loads.

- *Hazardous Atmosphere*: an atmosphere that is explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, that may cause death, illness, or injury.
- *Kick out*: the accidental movement or failure of a cross brace.
- *Layered Geological Strata*: where soil types are configured in layers. The soil should be classified on the basis of the weakest soil layer classification. Each layer may be classified individually if a more stable layer lies below a less stable layer.
- *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.
- *Qualified Person*: means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.
- *Ramp*: an inclined walking or working surface that is used to gain access to one point from another. A ramp may be constructed from earth or from structural materials such as steel or wood.
- *Registered Professional Engineer*: a person who is registered as a professional engineer in the state in which they are operating.
- *Soil Types*:
 - Type A - Most stable: clay, silty clay and hardpan. No soil is Type A if it 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 the requirement of 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.
- *Sheeting*: the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.
- *Shielding/Shielding System*: a structure used in an excavation that is able to withstand cave-ins and which will protect those working within the shield system. Shields can be permanent structures or portable units moved along as work

progresses. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

- *Shoring/Shoring System*: a structure that is built 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 will vary with soil type, weather and surface or near surface loads that may affect the soil in the area of the trench (Such as adjacent building, vehicles near the edge of the trench).
- *Stable Rock*: natural solid mineral material that can be excavated with vertical sides that will remain intact while exposed.
- *Structural Ramp*: a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.
- *Support System*: a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.
- *Trench*: A narrow excavation below the surface of the ground, less than 15 feet wide, with a depth no greater than the width.
- *Uprights*: 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."
- *Wales*: horizontal members of a shoring system placed in the direction of the excavation face whose sides bear against the vertical members of the shoring system or earth (the uprights or sheeting).

IV. PROCEDURE

Excavation and Trenching Procedure

Pre-Site Inspection and Utility Identification

Prior to any excavation or trenching operations, a Designated Person shall conduct a site inspection to determine if underground utilities are present and could potentially be impacted by the operation.

Maryland's Miss Utility notification center shall be contacted (**800-257-7777**) to arrange for the marking of underground utilities. Miss Utility must be notified at least two (2) full business days, but no more than ten (10) days prior to the beginning of work.

Underground utility markings can be identified by referring to the table below.

Color	Utility Type
Red	Electrical, Conduit, Lighting Cable
Yellow	Natural Gas, Oil, Steam, Petroleum
Orange	Communication, Fiber Optic, Phone, Cable
Blue	Water
Green	Sewer
Purple	Reclaimed Water
White	Proposed Excavation
Pink	Temporary Survey Marking

If underground utilities are identified as being present or impacted by the excavation or trenching project, the project supervisor or manager shall arrange to have the utilities guarded, relocated, or removed as deemed appropriate by Facilities Management and the associated utility company.

Soil Class Determination

The Designated Supervisor or other competent person shall classify the type of soil in the excavation area to determine the most appropriate protective system.

Soil in the State of Maryland is generally found to be either Type B or Type C (refer to the Definitions section in this procedure for information on soil types).

The person classifying the soil shall perform a visual inspection followed by at least one of the below manual tests to determine soil classification:

- Visual Test
 - This consists of a visual inspection of the soil in the excavation site as well as adjacent to the site. The inspector shall look for conditions such as signs of tension cracks, layered geologic structuring, and signs of bulging, boiling, sloughing, or surface water intrusion.
- Manual Tests
 - Thumb Penetration Test -
 - The least accurate of the manual tests. If the thumb penetrates no further than the thumb nail's length, it is typically class B soil. If the entire thumb is able to penetrate into the soil, it is considered Class C.
 - Dry Strength Test -

- A sample of dry soil is taken and tested for consistency. If the soil crumbles under moderate or less pressure, it is considered Type C.
- Dry soil that breaks into progressively smaller clumps consistent with a combination of clay and gravel, sand, or silt is considered Type B soil.
- Plasticity/Wet Thread Test -
 - A moist sample of soil is taken and formed into a ball. The soil is then rolled into a thread until it measures $\frac{1}{8}$ inch in diameter by 2 inches in length. If the soil sample does not break when held by one end, it is considered Type B. If the sample breaks, it is considered Type C.
- Penetrometer Test -
 - Should only be used when the soil is close to saturated. The instrument will show the compressive soil strength in tons per square foot (TSF) or kilograms per cubic centimeter.

Stability of Adjacent Structures

Necessary precautions shall be taken by the Designated Supervisor to ensure the stability of nearby buildings and other structures is not compromised. Evaluation of adjacent structures shall be conducted by a Registered Professional Engineer. The engineer will recommend the appropriate precautionary measures (i.e., shoring, bracing, or underpinning). The Designated Supervisor shall ensure the recommended measures are implemented.

Protection of the Public

All necessary protective equipment shall be provided and implemented to ensure that the public and members of the campus community are alerted to and protected from hazards during excavation or trenching operations.

Barricades, signage, designated walkways, and lighting shall be provided as necessary to adjacent thoroughfares such as pedestrian walkways, driveways, and roadways.

Protection of Employees in Excavations

General Requirements:

- The Designated Supervisor shall be responsible for ensuring that workers in excavations are appropriately protected.
- Stairs, ladders, or ramps shall be provided for excavations exceeding four (4) feet in depth.
 - Excavations exceeding 20 feet in length require two (2) or more means of egress.
 - A means of egress shall be provided for every 25 feet of trench length.
 - Ladders must be secure and extend 36 inches above the landing.

- o Metal ladders may not be used when electrical utilities are present.
- Ramps used for egress or equipment access must be designed by a competent person and must be constructed in accordance with the design and in a fashion that will not pose a displacement or tripping hazard.
- Structural members of ramps must be connected and have uniform thickness.
- Employees shall maintain a safe distance away from vehicles being loaded or unloaded to avoid being struck by falling or spilling materials.
- Employees are not permitted to work or traverse underneath a load handled by earth-moving vehicles or equipment.
- Employees working near vehicle traffic are required to wear a high-visibility/reflective vest.
- Spoil piles, materials, and equipment must be kept at least two (2) feet from the edge of the excavation. If the two foot rule cannot be utilized, a retaining device must be in place to prevent cave-ins or falling materials.
- When the equipment operator does not have a clear view of the edge of the excavation, a warning system shall be used.

Personal Protective Equipment:

- Hard Hat – required at all times
- Steel or Reinforced Safety-Toe Boots - required at all times
- Gloves - required when performing activities where there is a risk of hand injuries such as cuts and crush/pinch points
- Safety Glasses with Side Shields – required when exposed to flying debris, fragments, dust, or other material.
- Appropriate Welding Attire and Face Shield/Helmet – required when performing welding, cutting, or other hot work activities.

Fall Protection:

- Guardrails shall be provided to protect from falls when employees are working within 15 feet of an edge of any excavation that is four (4) feet or greater in depth. If a competent person determines that guardrails are not feasible, another form of fall protection shall be selected and implemented by the competent person and the Designated Supervisor (refer to the UMBC ESH Fall Protection Program).
- Walkways with guardrails shall be provided for all excavations exceeding 4 feet in depth where personnel or equipment is required to cross over the excavation. Toeboards shall be required on guardrails if personnel will be working underneath the walkway.

Confined Spaces:

Some excavations have the potential to be confined spaces. An excavation is considered to meet the criteria of a confined space if it is greater than 4 feet deep.

An excavation is considered to be a *permit-required confined space* if it exhibits one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere.
- Contains a material that could potentially entrap, engulf, or suffocate an entrant.
- Has an internal configuration such as inwardly converging walls or a floor that slopes downward and tapers to a smaller cross section that could entrap or asphyxiate an entrant.
- Contains any other serious recognized health or safety hazard.

If the excavation is determined to be a permit-required confined space by the Designated Supervisor, the Office of Environmental Safety and Health, or other competent person, then UMBC employees shall not be permitted to enter the space unless it can be reclassified to non-permit required through hazard elimination (refer to the UMBC ESH Confined Space Entry Procedure).

Water Accumulation Hazards:

No one shall be permitted to work inside an excavation during periods of heavy or prolonged rain. The Designated Supervisor shall inspect the excavation following a rain storm before work inside the excavation may resume.

Work inside excavations that contain standing or accumulating water should be avoided whenever possible. If work must be done inside a space with water conditions, the Designated Supervisor shall implement appropriate control measures to control water accumulation, such as wellpoint dewatering systems or mechanical water removal systems. Special shielding systems designed to prevent water accumulation must be designed by a Registered Professional Engineer.

Requirements for Protective Systems

Selection of Protective Systems

When employees are working in an excavation, protective systems must be implemented to protect against cave-ins.

The following scenarios do not require the use of protective systems:

- The excavation is less than 4 (four) feet in depth and a competent person has determined that a protective system is not required.
- The excavation is made entirely in stable rock.

Excavations exceeding 20 feet in depth must be designed by a Registered Professional Engineer.

For excavations 20 feet or less in depth, refer to the decision tree located in [Appendix F to OSHA 1926, Subpart P](#) to determine the appropriate protective system.

Types of Protective Systems

There are four basic types of protective systems for excavations and trenches - Sloping, Benching, Shoring, and Shielding. The Designated Person shall select the appropriate system, taking into consideration the type/class of soil, the findings of the site inspection, and the surrounding structures.

The following systems apply only to excavations not exceeding 20 feet in depth. Protective systems for excavations greater than 20 feet deep are required to be designed by a Registered Professional Engineer.

- Sloping Systems
 - Maximum Allowable Slope for Excavations Less than 20 Feet in Depth:

Soil Type	Height/Depth Ratio	Slope Angle
Stable Rock	Vertical	90 ⁰
Type A	¾ : 1	53 ⁰
Type B	1 : 1	45 ⁰
Type C	1 ½ : 1	34 ⁰

- Example: A ten feet deep trench in Type B soil would have to be sloped to a 45 degree angle, or sloped 10 feet back in both directions. Total distance across a trench ten feet deep would be 20 feet plus the width of the trench. In Type C soil, the trench would be sloped at a 34-degree angle or 15 feet in both directions for a total of 30 feet across plus the width of the trench.
- Benching Systems:
 - Benching may not be used in Type C soil.
 - Benching can be single or multiple:
 - Single - one level, may not exceed 4 feet in height
 - Multiple, more than one level, each not to exceed 4 feet in height
 - Benching can be used in conjunction with sloping. Benches must be below the maximum allowable slope for the soil type.
 - Example: A ten-foot deep trench in Type B soil must be benched back 10 feet in each direction with the maximum of a 45- degree angle.

- Shoring Systems:
 - Shoring systems can be used when sloping is determined to be impractical by the Designated Person based on the location or depth of the excavation. There are two basic types of shoring - Timber and Aluminum Hydraulic.
 - Examples with additional guidance can be found in the following Appendices of OSHA 1926 Subpart P (Excavations):
 - Timber Shoring - [Refer to Appendix C of the OSHA Standard](#)
 - Aluminum Hydraulic Shoring - [Refer to Appendix D of the OSHA Standard](#)

- Shielding Systems (Trench Boxes)
 - Unlike other systems, shielding systems do not prevent a cave-in, rather they protect the occupants inside the structure by withstanding the force of a cave-in. Shields may be used in open areas or in conjunction with sloping or benching.
 - General Shielding System Requirements:
 - Inspect trench boxes for good condition before each use.
 - Minimize the excavated area between the outside of the trench box and the face of the trench.
 - Backfill the space between the trench box and the excavation side to prevent lateral movement of the box.
 - Ensure the shield system extends at least 18 inches above the surrounding area if there is sloping toward the excavation. Providing a sloped area adjacent to the box.
 - Ensure the shields ride two feet above the bottom of the excavation provided they are calculated to support the full depth of the excavation and there is no caving under or behind the shield.
 - Modifications to the shields are prohibited unless approved by the manufacturer.
 - Workers must enter and leave the shield in an appropriate protected manner, such as with a ladder.
 - No one shall be permitted to occupy or remain inside the shield system while it is being moved.

Earth-Moving Vehicles

Earth-moving vehicles refers to any piece of heavy machinery that can be used to move large amounts of soil or other earth materials. These vehicles perform activities such as excavating, transporting, pushing, grading, and digging.

Examples of Earth-Moving Vehicles:

- Scrapers
- Loaders
- Excavators/Backhoes
- Compactors
- Dumpers
- Tractors (Crawler, Wheel, Agricultural, Industrial)
- Bulldozers
- Off-Highway Trucks
- Graders

Earth-moving vehicles are large, heavy machines, and as such, special care and attention must be paid when operating or working around them.

General Requirements:

- Only UMBC employees who possess requisite training and demonstration of skills may be permitted to operate an earth-moving vehicle.
- A copy of the operator's manual shall be kept with the vehicle at all times. Operators shall review the operator's manual prior to first operation.
- Contractors and other third-party entities may not operate or borrow a UMBC-owned or leased vehicle.
- Seat belts shall be equipped in vehicles and must be worn at all times unless the vehicle is designed for stand-up operation.
- A pre-shift inspection shall be conducted and documented prior to the first operation of the working day. Any vehicle that does not pass inspection shall be immobilized/locked-out and removed from service until repairs can be made.
- All vehicles left unattended shall have the keys removed or otherwise immobilized and have appropriate lights, reflectors or barricades in place to identify the vehicle's location.
- Vehicles are required to have normal operation, emergency, and parking brake systems.
- Vehicles shall have the parking brake engaged when not in use. Vehicles parked on an incline shall have the wheels chocked and the parking brake engaged.
- All bidirectional machines, such as rollers, compactors, front-end loaders, bulldozers, and similar equipment, shall be equipped with a horn, distinguishable from the surrounding

noise level, which shall be operated as needed when the machine is moving in either direction. The horn shall be maintained in an operative condition.

- When operating in reverse, vehicles which have an obstructed view to the rear shall be equipped with a reverse signal alarm distinguishable from the surrounding noise level, or a designated signal person must be used.
- Vehicles that will be operated in low lighting conditions shall be equipped with headlights and tail lights. Headlights are required to be ON in dusk/nighttime and inclement weather conditions.
- Vehicles that can exceed speeds of 15 miles per hour must be equipped with fenders or other guards on the wheels.
- Scissor points on all front-end loaders, which constitute a hazard to the operator during normal operation, shall be guarded.
- Earth-moving vehicles may not move on any access roadway or grade unless the access roadway or grade is constructed and maintained to safely accommodate the movement of the vehicles.
- Emergency access ramps and berms shall be constructed to restrain and control runaway vehicles.

Training Requirements

UMBC employees who will be expected to operate an earth-moving vehicle(s) shall complete the following training steps prior to being permitted to operate an earth-moving vehicle.

- Review the Operator's Manual for the vehicle assigned and document/sign of confirmation of having read the Manual.
- Perform a satisfactory hands-on demonstration of competency and skill under the observation of a supervisor or other department-designated individual with the requisite knowledge of safe and appropriate operation.

The hands-on demonstration shall be required at a frequency of at least three years.

Training shall also be required in the following instances:

- The employee is assigned to operate a different type of earth-moving vehicle.
- Following any incident or near-miss involving an earth-moving vehicle.
- When the employee demonstrates a deficiency in their ability to safely operate an earth-moving vehicle.

Inspection and Maintenance

All earth-moving vehicles shall undergo a pre-use inspection prior to the first operation of the day. Preventative maintenance and inspections of vehicles shall also be performed by a qualified

person at the schedule recommended by the manufacturer. Repairs shall be made in a timely manner as needed to ensure continued safe operation.

Recordkeeping

Records of maintenance, inspections, or repairs shall be maintained by the department which maintains authority or ownership of the vehicle, for a period of at least three (3) years.

Current records of earth-moving vehicle operator training shall be maintained with the employees' department for the duration of their employment with the University.

V. ROLES AND RESPONSIBILITIES

Department of Facilities Management

- Review all projects involving excavation and trenching on University property to identify potential impact on University systems, utilities, and operations.
- Interface with contractors, utility personnel, and other third-party entities involved in University excavation and trenching operations.
- Appoint a Designated Supervisor for internal or UMBC-supervised excavation and trenching operations.

Department Heads, Area Managers/Directors, Deans

- Ensure employees that are involved in excavation and trenching operations have appropriate equipment and resources to safely perform the operations.
- Ensure employees that are assigned to operate earth-moving vehicles have received training and maintain current training records.
- Retain records of all service, repairs, and inspections of earth-moving vehicles for at least 3 (three) years.
- Ensure employee compliance with all other requirements of this procedure.
- Notify Environmental Safety and Health (ESH) of any safety concerns, incidents, injuries, or near-misses.

Office of Environmental Safety and Health

- Maintain the Excavation, Trenching, and Earth-Moving Vehicles written plan and perform periodic review and modification when necessary.
- Provide consultation and guidance to affected departments to ensure safety and compliance with this procedure and all applicable regulations and standards.
- Perform periodic reviews and inspections as needed to ensure continued safety and compliance.
- Investigate and facilitate correction or resolution of reported safety concerns, incidents, injuries, and near-misses.

Employees

- Adhere to the requirements of this procedure.
- Perform work in a safe manner and use all appropriate personal protective equipment when required.
- Complete all necessary training prior to operating an earth-moving vehicle or being assigned to an excavation or trenching operation.
- Report any safety concerns, incidents, injuries, or near-misses to supervision and Environmental Safety and Health.

VI. REFERENCES

- UMBC VI-13.00.01 – Environmental Safety and Health Management and Enforcement
- UMBC ESH Procedure – General Safety Rules for UMBC Employees
- Earthmoving Vehicle Inspection Form