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Trenching, Shoring and Excavation Safety

29 CFR 1926.650

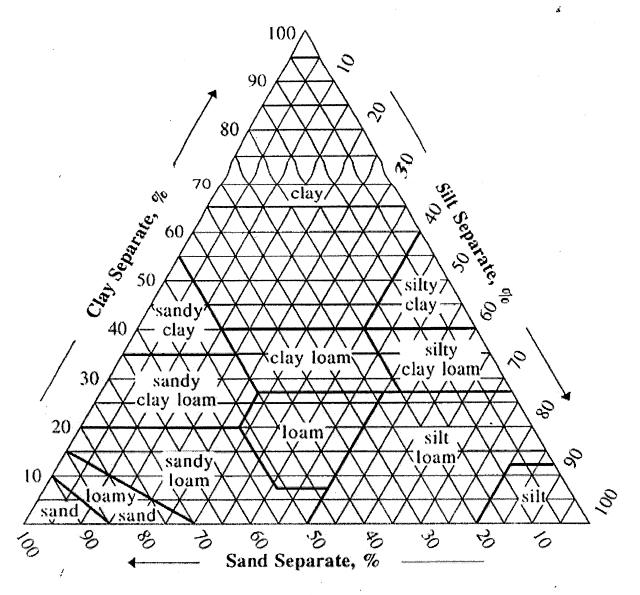
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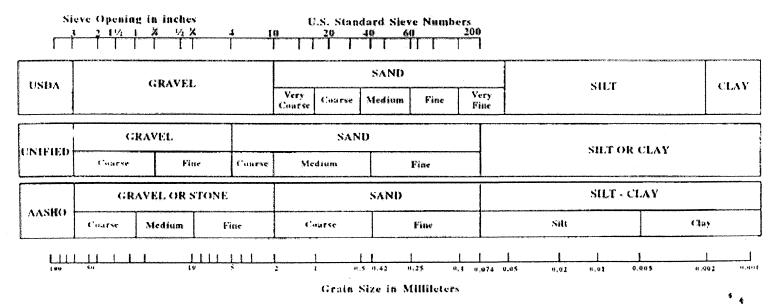
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COMPARISON OF PARTICLE SIZE SCALES



Trench/Excavation & Spoil Pile Map (Hand Drawn, Noting Soil Testing Locations and Results)

Tuesday, Feb. 26, 2008

Construction engineer's death stuns friends, co-workers

By Paula Horton, Herald staff writer

A longtime construction engineer killed when he fell into a trench after the sides collapsed "always made sure jobs got done and got done right," said a co-worker and friend.

William Talbott, 65, of Kennewick, died of asphyxiation Saturday after he was buried in about three feet of wet sand, according to autopsy results released Monday. He was standing on the edge of a 12-foot-deep trench when the sides gave way.

Talbott, who worked for J-U-B Engineers, had re-tired Jan. 14 and was working as a contract employee to finish a couple of projects with the Port of Pasco, said Ben Volk, area manager for the company's Kennewick office.

"He was responsible for watching over contractors and making sure the projects got built properly," Volk said. "Our whole staff was shocked and dismayed. He just retired and had a couple of minor jobs to finish up, then he was going to cruise around on his boat and enjoy retirement."

His company had planned a retirement party for him this week.

On Saturday, Talbott was working with Carl Kinion of Carl Kinion Excavators when the accident happened.

They were trying to find a water line as part of a preliminary design plan for a taxiway extension at the Tri-Cities Airport, Volk said.

"A co-worker was able to get his mouth and head uncovered, but couldn't get him to breathe," said Franklin County Coroner Dan Blasdel.

Pasco fire paramedics took him to Lourdes Medical Center, where he was pronounced dead at 9:44 a.m.

Talbott was one of three people who started J-U-B Engineers' Kennewick office in May 1978.

Volk said Talbott was a "fun-loving guy" who was a little rough around the edges.

"He usually put our young engineers through their paces when they got here," Volk said. "He had always done construction management. He always made sure jobs got done and got done right."

Talbott's longtime friend, Bob Westfall of Kennewick, said Talbott had a "never-ending patience" for helping people and especially loved dogs and small kids. He liked to take the time to teach children to ski or wakeboard.

"Bill's been my best friend for the last 18 years," Westfall said. "We all called him coach because he taught so many of us to water ski, but he was a coach in so many other ways. He touched so many people."

"He lived life his way and enjoyed it to the fullest," he added. "He was definitely one of a kind."

Talbott is survived by his wife, Sandy, and daughters Stacey, 38, of Pasco, and JeNeane, 35, of Kennewick.

Fatality Assessment and Control Evaluation (FACE) Program

Worker Dies in Trench Collapse

Michigan Case Report: 05MI084

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Summary

On Friday, August 19, 2005, at approximately 12:00 p.m., a 24-year-old worker died when he was buried under a wall of the trench he was working in (Figure 1). The excavation wall and part of the sidewalk next to the concrete garage floor collapsed onto him while he was attempting to attach the new PVC pipe he and his coworkers had installed that morning to the main sewer in the alley. One of the decedent's coworkers was also caught in the collapse. Two other workers on-site, neighbors who heard their calls for help, and firefighters who arrived on the scene were able to extricate the decedent's coworker (the company owner) from the excavation. He was transported to a hospital and recovered. The decedent's body was recovered from the excavation approximately 8 hours after the wall collapsed.

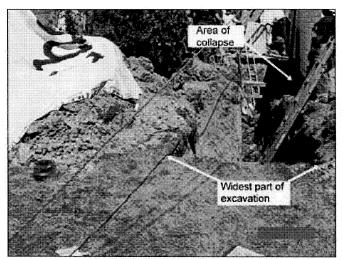


Figure 1. View of excavation from west to east showing widest part, area of collapse, vertical sides and spoils.

Recommendations:

- Employers and self-employed contractors should slope or shore or use trench boxes in all excavations greater than 5 feet deep.
- Employers and self-employed contractors should ensure that excavations are inspected by a competent person prior to start of work and as needed throughout a shift to look for evidence of any situation that could result in possible cave-in.
- Employers and self-employed contractors should design, develop, and implement a comprehensive safety program that includes training in hazard recognition and avoiding unsafe conditions.
- Emergency medical services and fire-rescue personnel should be knowledgeable about proper rescue techniques involving excavation sites and ensure that adequate shoring equipment is on hand at all times.

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On Friday, August 19, 2005, at approximately 12:00 p.m., a 24-year-old worker died when he was buried under a wall of the trench he was working in. The wall and part of the sidewalk next to the concrete garage floor collapsed onto him while he was attempting to attach the new PVC pipe he and his coworkers had installed that morning to the main sewer in the alley. On August 19, 2005, MIFACE investigators were informed of the fatality by the Michigan Occupational Safety and Health Act (MIOSHA) personnel who had received a report on their 24 hour-a-day hotline that a work-related serious injury had occurred. On December 9, 2005, the MIFACE researcher interviewed the company owner (the father of the decedent) who was the coworker who had been extricated from the excavation and recovered. During the writing of the report, the medical examiner's report, photographs taken by the MIOSHA officer at the incident site, and the MIOSHA file and citations were reviewed. The figures and diagrams included in the report are courtesy of the MIOSHA investigating officer.

The owner of the company was self-employed and had been doing sewer work for about eight years on his own. He was not a licensed plumber or contractor. He had started to work on his own after he was laid off from a maintenance job he had worked at for 19 years for a large public school district. His job title when he worked for the maintenance department was sewer maintenance. He described this job as unstopping sewers, digging up and repairing sewers, and exposing water mains for the plumbers to fix.

The decedent had worked for his father's company for approximately 7 years. The company had no safety training program. According to the owner, he taught his employees (his sons) on-the-job what he had learned on-the-job and had been doing for his 19 years as a sewer maintenance worker. When he had worked for the school district maintenance department, he indicated he had never used a trench box. Their method of working was "get in, fix it, get out." He also indicated that during an excavation, someone was stationed at the top to watch the dirt. The lookout would look for cracks and slow-moving or shifting dirt. If the lookout saw these signs, he would shout something like, "Dirt is coming". At that warning the workers in the trench were to stand up and put their hands in the air.

The MIOSHA investigation resulted in three Serious violations being issued to the company: General Rules, Part 1, Rule 114(1) The employer had no safety program. Excavation, Trenching and Shoring, Part 9, Rule 933(2) Excavated and other material must be stored no less than 2 feet from the excavation edge. Excavation, Trenching and Shoring, Part 9, Rule 941(1) The sides of an excavation greater than 5 feet deep shall be sloped unless otherwise supported. The sides of the excavation were not sloped; there was no shoring; and no trench box was used.

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Investigation

The project the company was doing for the owner of the home where the incident occurred consisted of installing new sewer piping from about 15 feet from the house to the main sewer connection. The existing pipe was leaking somewhere under the garage in this area. The 4-man crew consisting of the company owner, two employees (his sons), and the backhoe owner and operator had begun digging at the site that morning at about 8:00 a.m.

The trench that had been dug from near the back of the house to the sewer main was approximately 30 feet long. It was approximately 5-feet wide at the beginning near the house. When the excavation reached the garage, it narrowed from 5 feet to 3-1/2 feet and continued at this width to the alley. The initial depth near the house was approximately 6 feet and the trench slanted down toward the sewer main to approximately 9-1/2 feet deep (Diagram 1). The sides of the trench were close to vertical.

According to the company owner, the size of the yard and proximity of a fence did not allow for the excavated soil to be piled away from the trench, so it was piled up on the edges of both sides of the trench. Also, he indicated that the congested area did not allow room for the trench to be sloped and shoring would have been too costly and taken too long.

The company owner and decedent were both working in the trench when it collapsed about four hours after they had started the job. An employee (the second son) was standing outside the trench handing down pipes and watching for cracks, slow-moving or shifting dirt. They had installed three 10-foot sections of 6-inch diameter PVC pipe. The decedent was attempting to attach the last section of pipe with a 45 degree elbow before tying into the sanitary sewer in the alley when the collapse occurred. The employee outside the trench saw the dirt start to collapse and yelled something like, "Dirt." The company owner, who was standing several feet away from the decedent toward the house where the trench was approximately 7-feet deep, stood up (<u>Diagram 2</u>). He was buried to his chest, but he was able to be extricated by neighbors and first responders. The decedent, bent over tying the pipe to the main in tight quarters where the trench was 9-1/2 feet deep, was completely buried (<u>Diagram 3</u>).

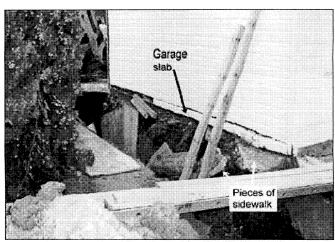


Figure 2. Pieces of sidewalk in collapsed area and garage slab separated from foundation.

The broken sewer line under the garage had been leaking water and saturating the soil under the garage floor for several months before the day of the incident. The trench wall area that collapsed was where the water had been leaking from the old, broken sewer line under the garage. Approximately 20 feet of water-saturated dirt 24 to 30 inches wide and a 4-inch thick concrete sidewalk running directly next to and the full length of the garage collapsed into the trench (Figure 2). The garage slab tilted toward the cave-in.

First responders used sections of neighbors' picket fences and 4-foot by 4-foot posts to create temporary shoring to rescue the company owner. Because the trench sides were still unstable, they waited for responders with the appropriate excavation shoring equipment (Figure 3). The body of the decedent was recovered approximately 8 hours later.



Figure 3. Shoring installation

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Cause of Death

The cause of death as stated on the medical examiner's report was traumatic asphyxia as a result of a trench collapse. The results of the toxicology tests for alcohol and drugs were negative.

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Recommendations/Discussion

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Employers and self-employed contractors should slope or shore or use trench boxes in all excavations greater than 5 feet deep.

MIOSHA Part 9, Rule 941(1) Excavation, Trenching and Shoring requires that any trench greater than 5 feet deep which may be entered by a worker be sloped or shored in order to prevent cave-in. Shoring may be accomplished by the use of trench boxes or by construction of an adequate structure. Because of the limited space available for sloping the sides of the trench in this backyard, the use of a trench box might have prevented this fatality.

Employers and self-employed contractors should ensure that excavations are inspected by a qualified person prior to start of work and as needed throughout a shift to look for evidence of any situation that could result in possible cave-in.

A qualified person means a person who by possession of a recognized degree or certificate of professional standing or who by extensive knowledge, training and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

A qualified person 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 the authorization to take prompt corrective measures to eliminate them. A qualified person would have had:

- A method for determining the soil type and conditions (leaking sewers, heavy rains, etc.). This would mean training on soils, use of either field testing methods or a penetrometer.
- Identified that in a confined excavation area there needs to be shoring.
- Given consideration to nearby structure/s that can affect the excavation stability or be affected by the excavation.
- 4. Not permitted employees to enter the excavation until it was safe to.

The conditions and the directions given to the employees were not consistent with those of a qualified person demonstrating adequate knowledge about safe work practices in excavation techniques. The company owner and his employees recognized that there are hazards associated with working in the trench, because one employee was assigned to constantly look for shifting or moving earth. The company owner indicated to the MIFACE investigator that it was "fate" that his son had died. He said it could as well have been himself. Unfortunately, they accepted the risks of not adequately shoring the excavation nor using a trench box, and a person died. The company owner indicated at the time of the interview that he had not done any excavation work since the fatality, and he did not know if he would do any again.

The MIOSHA Consultation, Education and Training (CET) Division presents many health and safety courses, including excavation safety. These courses are held at various locations across the State. MIFACE encourages persons doing excavation work to contact the MIOSHA CET Division to learn about the course schedule and locations. The MIOSHA CET Division website can be accessed through the Michigan Department of Labor and Economic Growth website at http://www.michigan.gov/cis/. Click on the MIOSHA link located in the box on the left side of the web page, then click on the Consultation, Education, and Training link. MIOSHA CET can also be contacted by telephone: (517) 322-1809.

Employers and self-employed contractors should design, develop, and implement a comprehensive safety program that includes training in hazard recognition and avoiding unsafe conditions.

Employers and self-employed contractors should be aware of and recognize their knowledge limitations and seek advice, assistance, consultation, and specific training as necessary. MIOSHA R408.40114(2)(d) requires that the employer have an accident prevention program that provides instruction to each employee in the recognition and avoidance of hazards. A comprehensive safety program should address all aspects of safety related to specific tasks that employees are required to perform. Safety rules, regulations, and procedures should include the recognition and elimination of hazards associated with tasks performed by employees.

Emergency medical services and fire-rescue personnel should be knowledgeable about proper rescue techniques involving excavation sites and ensure that adequate shoring equipment is on hand at all times.

Untrained coworkers (neighbors) and first responders using inadequate materials (picket fence sections) uncovered and removed one victim from the trench before trained rescue personnel with the proper equipment arrived at the scene. Workers should never, under any circumstances, enter a hazardous environment to attempt a rescue operation unless properly equipped and trained in the use of the equipment and methods required for rescue. In this instance, untrained workers entered the trench, uncovered one of the victims and removed him from the trench, placing themselves at risk of becoming victims.

Also, it was pointed out to them that the spoils were still too close to the excavation when they were installing shoring. Only those persons trained in the requirements of NFPA 1670 should attempt rescue operations after a trench cave-in occurs. All persons at the incident site should follow the directions given by the Incident Commander or his/her designee in order to provide the most optimal circumstances for the safety of all persons on the site during rescue operations. Rescue attempts should be discontinued when rescue personnel are placed in imminent and immediately dangerous situations until proper shoring of excavations can be accomplished.

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References

- MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Labor and Economic Growth (DLEG) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Labor and Economic Growth, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.
- NFPA [1999]. NFPA 1670, Standard on operations and training for technical rescue incidents 1999 Edition, Chapter nine, trench and excavation. Quincy, MA; National Fire Protection Association.

Michigan FACE Program

MIFACE (Michigan Fatality Assessment and Control Evaluation), Michigan State University (MSU) Occupational & Environmental Medicine, 117 West Fee Hall, East Lansing, Michigan 48824-1315. This information is for educational purposes only. This MIFACE report becomes public property upon publication and may be printed verbatim with credit to MSU. The author of this report is affiliated with Wayne State University. Reprinting cannot be used to endorse or advertise a commercial product or company. All rights reserved. MSU is an affirmative-action, equal opportunity employer.

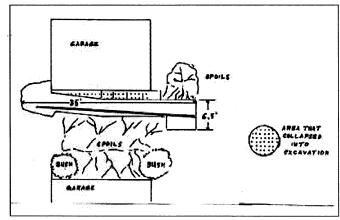


Diagram 1

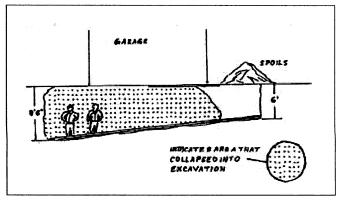
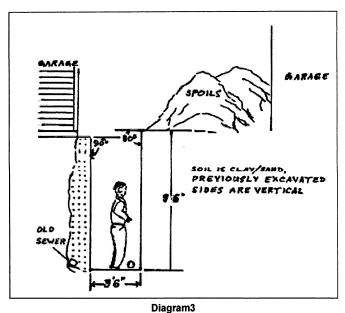


Diagram 2

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To contact Michigan State FACE program personnel regarding State-based FACE reports, please use information listed on the Contact Sheet on the NIOSH FACE web site Please contact In-house FACE program personnel regarding In-house FACE reports and to gain assistance when State-FACE program personnel cannot be reached.

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Fatality Assessment and Control Evaluation (FACE) Program

Excavation Worker Killed by Flying Rigging When Hook Fails

Oregon Case Report: 05OR024

August 4, 2006

Summary

On June 10, 2005, a 40-year-old pipelayer was struck in the head by the flying rigging of a towline that failed at an excavation site, and died 2 days later. During installation of a sewer pipeline, a hydraulic excavator, commonly called a track-hoe, pulled a 14,000 lb. steel trench shield forward inside a 14.5 ft trench, using a wire rope and hook system. The pipelayer was standing inside the

shield while it was being moved. A hook attached to the track-hoe failed, causing the rigging under tension to snap loose, fly into the trench shield, and hit the pipelayer on the back of his hard hat. The victim was air evacuated to a hospital, where he later died.



The track-hoe involved in this incident was pulling a trench shield forward in a trench for a sewer system when a hook failed and the rigging snapped loose.

Recommendations

- Hooks and other rigging fixtures should be selected and used properly to prevent loading beyond their structural capacity.
- In a towing or lifting operation, workers should be removed from the hazard area or guarded from the reach of the rigging in the event of failure.
- An excavation site must be inspected daily by a competent person to detect and correct hazards, particularly those related to expected loads on equipment.
- Employers are responsible for ensuring (a) compliance with all safety rules, (b) that
 equipment is maintained and used according to the manufacturer's instructions, and
 (c) that workers are properly trained to operate equipment safely.

Introduction

On Friday, June 10, 2005, a 40-year-old pipelayer was fatally injured when a hook on a quick coupler in a rigging system under heavy tension failed, causing the rigging to suddenly snap loose and strike the pipelayer on the back of his hard hat. OR-FACE was informed of the incident on June 12 by OR-OSHA. The employer did not respond to OR-FACE requests for an interview. This report is based on information from Oregon OSHA, Medical Examiner, and media reports.

The employer was a union construction contractor, specializing in underground utility installation since 1947. At the time of the incident, the contractor had 60 workers. A subsidiary of the firm, doing business as a nonunion employer with an additional 35 workers, provided office support and equipment maintenance to the main contractor. No information was available concerning the work experience of the pipelayer.

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employees, which met monthly. The safety committee, however, was not trained in hazard identification or accident investigation techniques, and did not perform regular site inspections.

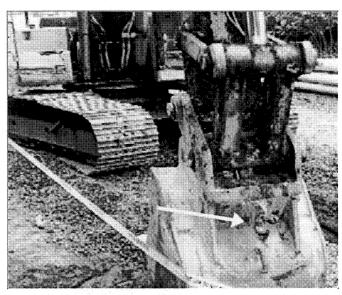
An engineering firm examined the equipment in this incident and determined that the unintentional release was caused by misuse of the hook assembly. Supervisors and workers using and maintaining the equipment were unaware of the manufacturer's written operating and safety requirements for the hook assembly on the arm of the track-hoe.

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Investigation

The work being performed at the time of the incident was installation of an underground sewer pipeline for a new residential subdivision project in an Oregon metropolitan area. A 14.5 ft. deep trench had been cut in hard soil at the construction site. A 14,000 lb steel trench shield was placed inside the trench to prevent collapse while work was conducted. The crew was in the process of moving the trench shield forward inside the trench when the incident occurred.

The trench shield was 20 ft long, with a bottom box 8 ft high, and a fitted top box another 6 ft high. The shield was being pulled forward up a 5% grade to a new position inside the trench by a hydraulic excavator, commonly called a track-hoe. The pipelayer remained in the shield while it was being moved, according to the company's standard practice. His task was to protect the newly laid pipe from being crushed by the moving shield. The access ladder was removed from the trench before the shield was moved, in order to prevent damage to the ladder.



Latched hook welded onto the quick-coupler to replace the original closed "lifting eye" supplied by the manufacturer.

The rigging used for towing the trench shield consisted of a wire-rope sling with two sections, each with a J-hook and shackle assembly on one end to attach to the load. On the other end, the cables were connected to a single steel ring, with each end doubled back and fastened to its cable with a metal sleeve.

The steel ring connecting the two cables was attached to a J-hook on the arm of the track-hoe. The J-hook was shackled to a latched Gunnebo Johnson Model UKN10 hook that was welded to a Hendrix Quick Coupler attachment on the arm of the track-hoe. A quick coupler allows the track-hoe operator to quickly attach or detach the bucket. The latched UKN10 hook was not part of the original equipment.

The Hendrix Quick Coupler comes from the manufacturer equipped with a closed lifting eye, which the employer removed and replaced with the latched hook to allow an easier rigging setup. Manufacturer safety instructions warn that the coupler and components should not be modified. In addition, the advantage of quicker setup is not clear, because the J-hook and shackle attached to the quick coupler always remained on the arm of the track-hoe, even while digging.





The hook and shackle attached to the track-hoe, like the one shown here (without the cable), snapped loose when the rigging failed and struck the pipelayer.



Part of the latch remained attached to the hook welded on the Hendrix Quick Coupler on the arm of the track-hoe.

A few weeks prior to the incident, the construction crew replaced the latched hook on the quick coupler, because the spring and latch mechanism was plugged with clay and would not stay closed, which allowed the J-hook and shackle to fall off. A new UKN10 latched hook was welded to the quick coupler, but the latch problem recurred. A week later, the maintenance department came to the job site and tack-welded shut the latch on the UKN10 hook, making it a closed ring.

While towing the trench shield on the day of the incident, the latched UKN10 hook on the quick coupler failed. The weight of the load was concentrated on the latch mechanism instead of the working part of the hook, resulting in the hook tip bending outward and releasing the rigging. The J-hook and shackle attached to the coupler flew off, disengaged from the sling, and struck the pipelayer in the trench shield on the back of his hard hat. The hook and shackle weighed 32 pounds.

Coworkers immediately called 911 and placed the ladder back into the trench shield to allow rescue workers to reach the pipelayer. The victim was evacuated by helicopter to the hospital, where he died 2 days later of severe head trauma.

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Cause of Death

Head injury with skull fracture and hemorrhage.

Recommendations/Discussion

Recommendation #1: Hooks and other rigging fixtures should be selected and used properly to prevent loading beyond their structural capacity.

Employers and workers need to know and follow safety instructions supplied by equipment manufacturers. In this instance, the closed lifting eye on the Hendrix Quick Coupler attachment should not have been replaced. The manufacturer's lifting eye was closed and circular in shape, maximizing its ability to withstand lifting and pulling forces from any direction, vertical or horizontal. The latched Gunnebo Johnson Model UKN10 hook that was welded to the quick coupler to replace the original lifting eye was designed for vertical lifting. When using the track-hoe to pull the trench shield, the load was mostly horizontal and the force was concentrated at the tip and latch of the hook, which were incapable of carrying the load.

Recommendation #2. In a towing or lifting operation, workers should be removed from the hazard area or guarded from the reach of the rigging in the event of failure.

Workers should move beyond the potential reach of whipping cables or flying rigging during a towing or lifting operation. If a worker must remain in the hazard area, then other safeguards must be implemented.

Safety regulations for excavation sites include a provision that prohibits workers from being inside a trench shield during movement; but only when being "installed, removed, or moved vertically" (29 CFR 1926.652(g)(1)(iv)). Horizontal movement was specifically excluded from the rule to accommodate the kind of work activity observed in this incident. In this case, a metal-plate guard on the nose of the trench shield could have protected the worker during the towing operation.

Another safeguard involves the use of a secondary connection through a bridal or safety line attached near each end of a tow line, connected to the towing equipment on one end, and the load on the other. The bridal remains slack during towing (Figure 1).

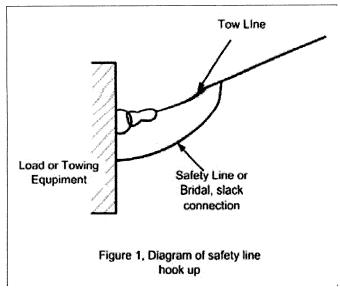


Figure 1. Diagram of safety line hook up.

In this incident, the J-hook attached to the arm of the track-hoe disengaged from both the arm of the track-hoe and the tow line, making it a completely independent missile that could have injured workers well beyond the hazard area designated by the reach of the cables. With the original lifting eye on the Hendrix Quick Coupler, the attached hook and shackle would have been very unlikely to break free. In cases of less certainty, such as this one, the use of a latched hook instead of an open J-hook could keep the hook attached to the wire sling and reduce its range of flight in the event of failure.

Recommendation #3. An excavation site must be inspected daily by a competent person to detect and correct hazards, particularly those related to expected loads on equipment.

Oregon rules for excavation sites require daily inspection of protective systems and operational hazards by a competent person (29 CFR 1926.651(i)(2)(k)). This incident emphasizes the importance of inspecting daily the condition of rigging, cables, and anchor points for lifting and towing operations.

Recommendation #4. Employers are responsible for ensuring (a) compliance with all safety rules, (b) that equipment is maintained and used according to the manufacturer's instructions, and (c) that workers are properly trained to operate equipment safely.

State safety standards address known hazards in the workplace, and employers are responsible to understand and implement the standards to prevent worker injuries. Employers are also responsible to ensure that equipment is maintained and used according to the manufacturer's specifications and recommendations. Manufacturing instructions for the coupler used in this incident warns users to read the operating manual before attempting to install, operate, or maintain the coupler, and that failure to comply may result in injury or death, and damage to the coupler. Specifications for rigging equipment apply to all lines, hooks, and rigging assembly. Operator and maintenance personnel training should include the equipment manufacturer's written specifications, operating instructions, limitations, and recommendations for use.

A company safety committee needs to actively pursue safety in the workplace. Safety committee members should be trained in and conduct hazard inspections appropriate to their industry. Work site inspections should be conducted at least quarterly. Committee members should also be trained in accident investigation techniques, in order to detect and correct hazards in a specific work setting.

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- Gunnebo Chain and Lifting. (n.d.). Universal weld-on hook type UKN. Working load limits available online: http://www.eastwood-dickinson.co.uk/images/gunnebo/product_spec_pdfs/g8/universal_weld_on_type_ukn.pdf
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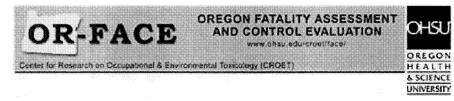
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Oregon FACE Program

To contact <u>Oregon State FACE program personnel</u> regarding State-based FACE reports, please use information listed on the Contact Sheet on the NIOSH FACE web site. Please contact <u>In-house FACE program personnel</u> regarding In-house FACE reports and to gain assistance when State-FACE program personnel cannot be reached.

CROET at OHSU performs OR-FACE investigations through a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research. The goal of these evaluations is to prevent fatal work injuries in the future by studying the work environment, the worker, the task, the tools, the fatal energy exchange, and the role of management in controlling how these factors interact.

Oregon FACE reports are for information, research, or occupational injury control only. Safety and health practices may have changed since the investigation was conducted and the report was completed. Persons needing regulatory compliance information should consult the appropriate regulatory agency.



Oregon Case Reports



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Fatality Assessment and Control Evaluation (FACE) **Program**

Hispanic Laborer Dies After Footing Collapse - North Carolina

NIOSH In-house FACE Report 2005-04

August 22 . 2007

Summary

On December 31, 2004, a 32-year-old Hispanic laborer (the victim) was killed when the side wall of an eight-foot-deep trench collapsed. The victim was a member of a five-man crew that had been contracted to prepare an excavation for a concrete footing that would support the concrete basement for a new single-family, private residence in a housing development. The crew consisted of the company owner, a Hispanic crew leader who spoke little English, and three Hispanic laborers that spoke only Spanish. The depth of the excavation ranged from approximately two to three feet; however, due to a change in the building plans that included the addition of an additional garage stall, the crew had reached a backfilled area where the depth of the trench reached eight feet when the incident occurred. The company owner was operating the mini-excavator until he had to leave the site to run some errands. When he left, he instructed the crew leader to operate the mini-excavator.

As the crew leader was operating the mini-excavator, the victim entered the trench at the shallow end and walked to the deep end to clean loose dirt from the floor with a shovel. As the crew leader yelled for him to exit the trench, the side wall of the trench began to collapse. The victim tried to run to the shallow end, but was covered up. The crew tried to dig the victim out while a nearby homeowner called 911. Upon arrival, fire department personnel ordered the workers out of the trench. They then installed trench bracing, entered the trench, and removed the victim, who was pronounced dead at the scene. NIOSH investigators concluded that, to help prevent similar occurrences, employers should

- ensure that a competent person conducts daily inspection of excavations, adjacent areas, and protective systems and takes appropriate measures necessary to protect
- ensure that workers are protected from cave-ins by an adequate protective system
- develop, implement and enforce a comprehensive safety program, and provide safety training in language(s) and literacy level(s) of workers, which includes training in hazard recognition and the avoidance of unsafe conditions
- ensure that only qualified rescue personnel who have assumed responsibility for rescue operations and site safety should attempt rescue operations.

Introduction

On December 31, 2004, a 32-year-old Hispanic laborer (the victim) was killed when the side wall of an eight-foot-deep trench collapsed. On January 13, 2005, officials of the North Carolina Occupational Safety and Health Administration (NCOSHA) notified the Division of Safety Research (DSR) of the incident. On February 3-4, 2005, a DSR senior investigator conducted an investigation of the incident. The case was reviewed with the NCOSHA compliance officer assigned to the case, the city fire department and the company owner. The coroner's report was reviewed. The incident site was visited but it could not be determined exactly where the incident took place since work on the project had been completed. Photographs taken by NCOSHA immediately after the incident were obtained and

The employer was an excavation contractor that had been in business by himself since July 3, 2001. Prior to that, he had worked for his father performing the same type of work for more than eleven years. He employed four to five workers depending on the number of jobs he had. The employer had no written safety program. Workers were trained on the job. The four workers employed at the time of the incident were Hispanic. The crew leader spoke enough English to understand work instructions given by the owner. The other three workers did not speak English. None of the workers had received any training pertaining to working in excavations or trenches, although all stated, through an interpreter during OSHA interviews, that they had been told not to go into the trench. The victim had worked for the employer for approximately two months. This was the first fatality experienced by the employer.

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Investigation

The employer had been contracted to excavate a footing for a private residence to be constructed, and then form and pour the concrete footing. The owner stated that the excavations usually ranged from two to less than three feet in depth, and two to three feet wide, and that the concrete footings were usually poured on solid ground. Workers occasionally entered the excavations to check the firmness of the floor or to remove excess soil. The employer and his crew had been at the site for approximately two weeks when the owners of the residence decided they wanted a three-car garage instead of a two-car garage. The employer left the site while a second contractor came to the site to backfill the area that would accommodate the extra garage stall. When the second contractor completed backfilling the area, the employer returned to the site with his four-man crew.

On the second day back at the site, the owner began to excavate the backfilled area at approximately 7:00 a.m. with a mini-excavator equipped with a 24-inch wide bucket. The length of the front of the backfilled garage area was approximately 35 feet. To keep the floor of the excavation level, the depth ranged from two to eight feet deep from the front of the trench to the far end. The trench was to be filled with gravel up to a depth where the footing could be poured.

As the owner operated the mini-excavator, the crew leader operated a small tow motor to push the gravel into the excavation in order to keep the floor of the trench level for the footing (Photo 1).



Photo 1. Illustrates the usual depth of the footings and the gravel fill. Photo courtesy of NCOSHA.

At approximately 8:00 a.m., the owner left the site to cash the workers' paychecks and to run various errands. He instructed the crew leader to operate the mini-excavator, then instructed the other men not to enter the trench.

As the crew leader operated the mini-excavator, the victim stood to the side of the trench. The victim's brother and a coworker went to the other side of the property to set wooden stakes to mark the location of the next footing excavation.

The depth of the trench had reached approximately eight feet at this point. The victim asked the crew leader if he should enter the trench at a shallower spot to remove excess dirt. The crew leader stated during OSHA interviews that he told the victim to stay out.

At approximately 9:45 a.m. the owner returned to the site and began talking with another homeowner. The homeowner was in sight of all crew members. The victim again asked the crew leader if he could enter the trench to clean up loose dirt. The crew leader stated during OSHA interviews that he felt the victim did not want the owner to see him just standing at the side of the trench. The crew leader reportedly then told the victim to go in, but to come straight back out. The victim walked to a point where the excavation was less than five feet deep and jumped in. As the victim was walking toward the deeper end of the trench, the crew leader saw the wall of the trench start to fall away and screamed for the victim to get out. The victim turned and ran about five feet but was covered up when the wall caved in (Photo 2). The crew leader yelled for the other crew members. The owner and homeowner also heard the crew leader and ran to the trench to see what had happened. When it was evident the victim had been covered up, the homeowner called 911. The men tried to dig the victim out while the crew leader used the mini-excavator to remove dirt from the area. The fire rescue squad arrived within minutes and ordered the owner and workers to exit the excavation because of the danger of further cave in. The rescue squad then employed trench plates to secure the sides of the trench and began to uncover the victim (Photo 3). Approximately four feet of dirt had to be removed to completely uncover the victim, who was removed from the trench at 1:35 p.m.

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Cause of Death

The coroner listed the cause of death as asphyxiation due to compression of the chest.



Photo 2. Illustrates the position of the mini-excavator at the time of the incident and the approximate location of the victim. Photo courtesy of NCOSHA

Recommendations/Discussion

Recommendation #1: Employers should ensure that a competent person conducts daily inspections of excavations, adjacent areas, and protective systems and takes appropriate measures necessary to protect workers.

Discussion: Although the contractor had not been contracted to perform trenching operations, unusual circumstances were present at the site due to the change in building plans. Regulations and other safety measures pertaining to trenching operations should be followed when excavations exceed four feet in depth. Significant hazards are associated with trenching and similar excavating operations, including cave-in, positioning of machinery, and changes in environmental and physical conditions. For these reasons, 29 CFR 1926.651 (k) (1)1 requires that "daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person^a 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." 29 CFR 1926.651 (k) (2)1 requires that "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."

^a Competent person is defined by OSHA as 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 the authorization to take prompt corrective measures to eliminate them.

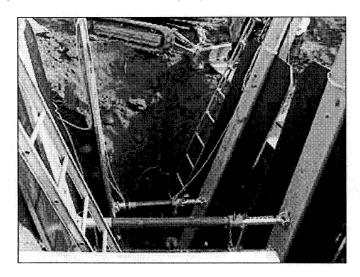


Photo 3. Illustrates the trench plates installed by the rescue squad. Photo courtesy of NCOSHA

Recommendation #2: Employers should ensure that workers are protected from caveins by an adequate protective system.

Discussion: Due to the backfilling performed due to the change in building plans, the depth of the excavation had reached eight feet. Although the crew was instructed not to enter the excavation, should the need arise for workers to enter an excavation, the applicable OSHA Excavation Standard, 29 CFR 1926.652 (a) (1)¹ states that "each employee in an excavation shall be protected from caveins by an adequate protective system." A protective system designed for the soil conditions found in this excavation could have included a trench shield (also known as a trench box), shoring, or a combination of shoring and shielding. Sloping would not have been appropriate because of the sandy composition of the back-filled soil. Employers should consult tables located in the appendices of the OSHA Excavation Standard that detail the protection required based upon the type of soil and environmental conditions present at the site. Employers can consult with manufacturers of protective systems to obtain detailed guidance for the appropriate use of these products. In this incident, no protective system had been placed at any point in the footing excavation.

Recommendation #3: Employers should develop, implement and enforce a comprehensive safety program, and provide safety training in language(s) and literacy level(s) of workers, which includes training in hazard recognition and the avoidance of unsafe conditions.

Discussion: Employers should evaluate tasks performed by workers, identify all potential hazards, and then develop, implement, and enforce a safety program that meets applicable OSHA standards addressing these identified hazards. The safety program should include, at a minimum, worker training in hazard identification, and the avoidance and abatement of these hazards. For example, workers need to be trained to recognize potential hazards associated with excavation operations, such as a possible collapse hazard. A rescue plan should be incorporated into a comprehensive safety program. Companies that employ workers who do not understand English should identify the languages spoken by their employees and design, implement, and enforce a multi-language safety program. To the extent feasible, the safety program should be developed at a literacy level that corresponds with the literacy level of the company's workforce. Employers may need to consider providing special safety training for workers with low literacy to meet their safety responsibilities. The program, in addition to being multi-language, should include a competent interpreter to explain worker rights to protection in the workplace, safe work practices workers are expected to adhere to, specific safety protection for all tasks performed, ways to identify and avoid hazards, and who they should contact when safety and health issues arise.

The victim had been told by the employer and coworkers not to enter the excavation under any circumstances; however, since he had received no training pertaining to trenching operations, it is unlikely that he really understood the hazards associated with entering the excavation, particularly the collapse hazard associated with the backfilled soil.

Recently, OSHA developed the Compliance Assistance: Hispanic Employers and Workers web page to assist employers with a Spanish-speaking workforce in learning more about workplace rights and responsibilities, identifying Spanish-language outreach and training resources, and learning how to work cooperatively with OSHA. In addition, the Compliance Assistance: Hispanic Employers and Workers web page provides a list of OSHA's Hispanic/English-as-a-second-language coordinators. These materials are available at

http://www.osha.gov/dcsp/compliance_assistance/index_hispanic.html³ or can be obtained by contacting an area OSHA office. Information provided can be used by employers who are developing or improving safety and training programs for their Spanish speaking employees.

Recommendation #4: Employers should ensure that only qualified rescue personnel who have assumed responsibility for rescue operations and site safety should attempt rescue operations.

Discussion: Although not a factor in this incident, no rescue plan for the site existed and untrained coworkers tried to uncover the victim from the trench before trained rescue personnel arrived at the scene. When the rescue personnel arrived, they reportedly had to remove the untrained workers from the trench before rescue operations could commence. Workers should never, under any circumstances, enter a hazardous environment to attempt a rescue operation unless properly equipped and trained in the use of the equipment and methods required for rescue. In this instance, untrained workers entered the trench and tried to uncover the victim, placing themselves at risk of becoming victims themselves. Only those persons trained in the requirements of NFPA 1670⁴ should attempt rescue operations after a trench cave-in occurs. All persons at the incident site should follow the directions given by the Incident Commander or his/her designee in order to provide the most optimal circumstances for the safety of all persons on the site during rescue operations.

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References

- 29 CFR 1926.650 (2006). Excavations: Code of Federal Regulations, Washington D.C.: U.S. Government Printing Office, Office of the Federal Register. http://www.osha.gov/pls/oshaweb/owadisp.show_document? p_table=STANDARDS&p_id=10774
- Code of Federal Regulations [2006]. 29 CFR 1926.21(b)(2). Safety Training and Education. Washington, DC: U.S. Printing Office, Office of the Federal Register.
- 3. OSHA [2005]. Compliance Assistance: Hispanic Employers and Workers web page. Accessed April 7, 2005 at http://www.osha.gov/dcsp/compliance assistance/index hispanic.html.
- NFPA [1999]. NFPA 1670, Standard on operations and training for technical rescue incidents 1999 Edition, Chapter nine, trench and excavation. Quincy, MA; National Fire Protection Association.

Investigator Information

This investigation was conducted by Virgil Casini, Senior Investigator, Fatality Investigations Team, Surveillance and Field Investigations Branch, Division of Safety Research.

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OSHA News Release

2003 - 05/09/2003 - Potential Trenching Hazards Bring \$99,400 in Fines to Coushatta Empire Inc. in Oakdale, La.

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www.osha.gov

OSHA Regional News Release

U.S. Department of Labor Office of Public Affairs

Region 6

Region 6 News Release: OSHA-03-70

Fri., May 9, 2003

Contact: Diana Petterson or Elizabeth Todd Phone: (214)767-4776, Ext. 222 or 221

> Potential Trenching Hazards Bring \$99,400 in Fines to Coushatta Empire Inc. in Oakdale, La.

BATON ROUGE, La. -- Failure to protect employees from potential trenching and excavation hazards has brought Coushatta Empire Inc. of Oakdale, La., \$99,400 in proposed penalties from the Baton Rouge area office of the U.S. Department of Labor's Occupational Safety and Health Administration.

Coushatta Empire, a trenching and excavation utility contractor that employs 130 workers, was cited with six alleged safety violations following an OSHA inspection on Nov. 14, 2002, at the company's worksite in Lafayette, La. Compliance officers were driving by the construction site when they observed the violations.

"From previous inspections, OSHA has found that Coushatta continues to ignore proper OSHA trenching regulations that can save lives," said Gregory Honaker, OSHA's Baton Rouge area director. "Fortunately, the employees working in this 14-foot deep trench were removed without incident."

The alleged willful violation was issued for failing to protect employees from the hazards of a cave-in while working at the base of a trench approximately 14 feet deep. OSHA defines a willful violation as one committed with an intentional disregard of or plain indifference to the requirements of the Occupational Safety and Health Act.

Two alleged serious violations were issued for failing to post construction traffic warning signs and failing to provide employees with reflective work vests while working at and near the roadway. A serious violation is one that could cause death or serious physical harm to employees and the employer knew or should have known of the hazard.

Three alleged repeat violations were issued for failing to provide employees with protective hats, failing to provide a ladder for employees to get into and out of the trench and placing soil from the trench within two feet from the trench's edge. A repeat violation is defined as a violation that was previously cited where, upon re-inspection, a substantially similar violation is found. Couchatta Empire was fined almost \$3,000 as a result of OSHA's inspection on Sept. 18, 2001, for the same violations.

Coushatta Empire Inc. has 15 working days from receipt of the citations to comply, request an informal conference with the Baton Rouge area office, or to contest the citations and penalties before the independent Occupational Safety and Health Review Commission.

Employers and employees with questions regarding workplace safety and health standards can call OSHA's Baton Rouge area office at (225) 298-5458 or OSHA's toll-free hotline

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number at 1-800-321-6742 to report workplace accidents, fatalities or situations posing imminent danger to workers.

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Standard Interpretations

10/23/2003 - Use of hydro-vacuum excavation equipment and other acceptable means to locate underground utility installions.

Standard Interpretations - Table of Contents

Standard Number:

1926.651; 1926.651(b)(2); 1926.651(b)(3)

OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov.

October 23, 2003

Mr. Joseph Caldwell Consultant Governmental Liaison Pipeline Safety Regulations 211 Wilson Boulevard Suite 700 Arlington, Virginia 22201

Re: Use of hydro-vacuum or non-conductive hand tools to locate underground utilities; $\S1926.651(b)(2)$ and (b)(3).

Dear Mr. Caldwell:

In a letter dated July 7, 2003, we responded to your inquiry of September 18, 2002, regarding the use of hydro-vacuum equipment to locate underground utilities by excavation. After our letter to you was posted on the OSHA website, we received numerous inquiries that make it apparent that aspects of our July 7 letter are being misunderstood. In addition, a number of industry stakeholders, including the National Utility Contractors Association (NUCA), have provided new information regarding equipment that is available for this work.

To clarify these issues, we are withdrawing our July 7 letter and issuing this replacement response to your inquiry.

Question: Section 1926.651 contains several requirements that relate to the safety of employees engaged in excavation work. Specifically, paragraphs (b)(2) and (b)(3) relate in part to the safety of the means used to locate underground utility installations that, if damaged during an uncovering operation, could pose serious hazards to employees.

Under these provisions, what constitutes an acceptable method of uncovering underground utility lines, and further, would the use of hydro-vacuum excavation be acceptable under the standard?

Answer

Background

Two provisions of 29 CFR Part 1926 Subpart P (Excavations), §1926.651 (Specific excavation requirements), govern methods for uncovering underground utility installations. Specifically,

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paragraph (b)(2) states:

When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours * * * 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. (Emphasis added.)

Paragraph (b)(3) provides:

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by **safe and acceptable means**. (Emphasis added.)

Therefore, "acceptable means" must be used where the location of the underground utilities have not been identified by the utility companies and detection equipment is not used.

Subpart P does not contain a definition of either "other acceptable means" or "safe and acceptable means." The preambles to both the proposed rule and the final rule discussed the rationale behind the wording at issue. For example, the preamble to the proposed rule, 52 FR 12301 (April 15, 1987), noted that a 1972 version of this standard contained language that specified "careful probing or hand digging" as the means to uncover utilities. The preamble then noted that an amendment to the 1972 standard later deleted that language "to allow other, equally effective means of locating such installations." The preamble continued that in the 1987 proposed rule, OSHA again proposed using language in paragraph (b)(3) that would provide another example of an acceptable method of uncovering utilities that could be used where the utilities have not been marked and detection equipment is not being used - "probing with hand-held tools." This method was rejected in the final version of 29 CFR Part 1926. As OSHA explained in the preamble to the final rule, 54 FR 45916 (October 31, 1989):

OSHA received two comments * * * and input from ACCSH [OSHA' Advisory Committee on Construction Safety and Health] * * * on this provision. All commenters recommended dropping 'such as probing with hand-held tools' from the proposed provision, because this could create a hazard to employees by damaging the installation or its insulation.

In other words, the commenters objected to the use of hand tools being used unless detection equipment was used in conjunction with them. OSHA then concluded its discussion relative to this provision by agreeing with the commentators and ultimately not including any examples of "acceptable means" in the final provision.

Non-conductive hand tools are permitted

This raises the question of whether the standard permits the use of hand tools alone -- without also using detection equipment. NUCA and other industry stakeholders have recently informed us that non-conductive hand tools that are appropriate to be used to locate underground utilities are now commonly available.

Such tools, such as a "shooter" (which has a non-conductive handle and a snub nose) and non-conductive or insulated probes were not discussed in the rulemaking. Since they were not considered at that time, they were not part of the class of equipment that was thought to be unsafe for this purpose. Therefore, we conclude that the use of these types of hand tools, when used with appropriate caution, is an "acceptable means" for locating underground utilities.

Hydro-vacuum excavation

It is our understanding that some hydro-vacuum excavation equipment can be adjusted to use a minimum amount of water and suction pressure. When appropriately adjusted so that the equipment will not damage underground utilities (especially utilities that are particularly vulnerable to damage, such as electrical lines), use of such equipment would be considered a "acceptable means" of locating underground utilities. However, if the equipment cannot be sufficiently adjusted, then this method would not be acceptable under the standard.

Other technologies

We are not suggesting that these are the only devices that would be "acceptable means" under the standard. Industry stakeholders have informed us that there are other types of

special excavation equipment designed for safely locating utilities as well.

We apologize for any confusion our July 7 letter may have caused. If you have further concerns or questions, please feel free to contact us again by fax at: U.S. Department of Labor, OSHA, Directorate of Construction, Office of Construction Standards and Compliance Assistance, fax # 202-693-1689. You can also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, N.W., Washington, D.C. 20210, although there will be a delay in our receiving correspondence by mail.

Sincerely,

Russell B. Swanson, Director Directorate of Construction

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Standard Interpretations

08/05/1992 - Competent person responsibilities at excavations.

Standard Interpretations - Table of Contents

• Standard Number:

1926.651(k)(1)

August 5, 1992

Kenneth G. Fellers Manager, QA & Productivity Johnson Controls World Services, Inc. 381 Eniwetok Drive, MS-JQAP Los Alamos, NM 87544

Dear Mr. Fellers:

This is in response to your June 18 letter requesting an interpretation of the Occupational Safety and Health Administration (OSHA) standard addressing competent person responsibilities at excavations. I apologize for the delay in responding to your inquiry.

In regard to whether the competent person mentioned in 29 CFR 1926.651(k)(1) must be on site at all times, please be advised that there is no blanket requirement that a competent person be present at a construction jobsite at all times. The competent person can leave the site periodically, consistent with the goals of this section. It is the responsibility of the competent person to make those inspections necessary to identify situations that could result in hazardous conditions (e.g., possible caveins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions), and then to insure that corrective measures are taken. It is, therefore, subject to the conditions present at each individual worksite whether or not a competent person is required to be present at the jobsite at all times.

If we can be of any further assistance, please contact Mr. Roy F. Gurnham or Mr. Dale R. Cavanaugh of my staff in the Office of Construction and Maritime Compliance Assistance at (202) 523-8136 until September 27 and (202) 219-8136 thereafter.

Sincerely,

Patricia K. Clark, Director Dlirectorate of Compliance Programs

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Standard Interpretations

09/30/2004 - Permissibility of using average excavation depth to determine protective system requirements for the excavation.

Standard Interpretations - Table of Contents

Standard Number:

1926.650; 1926.652(a)(1)(ii); 1926.652(a)(1); 1926.652

(b); 1926.652(c)

OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov.

September 30, 2004

Mr. Richard Johnston Director of Loss Hausmann Johnson Insurance 700 Regent Street P.O. Box 259408 Madison, WI 53725-9408

Re: 29 CFR 1926.652(a)(1)(ii); whether averaging excavation depth is permitted for determining whether the protective requirements of §1926.652 apply.

Dear Mr. Johnston:

This is in response to your letter dated July 16, 2004, to the Occupational Safety and Health Administration (OSHA). You requested that OSHA address how measurements should be made when establishing the depth of an excavation pursuant to §1926.652(a)(1)(ii).

We have paraphrased your question as follows:

Question: Scenario: Equally spaced measurements are taken along the area of the trench that employees will be in. Some parts of a trench are more than 5 feet deep, while other parts are less than 5 feet deep. The average of those measurements is less than 5 feet. Would that establish that cave-in protection under 1926.652(a)(1) is not required?

Answer

No. Section 29 CFR 1926.652(a)(1) states:

- (a) Protection of employees in excavations. (1) Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:
- (ii) Excavations are less than 5 feet (1.52 m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

In §1926.650, the standard defines "excavation" as:

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

No minimum length was included in the definition. That is consistent with the fact that the danger of a cave-in an excavation 5 feet or more in depth does not significantly vary based on its length. Consequently, in a trench, at all points where the excavation is 5 feet or more (except in stable rock), cave-in protection is required. In a trench that varies above and below 5 feet along its length, there will be places in the trench where protective measures will be required and areas where they will not be required. The less than 5-foot average in your scenario for measurements taken at points along the excavation would not fall under the exemption of §1926.652(a)(1)(ii) because protective measures are required at each point where the excavation is 5 feet or deeper, or at each point less than 5 feet where there is evidence of a potential cave-in.

If you need any information on this matter, please contact us by fax at: U.S. Department of Labor, Directorate of Construction Office of Construction Standards and Guidance, (202) 693-1689. You may also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, N.W., Washington, D.C. 20210, although there may be a delay in our receiving correspondence by mail.

Sincerely,

Russell B. Swanson, Director Directorate of Construction

¹ Even in those areas of the trench that are less than 5 feet in depth, a protective system would be required, unless examination of the ground by a competent person did not reveal any indication of a potential cave-in. [back to text]

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Standard Interpretations

07/29/2005 - Adjusting work practices to comply with cave-in protection requirements in §1926.652, Requirements for protective systems in excavations.

Standard Interpretations - Table of Contents				
Standard Number:	1926.652(g)(2)			

OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keepapprised of such developments, you can consult OSHA's website at http://www.osha.gov.

July 29, 2005

David McClintock President IKOCPA, Ohio Executive Committee 100 South Third Street

Columbus, Ohio 43215

Re: Adjusting work practices to comply with cave-in protection requirements in §1926.652, Requirements for protective systems in excavations.

Dear Mr. McClintock:

This is in response to your letter dated November 15, 2004, to Richard Gilgrist, the Cincinnati Area Director for the Occupational Safety and Health Administration (OSHA). Your letter was forwarded to the Directorate of Construction, Office of Construction Standards and Guidance for response. We appreciate the additional information you provided in our telephone calls with you. We apologize for the delay in our response.

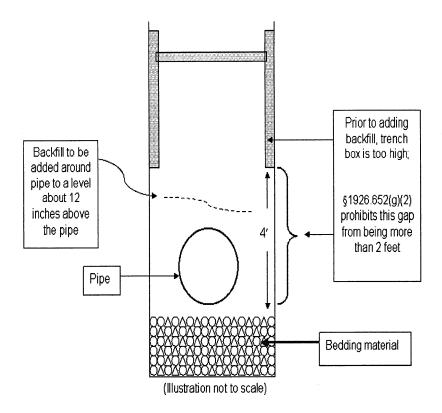
We have paraphrased your question as follows:

Question (1): Scenario: An 18-inch diameter (or larger) plastic pipe is installed in an excavated trench deeper than 5 feet. The trench has a layer of "bedding" material, which is typically crushed stone, which the pipe rests on. After the pipe is installed, backfill material (crushed stone) is added, which extends from the bedding to about 12 inches above the top of the pipe. During the process of installing the pipe, in accordance with Part 1926 Subpart P, a trench box is used.

One of the work practices used in this type of project is to use an excavator to drag the trench box to the next location after the backfill has been added. ASTM D2321 sections 6.4.1 and 6.4.2 recommend not disturbing the backfill when using a movable trench box and/or shield. In some cases, some contractors have found that if the trench box is installed in accordance with $\S1926.652(g)(2)$ - that is, no more than 2 feet above the bedding material - a problem arises.

With the trench box no more than 2 feet above the bedding, once the backfill is added the

trench box walls wind up below the surface of the backfill. When the trench box is dragged to the next location, the backfill sloughs off into the space previously occupied by the trench box walls and the pipe loses the support provided by the backfill. Consequently, some contractors want to install the trench box higher than 2 feet above the bedding to avoid disturbing the backfill (see illustration below).



There seems to be a conflict between ASTM D2321 and $\S1926.652(g)(2)$. Does such a conflict mean that this work practice is permissible under $\S1926.652(g)(2)$?

Answer: No, it is not permissible if workers are in the trench when the trench box is more than 2 feet above the bedding. 29 CFR 1926.652(g)(2) states:

Excavations of earth material to a level not greater than 2 feet (0.61 m) 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 there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

The employer would have to adjust its work practices to ensure that the requirements of $\S1926.652(g)(2)$ are met. Our understanding is that there are several ways an employer could comply with the OSHA requirements ($\S1926.652(g)(2)$) and ensure the pipe is adequately supported. For example, in the scenario you described, the employer could meet both the requirements of $\S1926.652(g)(2)$ and the ASTM recommendation by removing the employees in the trench before raising the trench box more than 2 feet. With the employees removed, there would be no employee exposure to the cave-in hazard while the trench box was lifted and moved, and therefore no violation of $\S1926.652(g)(2)$. Once the box is in its new position (and set less than 2 feet above the working surface, the employees could reenter the trench.

Question (2): What is the penalty for violating §1926.652(g)(2)?

Answer: In accordance with Section 17 of the Occupational Safety and Health Act of 1970 (as amended through January 1, 2004), the maximum penalty that may be assessed for a single, non-criminal violation of this requirement is \$70,000. The penalty assessed in a

particular case may be equal to or less than that amount, depending on a number of factors. These factors include whether the violation is classified as "willful," "repeated," "serious" or "other than serious." Other factors that may also affect the penalty assessment include the gravity of the violation, the size of the business of the employer being cited, the good faith of the employer and the employer's history, if any, of previous violations.

If you need any further information, please contact us by facsimile at: U.S. Department of Labor - OSHA, Directorate of Construction, Office of Construction Standards and Guidance 202-693-1689. You can also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, NW, Washington, DC 20210; although, there will be a delay in our receiving correspondence by mail.

Sincerely, Russell B. Swanson, Director

Directorate of Construction

cc: Michael Connors, Regional Administrator

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Standard Interpretations

05/11/2004 - Evaluation of the use of aluminum forms as an exit route from trench excavations.

Standard Interpretations - Table of Contents

• Standard Number:

1926.651; 1926.651(c)(2)

OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov.

May 11, 2004

Charles O. Engelken Wall-Ties & Forms, Inc. 4000 Bonner Industrial Drive Shawnee, Kansas 66226

Re: Use of aluminum forms as a means of egress [exit route] from trench excavations.

Dear Mr. Engelken:

This is in response to your June 16, 2003, letter to the Occupational Safety and Health Administration (OSHA) in which you asked whether using aluminum forms to climb out of trench excavations is considered an "other safe means of egress" under 29 CFR 1926.651(c) (2). Unfortunately, your letter was not forwarded from OSHA's Regional Office to us until December 24, 2003; we apologize for the delay in responding.

We have paraphrased your question below:

Question: Our residential construction workers are using aluminum forms as an alternative means of egress from trench excavations. Does this method of egress meet OSHA's requirements under §1926.651(c)(2)?

Answer:

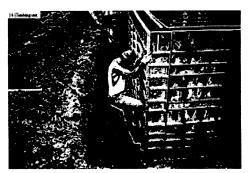
No. Section 1926.651(c)(2) states:

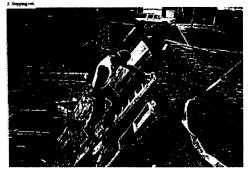
- (c) Access and egress--
- (2) Means of egress from trench excavations. A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

The photographs included in your letter indicate that workers are using aluminum forms as a means of egress from trench excavations in two different manners. In the first method, the workers lean the form against the sloped side of the trench and climb up the stiffeners and step out onto the bank. In the second, the workers ascend an assembled (vertical) form, place

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one foot on the opposite side of the trench (the bank), and then subsequently step across with the other foot; these are pictured below:







Both manners of using aluminum forms as a means of egress fail to meet the intent of the standard. The preamble to Subpart P (Excavations) states that "[T]his requirement [29 CFR 1926.651(c)(2)] is intended to provide employees working down in a trench with a safe means of escape in case of an emergency." (54 FR 45918, October 31, 1989.)

The photographs indicate that the stiffener only provides space for the tip of a worker's boot. This insufficient tread depth enhances the potential for tripping, slipping, or falling while trying to climb out of the trench in an emergency.

A slipping, tripping, or falling risk is further compounded by the worker having to step from a vertical form across to the bank. The photographs illustrate the worker precariously stepping onto the bank while straddling the trench. In particular, in a time of emergency (for example, a cave-in), the use of a form in this manner would not provide a safe means of egress as required by §1926.651(c)(2), which contemplates a means of egress that permits a quick and easy means of escape in case of an emergency.

If you need additional information, please do not hesitate to contact us by fax at: U.S. Department of Labor, OSHA, Directorate of Construction, Office of Construction Standards and Guidance, fax # 202-693-1689. You can also contact us by mail at the above office, Room N3468, 200 Constitution Avenue, N.W., Washington, D.C. 20210, although there will be a delay in our receiving correspondence by mail.

Sincerely,

Russell B. Swanson, Director **Directorate of Construction**

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Standard Interpretations

12/02/1991 - Standards addressing excavations

Standard Interpretations - Table of Contents

• Standard Number:

1910.120; 1926.652

December 2, 1991

Mr. Dennis E. Palmer, P.E. Vice President Barr Engineering Company 7803 Glenroy Road Minneapolis, Minnesota 55439-3123

Dear Mr. Palmer:

This is in response to your letter requesting an interpretation of the Occupational Safety and Health Administration standards addressing excavations. I apologize for the delay in responding to your inquiry.

In your letter, you asked whether distance alone was adequate to protect employees from the hazards of cave-ins. We reviewed the situation discussed in your letter and determined that at the times your employee maintained a distance of at least two times the height of the vertical sidewall from the toe of the sidewall, the employee was not exposed to the hazards of cave-in. Therefore, no additional protective system was necessary. However, when distance alone is relied upon to protect employees from the hazards of cave-in, all employees entering the excavation must be instructed not to enter the danger zone and a warning system must be provided to prevent workers from entering the danger zone inadvertently. Roping off the area or adequately marking the area with cones, flags or other highly visible means are examples of acceptable warning systems.

Please be advised that it is the responsibility of a competent person to determine, based on the conditions existing at each site, the distance away from the highwall necessary to protect the workers and the warning system necessary to adequately warn workers of the hazardous area.

If we can be of any additional assistance, please contact Roy F. Gurnham or Dale R. Cavanaugh of my staff in the Office of Construction and Maritime Compliance Assistance at (202)235-8136.

Sincerely,

Patricia K. Clark
Director
Directorate of Compliance Programs

April 3, 1991

Ms. Patricia K. Clark
Director
Directorate of Compliance Programs
Room N-3471
USDOL-OSHA
200 Constitution Ave.
Washington, D.C. 20210

Re: 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response Request for Interpretation on Site Excavation Section

Dear Ms. Clark:

Barr Engineering Co. (Barr), respectfully requests an interpretation of the Site Excavation requirement in the Hazardous Waste Operations and Emergency Response Standard [29 CFR 1910.120(b)(1)(iii)] as it relates to appropriate protective systems.

On November 20, 1990 the Peoples Natural Gas Site in Dubuque, Iowa was inspected by an Iowa OSHA Health compliance officer. The Iowa OSHA compliance officer observed the presence of sideslopes that were not in compliance with the OSHA requirements for excavations. Barr subsequently received a citation that stated:

"Near Coal Tar Tanks, Exclusion Zone-Class "C" soil of excavation area was stepped in two vertical cuts of 5 feet each. This did not meet the sloping or benching specifications for that type of soil as per 1926.651."

Barr's responsibility at the site is to observe the contractor for conformance with the plans and specifications, on behalf of the owner, and to perform soil sampling for chemical analysis and other miscellaneous work as a consultant to the owner. Barr was aware that the sideslopes cited by the Iowa OSHA compliance officer were present, and the Barr employee on-site maintained a safe distance from these sidewalls at all times while working in the excavation. Barr did not have the responsibility for the construction of these sideslopes and did not have the authority to correct the problem. Barr had informed the owner and the contractor of the presence of these sideslopes.

Because the Barr employee maintained what we considered to be a safe distance from the vertical sidewalls during the performance of his work, we believe that our employee was adequately protected from cave-in. The following paragraphs outline the methods that the Barr employee used while working at the site to protect himself from the potential danger associated with the unsafe sideslopes.

Figure 1 shows a layout of the project site. Figures 2 and 3 show a representation of the excavation and cross sections of the excavation. These figures illustrate the location of the two vertical sidewalls seen by the Iowa OSHA compliance officer who visited the site. The areas which the Barr employee considered to be safe for the work of collecting soil samples or otherwise conducting observation activities are also identified on Figures 2 and 3. To conduct Barr's work at the site it was necessary for the Barr employee to enter the excavation, however, it was not necessary to be in the immediate vicinity of the vertical sideslopes.

Typically, Barr considered that the probable distance from a vertical sidewall that may be impacted during a slope cave-in would be two times the height of any given sidewall. Therefore, to be safe from the danger presented by the vertical sidewall, the Barr employee maintained a safe distance of at least two times the height of the vertical sidewall from the toe of the vertical sidewall.

Although the OSHA Excavation Standard (29 CFR 1926 Subpart P) does not describe the use of a safe distance as a specific safety protective system to protect employees from caveins, it is our belief that in a large excavation, distance from an unsafe sideslope could serve as a good safety measure. Barr believes that this may have been an oversight in the promulgation of the standard.

Please review this situation and offer an interpretation on whether distance, as determined by sound engineering principles, can be used as an adequate protective measure. If you have any questions concerning the methods that the Barr employee used to protect himself or if you need further information pertaining to the conditions of this site, please feel free to contact Jim Langseth or me at (612) 830-0555. We look forward to your reply.

Sincerely,

Dennis E. Palmer, P.E. Vice President

DEP/mls Enclosures

November 5, 1991

MEMORANDUM FOR: Patricia K. Clark

Director Directorate of Compliance Programs

ATTENTION:

Dale R. Cavanaugh

Office of Construction and Maritime

Compliance Assistance

FROM:

John T. Phillips Regional Administrator

SUBJECT:

Comments - Draft Response to Barr Engineering

Company

Upon review of your subject draft response letter, we are in agreement with your interpretation of a safe distance. However, we would suggest that once a safe distance has been determined, a system be provided to warn employees whenever they may inadvertently stray into the danger zone created by the vertical face. OSHA considers the assurances that determining and maintaining warning devices would fall under the responsibility of the competent person at each trench/excavation site. Some practical devices such as cones, warning lines or flags could be used to identify the potential danger to the employees.

Attachment

November 4, 1991

MEMORANDUM FOR: John T. Phillips

Regional Administrator

ATTENTION:

Darrell McClatchey/FSO

FROM:

Alonzo L. Griffin

Area Director

SUBJECT:

Comments--Draft Response to Barr Engineering Company

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The Des Moines Area Office has reviewed the proposed draft response and discussed it with the State of Iowa. Iowa's comments are as follows:

- 1. Iowa believes that being given one day to review and respond to these issues is not sufficient time to address the concerns raised, especially in light of the fact that National Office took six months to review these issues.
- 2. Iowa agrees that safe distances are one means to protect an employee (i.e., not exposed to a hazard), but sufficient analyses and design must be made to determine the safe distances as required by 29 CFR 1926.652 (c). Iowa does not feel the assumption that one is protected if one is two times the height away from the toe of a vertical excavation is sufficient unless engineering or other competent data is presented to support such a conclusion.

Iowa feels a competent person, trained to recognize the hazards and understand the standards, would be required to evaluate an excavation. This person would be required to inspect the site and change any distance requirements if conditions on the site should change (i.e., excavation equipment operating on the slope in question).

3. Iowa also feels that positive means be used to prevent entry into those excluded areas, as pointed out in comments made by Region VII.

The Des Moines Area Office comment is as follows:

The response letter should state with absolute certainty that the interpretation applies only to the situation as presented, not to situations in general.

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Standard Interpretations

03/23/1992 - Construction standards addressing excavations.

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• Standard Number:

1926.651(h)

March 23, 1992

Mr. George Kennedy, C.S.P. Director of Safety National Utility Contractors Association 137 Ruhle Road Ballston Spa, New York 12020

Dear Mr. Kennedy:

This is in response to your September 20 request for interpretation of the Occupational Safety and Health Administration (OSHA) construction standards addressing excavations. I apologize for the delay in responding to your inquiry.

In regard to whether workers can enter a trench with water accumulation if the workers are protected from cave-in by shoring, shields or sloping and the water level is controlled, please be advised by the following: Paragraph .651(h) of 29 CFR 1926 allows workers to work in a trench with water accumulation, provided adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to comply with the standard vary with each situation, and the precautions you listed, such as additional shoring and control of the water level may not, in all cases, provide the required employee protection.

In regard to whether a stairway or ladder is required at points of access to a trench where there is a break in elevation of 19 inches or more, please be advised that since the specific excavation standard also addresses means of access and egress, the more general requirement in the stairways and ladders subpart is not applicable. A ladder, stairway, ramp or other safe means of access is required only when the trench is four feet or more in depth.

In regard to whether emergency rescue equipment is required at every trenching jobsite located near or passing by a gas station, refinery, gas line, sewer main, etc., please be advised by the following: Emergency rescue equipment is required to be readily available where a competent person determines, based on the conditions at each jobsite, that hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. In regard to whether a contractor can rely on a local rescue squad instead of providing the rescue equipment, please be advised that many emergency situations associated with the hazards involved with hazardous atmospheres in trenches would normally require an immediate response within a few minutes or even seconds. A rescue squad would be unable to provide the necessary response and therefore could not be used to comply with 1926.651 (g)(2).

In regard to whether a contractor must have separate manufacturer's tabulated data on hand for each specific shield, please be advised that only one set of tabulated data is required for each different shield design. If a contractor uses several shields of the identical make and model, only one set of tabulated data would be required for them.

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In regard to whether manufacturer's tabulated data can be used to design protective systems for trenches more than 20 feet in depth, please be advised as follows: Protective systems that are designed using manufacturer's tabulated data can be used in trenches deeper than 20 feet provided the use is within the limits of the data, including depth limitations and soil type. It should be noted that all tabulated data, by definition (1926.650), must be approved by an RPE.

In regard to the need to recertify protective systems that have been damaged or repaired, please be advised as follows: Shields or other protection systems, damaged to the extent that the structural integrity or the ability of the system to perform as designed is affected, cannot be used until repaired and recertified by a Registered Professional Engineer (RPE) or the manufacturer of the system. Minor repairs or normal maintenance done in accordance with manufacturers specifications do not need recertification.

In regard to how ladders must be secured in trenches, please be advised that paragraphs 1926.1053(b)(6) and (7) address ladder footing displacement which is not normally a problem in trenches. If a ladder needs to be secured against tipping, it may be secured to a shield or member of a protective structure provided the ladder does not alter the effectiveness of the protective system.

In regard to whether a competent person must be present at a trench at all times, please be advised that it is not normally necessary for a competent person to be at a jobsite at all times. However, it is the responsibility of a competent person to ensure compliance with applicable regulations and to make those inspections necessary to identify situations that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, and then to insure that corrective measures are taken. Consistent with these goals, the competent person may perform other duties.

In regard to whether an RPE must approve all work when digging below a footing, foundation, retaining wall, sidewalk or pavement, please be advised by the following: An RPE approval is not required when the excavation is not "reasonably expected to pose a hazard to employees." In situations where it is reasonably expected to pose a hazard, an RPE approval is not required when a support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure, or the excavation is in stable rock.

In regard to the conditions under which OSHA would consider a trench a confined space, please be advised that under normal circumstances, a trench would not be considered a confined space. The excavation standards address the hazards associated with employees entering potentially harmfully atmospheres by requiring atmospheric testing and controls where hazardous atmospheres exist or could reasonably be expected to exist.

In regard to trenching along a hillside where the trench walls are at different heights, a contractor must provide a support system that will withstand the forces present at the bottom of the deepest side, or rely on a protective system approved by an RPE.

In regard to whether OSHA will accept a thumb test when estimating the compressive strength of soil, please be advised that the thumb penetration test is one of the acceptable methods of estimating soil compressive strength. The compressive strength can be determined by laboratory testing, or estimated in the field using a penetrometer, shearvane, thumb penetration tests, as well as by other methods.

I hope these explanations will be helpful to you and your members. If we can be of any further assistance, please contact Roy F. Gurnham or Dale R. Cavanaugh of my staff in the Office of Construction and Maritime Compliance Assistance at (202) 523-8136.

Sincerely,

Patricia K. Clark, Director Directorate of Compliance Programs

September 20, 1991

Mr. Roy Gurham
Director of Compliance Assistance
U.S. Dept. of Labor - OSHA
200 Constitution Ave., N.W.
Room N3610
Washington, D.C. 20210

Dear Roy,

Our members are concerned about the way the Excavation Standard is being interpreted in different parts of the country. They have requested that I contact you to have some parts of the standard clarified.

If possible, please provide me with interpretations for the following questions, so that I can disseminate it to our members.

- 1. Can workers enter a trench with water accumulation if the workers are protected from cave-in by shoring, shields or sloping, and the water level is controlled?
- 2. The Stairways and Ladders Standard requires that a stairway or ladder shall be provided at points of access where there is a break in elevation of 19 inches or more. The Excavation Standard requires a ladder or other means of access and egress when the trench is 4 feet or more. Which of these requirements is applicable to trenching operations?
- 3. Must rescue equipment be available at every trenching jobsite that is located near of passes by a gas station, refinery, gas line, sewer main, etc? Can a contractor rely on the local rescue squad since they are probably better equipped to handle a rescue?
- 4. If a contractor has several of the same make and model trench shields at a jobsite, does he have to have separate manufacturer's tabulated data on hand for each specific shield? We have been told that the shields and the data sheets must have the same serial number in order to be in compliance.
- 5. Do excavations greater than 20 feet have to be designed by an RPE or can manufacturer's tabulated data be used in lieu of an RPE? For example, a contractor may have boxes rated for depths greater than 20 feet.
- 6. Does a RPE have to recertify a trench shield if the skin is patched? If the rail from an aluminum hydraulic shoring system is bent slightly out of shape, does it have to be removed from service, repaired and recertified by an RPE? At what point does and RPE have to recertify equipment that has been repaired?
- 7. We clearly understand that a ladder has to be secured, but we are not sure how. Contractors have informed us that compliance officers have told them that they can not secure a ladder to the shoring system or in some cases the trench shield. These same contractors have been told to secure the ladder by driving a stake into the ground and to tie the ladder off to the stake. This alternate method presents three different problems: 1) It is not always possible to drive a stake through concrete or asphalt sidewalks or pavement; 2) This method creates a tripping hazard next to the trench; 3) Some contractors believe that

driving a stake could create a stress crack. Please clarify these requirements for us?

- 8. Does the competent person have to be standing by the trench at all times during the work shift or can he/she go off site for short periods of time, such as lunch, meeting, or maybe to pick up supplies at the local builders supply store? Can the competent person move around the jobsite away from the trench? often the foreman is the competent person and he may have other responsibilities at the jobsite.
- 9. Must a RPE approve all work when digging below a footing, foundation, retaining wall, sidewalk or pavement? We recognize the need for an RPE to design a system to support buildings and structures. However, we don't agree that an RPE is needed to layout a system to support sidewalks, pavement, and in some cases small structures like a small retaining wall. It is often very difficult to find an RPE who is willing to take on small incidental projects.
- 10. At what point and under what conditions would OSHA consider a trench a confined space?
- 11. When trenching along the side of a hill, what criteria should a contractor use to determine the depth of the trench?
- 12. Some compliance officers are telling contractors that they must use a penetrometer or shearvane to estimate the compressive strength of soil and that the thumb test is unacceptable. Keeping in mind that these are field tests. We realize that the thumb test is not accurate, but neither is the penetrometer that many compliance officers swear by. What is OSHA's interpretation for using a thumb test versus an instrument?

These questions are common and in several cases contractors have been cited. We are concerned and want to make sure our members clearly understand the regulations.

Thank you for your assistance.

Sincerely,

George S. Kennedy, CSP Director of Safety

P.S. Please send your reply to me at: 137 Ruhle Road, Ballston Spa, NY 12020 (518)885-2560

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Occupational Safety & Health Administration 200 Constitution Avenue, NW Washington, DC 20210

IM-93-7

July 13, 1993

Jack Nelson Associated General Contractors 9450 SW Commerce Circle Wilsonville, OR 97070

Dear Mr. Nelson:

We have reviewed your final document "Alternate Sheeting for Shallow Trench Excavations" prepared for you by Bill B. Zubeck and W.L. Schroeder of the Civil Engineering Department of Oregon State University. As we discussed in the meetings to initiate this project, the excavation standard at 1926-652 provides, as one option for the protective system in an excavation, that they be based on designs using other tabulated data. The option for the use of other tabulated data must include in written form the identification of the parameters that affect the selection of the system, the limits of the use of the data, and an adequate explanation for the user of the data as to how to select the elements of the system.

The design tables in this document are considered acceptable by Oregon OSHA to satisfy the requirements for other tabulated data when used to design a system where steel plate and steel or aluminum sheet pile are used for uprights in lieu of timber and for use with aluminum hydraulic shoring. It is limited to use in excavations less than 20 feet deep and when the user is following all of the other limitations and specifications detailed in the tables and accompanying documentation. When these tables are being relied upon to design a protective system under option 3 of 1926.652, a copy of the tabulated data must be on the jobsite during construction of the protective system.

We appreciate your efforts to develop this information and make it available to the construction community. If you have any questions please feel free to call me at 378-3272.

Sincerely,

Marilyn K. Schuster, Manager Standards and Technical Resources Section Oregon Occupational Safety & Health Division 378-3272

2220-ORTECH/MS:mic

March 25, 2003

Jeremy L. Lawson, Safety Manager Slayden Construction, Inc. P.O. Box 625 Stayton, Oregon 97383

Dear Mr. Lawson:

In answer to the first question in your March 12th letter, the practice of dragging a trench shield along the bottom of a trench with an employee(s) inside is acceptable. The front of the shield may be lifted slightly, with the majority of the shield remaining in contact with the bottom of the trench. The sides of the shield must be kept close to the sides of the trench to prevent any chance of tipping or lateral displacement. The employee(s) must move with the shield and always stay within it. A ladder or other safe means of exit also must move with the shield and be available for immediate use.

In answer to your second question, ground-fault interrupter protection must be provided for all employees engaged in construction activities and using 125-volt, single-phase, 15-, 20-, and 30- amp receptacles. The standard is performance-based, which allows the actual GFCI to be located anywhere in the circuit (at the beginning of the circuit, mid-circuit, or between the cord and the tool) as long as GFI protection is provided to all employees working off from that circuit, or handling the energized cord.

For further information, please contact Mike Mitchell at (503) 947-7450. You are also invited to see the OR-OSHA pages on the Internet at the above address.

Sincerely,

Mike L. Mitchell for Marilyn K. Schuster, Manager Standards & Technical Resources Oregon Occupational Safety and Health Division

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TRENCH INSPECTION AND ENTRY AUTHORIZATION FORM									
LOCATION:		·							DATE:
TIME OF INSPECT	rion(s)								
WEATHER CONDITIONS:				APPROX. TEM			ЛР. :		
CREW LEADER:			su	SUPERVISOR:					
DIMENSIONS:	DEPTH =			Yes	s No	0	HΑ	ZARDOUS CO	NDITIONS
	TOP =	W L				Sa	atu	rated soil / stand	ding or seeping water
	BOTTOM =	W L				Cr	rac	ked or fissured	wall(s)
SOIL	TYPE:	TEST	TED:			Bı	ulgi	ing wall(s)	
☐ Solid rock (mos	t stable)	☐ Yes		□ □Floor heaving					
□ Average soil		□ No				Fr	oz	en soil	
☐ Fill material						Sເ	upe	er-imposed load	s
☐ Loose sand						Vi			
						De	ept	th greater than 1	0'
PROTECTION METHODS:					PLACEN	ΛE	NT OF SPOILS	& EQUIPMENT	
(Walls M	IUST be vertica	I—NO voids)			□ □ Spoils at least 2 feet from edge of trench				
	SHORING			□ □ Equipment at least 2 feet from edge					
□ Timber			□ □Backhoe at end of trench						
☐ Pneumatic				□ □ Compressor, etc. at remote location					
☐ Hydraulic				LADDER LOCATION					
☐ Screw Jacks				□ □Located in protected area					
☐ Trench Shield			□ □ Within 25 feet of safe travel						
UNEV	'EN, IRREGULA	R WALLS		□ □ Secured					
☐ Trench Box				□ □Extends 36 inches above the landing					
Sloping: q	1:1 (45°) q ′	1 ½:1 (34°)		□ □Leads to safe landing					
	IRONMENTAL (CONDITIONS:						OTHER:	
☐ ☐ Gas detecte	or used?			☐ ☐ Shoring equip. & matls inspected prior to use?					
☐ ☐ Confined space permit issued?			□ □ Is trench SAFE to enter?						
COMMENTS:						•			
								1	
				Wo	ork	Order#			
N All upoeto estadi	tions must be seen	noted prior to tra-	nch ontre	то	BE	FILLED OUT	۲В`	Y EHS PERSONNE	L
O If any hazardous	tions must be corre conditions are ob	served, the trend							
be immediately evacuated and no one allowed to re-enter until corrective action has been taken.			Ex	Excavation Entry Authorized By: EHS Inspector					

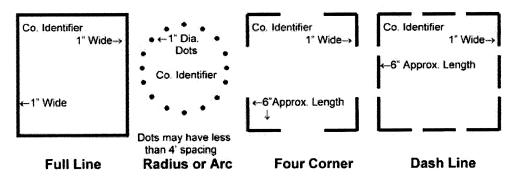
BEST PRACTICES CHAPTER - EXCAVATION PRACTICES

Practice Statement 5-2: When the excavation site cannot be clearly and adequately identified on the locate ticket, the excavator designates the route and/or area to be excavated using white premarking prior to the arrival of the locator. (See "Guidelines for Excavation Delineation" Below)

Guidelines for Excavation Delineation¹⁹

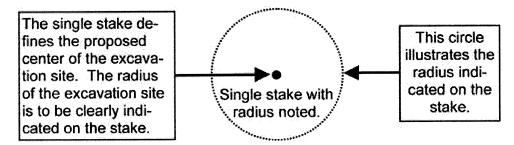
The following marking illustrations are examples of how excavators may choose to mark their area of proposed excavation. The use of white marking products (e.g. paint, flags, stakes, whiskers or a combination of these) may be used to identify the excavation site.

Single Point Excavations Markings



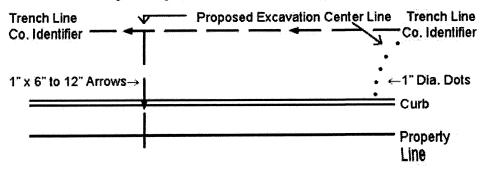
Delineate in white paint the proposed area of excavation through the use of: a continuous line, dots marking the radius or arcs, dashes marking the four corners of the project or dashes outlining the excavation project. Limit the size of each dash to approximately 6" to 12" in length and 1" in width with interval spacing approximately 4' to 50' apart. The maximum separation of excavation marks is to be reduced to a length that can be reasonably seen by the operator's locators when the terrain or excavation site conditions warrant it. Dots of approximately 1" diameter are typically used to define arcs or radii and may be placed at closer intervals in lieu of dashes.

Single Stake Marking Center Point of Excavation Site



When an excavation site is contained within a 50' maximum radius, or less, it can be delineated with a single stake that is positioned at the proposed center of the excavation. If the excavator chooses this type of delineation they must convey that they have delineated the excavation site with a single stake at the center of the excavation and include the radius of the site in the notification to the One-Call Center. This single stake is to be white in color with the following information: excavator's company identifier (name, abbreviations, or initials) and the radius of the excavation site in black letters on the stake or with a notice attached to the stake.

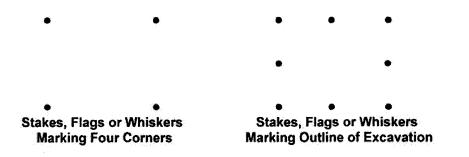
Trenching, Boring, or Other Continuous Type Excavations



Continuous Excavation Marking

Mark in white paint the proposed centerline of planned excavation 6" to 12" x 1" arrows, approximately 4' to 50' apart to show direction of excavation. The maximum separation of excavation marks is to be reduced to a length that can be reasonably seen by the operator's locators when the terrain at an excavation site warrants it. Mark lateral excavations with occasional arrows showing excavation direction from centerline with marks at curb or property line if crossed. Dots may be used for curves and closer interval marking.

Stakes, Flags or Whiskers Excavation Markers



Delineate the proposed area of excavation through the use of: stakes, flags or whiskers to mark radius or arcs, the four corners of the project or outlining the excavation project instead of using spray paint. Limit the interval spacing to approximately 4' to 50'. The maximum separation of excavation marks is to be reduced to a length that can be reasonably seen by the operator's locators when the terrain at an excavation site warrants it. Stakes, flags or whiskers provided to illustrate arcs or radii may be placed at closer intervals in order to define the arc or radius. Stakes, flags or whiskers are white in color with the excavator's company identifier (name, abbreviations, or initials) provided on the stake, flag or whisker.

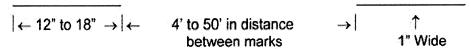
BEST PRACTICES CHAPTER - LOCATING & MARKING PRACTICES

Practice Statement 4-3: A uniform color code and set of marking symbols is adopted. (See "Guidelines for Operator's Facility Field Delineation" Below)

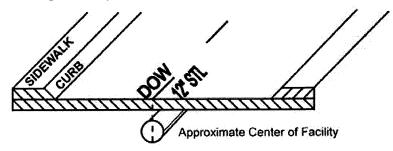
Guidelines for Operator's Facility Field Delineation²⁰

Operator markings of facilities include; the appropriate color for their facility type; their company identifier (name, initials, or abbreviation) when other companies are using the same color, the number and width of their facilities and a description of the facility (HP, FO, STL etc). Use paint, flags, stakes, whiskers or a combination to identify the operator's facility(s) at or near an excavation site.

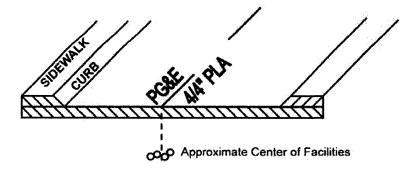
 Marks in the appropriate color are to be approximately 12" to 18" in length and 1" inch in width and separated by approximately 4' to 50' in distance as an example. When marking facilities the operator is to consider the type of facility being located, the terrain of the land, the type of excavation being done and the method to adequately mark its facilities for the excavator.



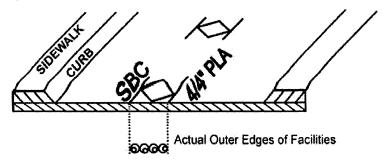
- 2. The following marking illustrations are examples of how an operator may choose to mark their subsurface installations
 - a. Single Facility Marking: Used to mark a single facility, marks are placed over the approximate center of the facility. This example indicates an operator's 12" facility. When a facility can be located or toned separately from other facilities of the same type it is marked as a single facility.



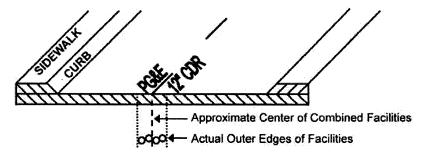
b. Multiple Facility Marking: Used to mark multiple facilities of the same type (e.g. electric), where the separation does not allow for a separate tone for each facility but the number and width of the facilities is known. Marks are placed over the approximate center of the facilities and indicate the number and width of the facilities. This example indicates 4 plastic facilities that are 4" in diameter (4/4" PLA).



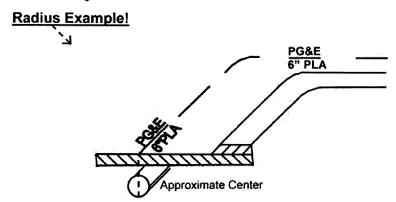
c. Conduit Marking: Used for any locatable facility being carried inside conduits or ducts. The marks indicating the outer extremities denote the actual located edges of the facilities being represented. An example would be 4 plastic conduits that are 4" in diameter (4/4" PLA), and the marks are 16" apart indicating the actual left and right edges of the facilities.



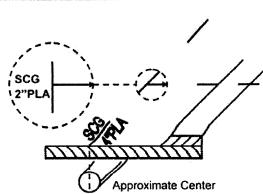
d. Corridor Marking: Used to mark multiple facilities of the same type (e.g. electric), in the same trench where the total number of facilities is not readily known (operator has no record on file for the number facilities) and that are bundled or intertwined. Marks are placed over the approximate center of the facilities and indicate the width of the corridor. The width of the corridor is the distance between the actual located outside edges of the combined facilities. This example indicates a 12" corridor (12" CDR).



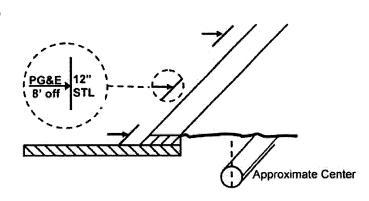
3. Changes in direction and lateral connections are to be clearly indicated at the point where the change in direction or connection occurs with an arrow indicating the path of the facility. A radius is indicated with marks describing the arc. When providing offset markings, (paint or stakes), show the direction of the facility and distance to the facility from the markings.



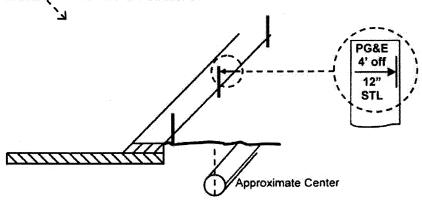
Lateral Connection Example!



Painted Offset (off) Example!



Staked Offset (off) Example!



4. An operator's identifier (name, abbreviation or initials) is to be placed at the beginning and at the end of the proposed work. In addition to the previous, subsequent operators using the same color will mark their company identifier at all points where their facility crosses another operator's facility using the same color. The maximum separation of identifiers is to be reduced to a length that can be reasonably seen by the excavator when the terrain at the excavation site warrants it.

CTYSAC

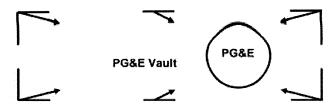
CITIZENS

VERIZON

5. Information as to the size and composition of the facility is to be marked at an appropriate frequency. Examples are: the number of ducts in a multi-duct structure, width of a pipeline, and whether it is steel, plastic, cable, etc.

CCWD 4" PLA RSVTEL 9 PLA DOW 12" STL 6. Facilities installed in a casing should be identified as such. Two examples are: 6" plastic in 12" steel = 6"PLA/12"STL and fiber optic in 4" steel = FO(4"STL).

 Structures, such as vaults, inlets, lift stations that are physically larger than obvious surface indications, are to be marked so as to define the parameters of the structure.

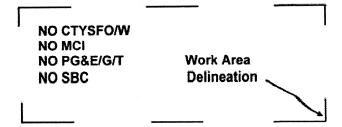


8. Termination points or dead ends are to be indicated as such.



- When there is "No Conflict" with the excavation complete one or more of the following:
 - Operators of a single type of facility (e.g. AT&T) would mark the area "NO" followed by the appropriate company identifier in the matching APWA color code for that facility (e.g. "NO AT&T")
 - Operators of multiple facilities would mark the area "NO" followed by the appropriate company identifier in the matching APWA color code for that facility with a slash and the abbreviation for the type of facility that there is "No Conflict" (e.g. "NO PG&E/G/D"). The example illustrates that PG&E has no gas distribution facilities at this excavation site. The abbreviation for; gas transmission facilities is "/G/T", electric distribution is "/E/D" and electric transmission is " E/T" these should be used when appropriate.
 - Place a clear plastic (translucent) flag that states "No Conflict" in lettering matching the APWA color code of the facility that is not in conflict. Include on the flag the operator's identifier, phone number, a place to write the locate ticket number and date. Operators of multiple facilities would indicate on the flag, which facilities were in "No Conflict" with the excavation as in the previous example.
 - If it can be determined through maps or records that the proposed excavation is obviously not in conflict with their facility (s) the locator or operator of the facility may notify the excavator of "No Conflict" by phone, fax, or email, or through the One-Call Center, where electronic positive response is used. Operators of multiple facilities would indicate a "No Conflict" for each facility as in the previous examples.
 - Place "No Conflict" markings or flags in a location that can be
 observed by the excavator and/or notify the excavator by phone,
 fax, or email that there is "No Conflict" with your facilities. When
 the excavation is delineated by the use of white markings, place "No
 Conflict" markings or flags in or as near as practicable to the
 delineated area.

"No Conflict" indicates; that the operator providing the "No Conflict" has no facilities within the scope of the delineation, or when there is no delineation, there are no facilities within the work area as described on the locate ticket.



Color Code Identifiers

White Pink Red Yellow Orange	Proposed Excavation Temporary Survey Markings Electric Power Lines, Cables, Conduit and Lighting Cables Gas, Oil, Steam, Petroleum or Gaseous Materials Communication, Alarm or Signal Lines, Cables or Conduit
	Communication, Alarm or Signal Lines, Cables or Conduit Potable Water Reclaimed Water, Irrigation and Slurry Lines
Green	Sewers and Drain Lines

Common Abbreviations:

Facility Identifier

CH	Chemical
E	Electric
FO	Fiber Optic
G	Gas
LPG	Liquefied Petroleum Gas
PP	Petroleum Products
RR	Railroad Signal
S	Sewer
SD	Storm Drain
SS	Storm Sewer
SL	Street Lighting
STM	Steam
SP	Slurry System
TEL	Telephone
TS	Traffic Signal
T∨	Television
l W	Water
W	Reclaimed Water "Purple"

Underground Construction Descriptions

	Conduit Corridor Distribution Facility Direct Buried Dead End Joint Trench High Pressure Hand Hole Manhole Pull Box Radius
STR	Structure (vaults, junction
Т	boxes, inlets, lift stations) Transmission Facility

Infrastructure Material

ABS ACP CICL CMLP COMPTDA COMP	Acrylonitrile - Butadiene - Styrene Asbestos Cement Pipe Cast Iron Cement Mortar Coated Cement Mortar Lined Corrugated Plastic Pipe Corrugated Metal Pipe Copper Creosote Wood Duct High Density Polyethylene Multiple Tile Duct Plastic (conduit or pipe) Reinforced Concrete Box Reinforced Concrete Pipe Reinforced Fiberglass Steel Cylinder Concrete Pipe Steel Vertrified Clay Pipe
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Guide for Abbreviation Use

This is a guide for placing the above abbreviations in the field. The Company Identifier is to be placed at the top or at the left of the abbreviations. Place the abbreviations in the following order, Company Identifier / Facility Identifier / Underground Construction Descriptions / Infrastructure Material (e.g. SBC/TEL/FO/PLA). This example indicates that SBC has a Telecommunication Fiber Optic line in a single Plastic conduit. The use of the abbreviation /TEL is not necessary, because the orange marking would indicate that the facility was a communication line, but its use is optional. To leave out one or more of the abbreviation types you would continue to follow the order of the abbreviations above leaving out the slash and abbreviation that does not apply (e.g. /TEL), the result would be the following (e.g. SBC/FO/PLA).

OSHA Technical Manual

SECTION V: CHAPTER 2 - EXCAVATIONS: HAZARD RECOGNITION IN TRENCHING AND SHORING

Contents:

I.	Introduction	VIII.	Sloping and Benching
II.	Definitions	IX.	Spoil
III.	Overview	Х.	Special Health and Safety
IV.	Determination of Soil Type		Considerations
٧.	Test Equipment	XI.	Bibliography
VI.	Shoring Types	XII.	Appendix V:2-1. Site
VII.	Shielding Types		Assessment Questions

I. INTRODUCTION.

Excavating is recognized as one of the most hazardous construction operations. OSHA recently revised Subpart P, *Excavations*, of 29 CFR <u>1926.650</u>, <u>.651</u>, and <u>.652</u> to make the standard easier to understand, permit the use of performance criteria where possible, and provide construction employers with options when classifying soil and selecting employee protection methods.

This chapter is intended to assist *OSHA Technical Manual* users, safety and health consultants, OSHA field staff, and others in the recognition of trenching and shoring hazards and their prevention.

II. **DEFINITIONS**.

- A. **ACCEPTED ENGINEERING PRACTICES** are procedures compatible with the standards of practice required of a registered professional engineer.
- B. **ADJACENT STRUCTURE STABILITY** refers to the stability of the foundation(s) of adjacent structures whose location may create surcharges, changes in soil conditions, or other disruptions that have the potential to extend into the failure zone of the excavation or trench.
- C. **COMPETENT PERSON** is an individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate or control these hazards and conditions.
- D. **CONFINED SPACE** is a space that, by design and/or configuration, has limited openings for entry and exit, unfavorable natural ventilation, may contain or produce hazardous substances, and is not intended for continuous employee occupancy.
- E. **EXCAVATION**. An **Excavation** is any man-made cut, cavity, trench, or depression in an earth surface that is formed by earth removal. A **Trench** is a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth of a trench is greater than its width, and the width (measured at the bottom) is not greater than 15 ft (4.6 m). If a form or

other structure installed or constructed in an excavation reduces the distance between the form and the side of the excavation to 15 ft (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

- F. **HAZARDOUS ATMOSPHERE** is an atmosphere that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygendeficient, toxic, or otherwise harmful may cause death, illness, or injury to persons exposed to it.
- G. **INGRESS AND EGRESS** mean "entry" and "exit," respectively. In trenching and excavation operations, they refer to the provision of safe means for employees to enter or exit an excavation or trench.
- H. **PROTECTIVE SYSTEM** refers to a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, and 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.
- I. **REGISTERED PROFESSIONAL ENGINEER** is a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer who is registered in any state is deemed to be a "registered professional engineer" within the meaning of Subpart P when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.
- J. **SUPPORT SYSTEM** refers to structures such as underpinning, bracing, and shoring that provide support to an adjacent structure or underground installation or to the sides of an excavation or trench.
- K. **SUBSURFACE ENCUMBRANCES** include underground utilities, foundations, streams, water tables, transformer vaults, and geological anomalies.
- L. **SURCHARGE** means an excessive vertical load or weight caused by spoil, overburden, vehicles, equipment, or activities that may affect trench stability.
- M. **TABULATED DATA** are tables and charts approved by a registered professional engineer and used to design and construct a protective system.
- N. **UNDERGROUND INSTALLATIONS** include, but are not limited to, utilities (sewer, telephone, fuel, electric, water, and other product lines), tunnels, shafts, vaults, foundations, and other underground fixtures or equipment that may be encountered during excavation or trenching work.
- O. **UNCONFINED COMPRESSIVE STRENGTH** is the load per unit area at which soil will fail in compression. This measure can be determined by laboratory testing, or it can be estimated in the field using a pocket penetrometer, by thumb penetration tests, or by other methods.
- P. **DEFINITIONS THAT ARE NO LONGER APPLICABLE**. For a variety of reasons, several terms commonly used in the past are no longer used in revised Subpart P. These include the following:

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- Angle of Repose Conflicting and inconsistent definitions have led to confusion as to the meaning of this phrase. This term has been replaced by Maximum Allowable Slope.
- 2. **Bank, Sheet Pile, and Walls** Previous definitions were unclear or were used inconsistently in the former standard.
- 3. **Hard Compact Soil** and **Unstable Soil** The new soil classification system in revised Subpart P uses different terms for these soil types.

III. OVERVIEW: SOIL MECHANICS.

A number of stresses and deformations can occur in an open cut or trench. For example, increases or decreases in moisture content can adversely affect the stability of a trench or excavation. The following diagrams show some of the more frequently identified causes of trench failure.

TENSION CRACKS. Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench, measured from the top of the vertical face of the trench. See the accompanying drawing for additional details.

SLIDING or sluffing may occur as a result of tension cracks, as illustrated below.

TOPPLING. In addition to sliding, tension cracks can cause toppling. Toppling occurs when the trench's vertical face shears along the tension crack line and topples into the excavation.

SUBSIDENCE AND BULGING. An unsupported excavation can create an unbalanced stress in the soil, which, in turn, causes subsidence at the surface and bulging of the vertical face of the trench. If uncorrected, this condition can cause face failure and entrapment of workers in the trench.

FIGURE 5:2-1. TENSION CRACK.

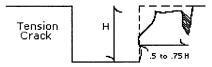


FIGURE 5:2-2. SLIDING.

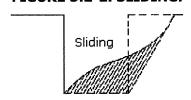


FIGURE 5:2-3. TOPPLING.

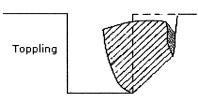
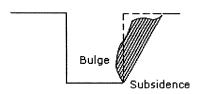


FIGURE 5:2-4. SUBSIDENCE AND BULGING.



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heaving or squeezing is caused by the downward pressure created by the weight of adjoining soil. This pressure causes a bulge in the bottom of the cut, as illustrated in the drawing above. Heaving and squeezing can occur even when shoring or shielding has been properly installed.

BOILING is evidenced by an upward water flow into the bottom of the cut. A high water table is one of the causes of boiling. Boiling produces a "quick" condition in the bottom of the cut, and can occur even when shoring or trench boxes are used.

FIGURE 5:2-5. HEAVING OR SQUEEZING.

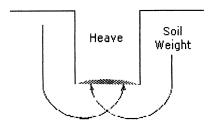
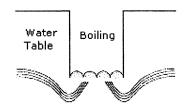


FIGURE 5:2-6. BOILING.



UNIT WEIGHT OF SOILS refers to the weight of one unit of a particular soil. The weight of soil varies with type and moisture content. One cubic foot of soil can weigh from 110 pounds to 140 pounds or more, and one cubic meter (35.3 cubic feet) of soil can weigh more than 3,000 pounds.

IV. **DETERMINATION OF SOIL TYPE.**

OSHA categorizes soil and rock deposits into four types, A through D, as follows:

- A. **STABLE ROCK** is natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed. It is usually identified by a rock name such as granite or sandstone. Determining whether a deposit is of this type may be difficult unless it is known whether cracks exist and whether or not the cracks run into or away from the excavation.
- B. **TYPE A SOILS** are cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) (144 kPa) or greater. Examples of Type A cohesive soils are often: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. (No soil is Type A if it is fissured, is subject to vibration of any type, has previously been disturbed, is part of a sloped, layered system where the layers dip into the excavation on a slope of 4 horizontal to 1 vertical (4H:1V) or greater, or has seeping water.
- C. **TYPE B SOILS** are cohesive soils with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa). Examples of other Type B soils are: angular gravel; silt; silt loam; previously disturbed soils unless otherwise classified as Type C; soils that meet the unconfined compressive strength or cementation requirements of Type A soils but are fissured or subject to vibration; dry unstable rock; and layered systems sloping into the trench at a slope less than 4H:1V (only if the material would be classified as a Type B soil).

- D. **TYPE C SOILS** are cohesive soils with an unconfined compressive strength of 0.5 tsf (48 kPa) or less. Other Type C soils include granular soils such as gravel, sand and loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable. Also included in this classification is material in a sloped, layered system where the layers dip into the excavation or have a slope of four horizontal to one vertical (4H:1V) or greater.
- E. **LAYERED GEOLOGICAL STRATA**. Where soils are configured in layers, i.e., where a layered geologic structure exists, the soil must be classified on the basis of the soil classification of the weakest soil layer. Each layer may be classified individually if a more stable layer lies below a less stable layer, i.e., where a Type C soil rests on top of stable rock.

V. TEST EQUIPMENT AND METHODS FOR EVALUATING SOIL TYPE.

Many kinds of equipment and methods are used to determine the type of soil prevailing in an area, as described below.

- A. **POCKET PENETROMETER**. Penetrometers are direct-reading, spring-operated instruments used to determine the unconfined compressive strength of saturated cohesive soils. Once pushed into the soil, an indicator sleeve displays the reading. The instrument is calibrated in either tons per square foot (tsf) or kilograms per square centimeter (kPa). However, Penetrometers have error rates in the range of \pm 20-40%.
 - 1. **Shearvane (Torvane)**. To determine the unconfined compressive strength of the soil with a shearvane, the blades of the vane are pressed into a level section of undisturbed soil, and the torsional knob is slowly turned until soil failure occurs. The direct instrument reading must be multiplied by 2 to provide results in tons per square foot (tsf) or kilograms per square centimeter (kPa).
 - 2. Thumb Penetration Test. The thumb penetration procedure involves an attempt to press the thumb firmly into the soil in question. If the thumb makes an indentation in the soil only with great difficulty, the soil is probably Type A. If the thumb penetrates no further than the length of the thumb nail, it is probably Type B soil, and if the thumb penetrates the full length of the thumb, it is Type C soil. The thumb test is subjective and is therefore the least accurate of the three methods.
 - 3. Dry Strength Test. Dry soil that crumbles freely or with moderate pressure into individual grains is granular. Dry soil that falls into clumps that subsequently break into smaller clumps (and the smaller clumps can be broken only with difficulty) is probably clay in combination with gravel, sand, or silt. If the soil breaks into clumps that do not break into smaller clumps (and the soil can be broken only with difficulty), the soil is considered unfissured unless there is visual indication of fissuring.

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- B. **PLASTICITY OR WET THREAD TEST**. This test is conducted by molding a moist sample of the soil into a ball and attempting to roll it into a thin thread approximately 1/8 inch (3 mm) in diameter (thick) by 2 inches (50 mm) in length. The soil sample is held by one end. If the sample does not break or tear, the soil is considered cohesive.
- C. **VISUAL TEST**. A visual test is a qualitative evaluation of conditions around the site. In a visual test, the entire excavation site is observed, including the soil adjacent to the site and the soil being excavated. If the soil remains in clumps, it is cohesive; if it appears to be coarse-grained sand or gravel, it is considered granular. The evaluator also checks for any signs of vibration.

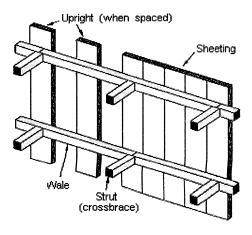
During a visual test, the evaluator should check for crack-line openings along the failure zone that would indicate tension cracks, look for existing utilities that indicate that the soil has previously been disturbed, and observe the open side of the excavation for indications of layered geologic structuring.

The evaluator should also look for signs of bulging, boiling, or sluffing, as well as for signs of surface water seeping from the sides of the excavation or from the water table. If there is standing water in the cut, the evaluator should check for "quick" conditions (see Paragraph III. F. in this chapter). In addition, the area adjacent to the excavation should be checked for signs of foundations or other intrusions into the failure zone, and the evaluator should check for surcharging and the spoil distance from the edge of the excavation.

VI. SHORING TYPES.

Shoring is the provision of a support system for trench faces used to prevent movement of soil, underground utilities, roadways, and foundations. Shoring or shielding is used when the location or depth of the cut makes sloping back to the maximum allowable slope impractical. Shoring systems consist of posts, wales, struts, and sheeting. There are two basic types of shoring, timber and aluminum hydraulic.



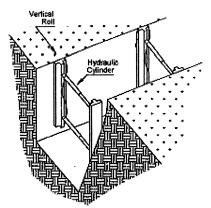


HYDRAULIC SHORING. The trend today is toward the use of hydraulic shoring, a prefabricated strut and/or wale system manufactured of aluminum or steel. Hydraulic shoring provides a critical safety advantage over timber shoring because workers do not have to enter the trench to install or remove hydraulic shoring. Other advantages of most hydraulic systems are that they:

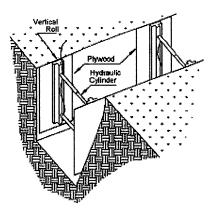
- Are light enough to be installed by one worker;
- Are gauge-regulated to ensure even distribution of pressure along the trench line;
- Can have their trench faces "preloaded" to use the soil's natural cohesion to prevent movement; and
- Can be adapted easily to various trench depths and widths.

All shoring should be installed from the top down and removed from the bottom up. Hydraulic shoring should be checked at least once per shift for leaking hoses and/or cylinders, broken connections, cracked nipples, bent bases, and any other damaged or defective parts.

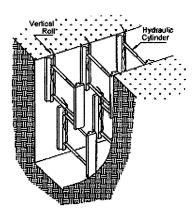
FIGURE V:2-8. TYPICAL ALUMINUM HYDRAULICSHORING INSTALLATIONS.



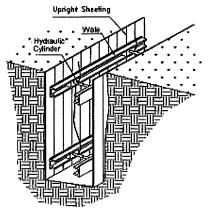
Vertical Aluminum Hydraulic Shoring (Spot Bracing)



Vertical Aluminum Hydraulic Shoring (With Plywood)



Vertical Aluminum Hydraulic Shoring (Stacked)

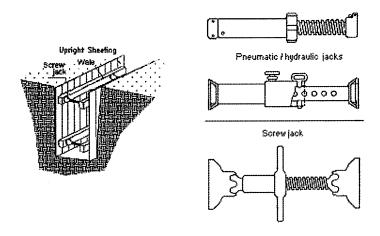


Aluminum Hydraulic Shoring Waler System (Typical)

PNEUMATIC SHORING works in a manner similar to hydraulic shoring. The primary difference is that pneumatic shoring uses air pressure in place of hydraulic pressure. A disadvantage to the use of pneumatic shoring is that an air compressor must be on site.

- Screw Jacks. Screw jack systems differ from hydraulic and pneumatic systems in that the struts of a screw jack system must be adjusted manually. This creates a hazard because the worker is required to be in the trench in order to adjust the strut. In addition, uniform "preloading" cannot be achieved with screw jacks, and their weight creates handling difficulties.
- Single-Cylinder Hydraulic Shores. Shores of this type are generally used in a water system, as an assist to timber shoring systems, and in shallow trenches where face stability is required.
- O Underpinning. This process involves stabilizing adjacent structures, foundations, and other intrusions that may have an impact on the excavation. As the term indicates, underpinning is a procedure in which the foundation is physically reinforced. Underpinning should be conducted only under the direction and with the approval of a registered professional engineer.

FIGURE V:2-9. SHORING VARIATIONS.



VII. SHIELDING TYPES.

TRENCH BOXES are different from shoring because, instead of shoring up or otherwise supporting the trench face, they are intended primarily to protect workers from cave-ins and similar incidents. The excavated area between the outside of the trench box and the face of the trench should be as small as possible. The space between the trench boxes and the excavation side are backfilled to prevent lateral movement of the box. Shields may not be subjected to loads exceeding those which the system was designed to withstand.

FIGURE V:2-10. TRENCH SHIELD.

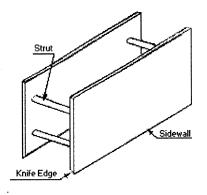
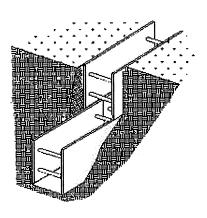


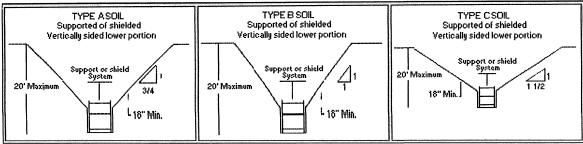
FIGURE V:2-11. TRENCH SHIELD, STACKED.



B. COMBINED USE. Trench boxes are generally used in open areas, but they also may be used in combination with sloping and benching. The box should extend at least 18 in (0.45 m) above the surrounding area if there is sloping toward excavation. This can be accomplished by providing a benched area adjacent to the box.

Earth excavation to a depth of 2 ft (0.61 m) below the shield is permitted, but only if the shield 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 possible loss of soil from behind or below the bottom of the support system. Conditions of this type require observation on the effects of bulging, heaving, and boiling as well as surcharging, vibration, adjacent structures, etc., on excavating below the bottom of a shield. Careful visual inspection of the conditions mentioned above is the primary and most prudent approach to hazard identification and control.

FIGURE V:2-12. SLOPE AND SHIELD CONFIGURATIONS.

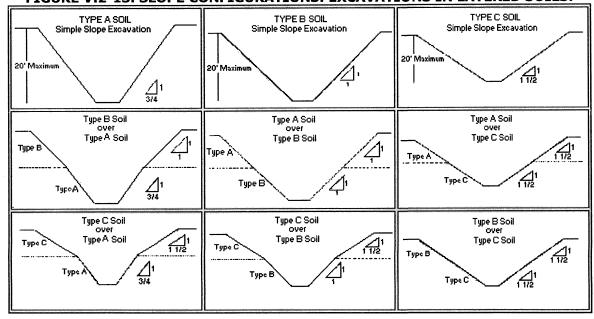


VIII. SLOPING AND BENCHING.

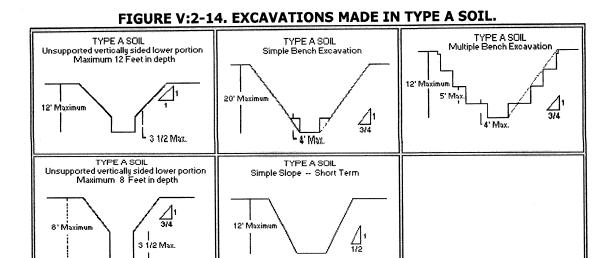
A. **SLOPING.** Maximum allowable slopes for excavations less than 20 ft (6.09 m) based on soil type and angle to the horizontal are as follows:

TABLE V:2-1. ALLOWABLE SLOPES.				
Soil type	Height/Depth ratio	Slope angle		
Stable Rock	Vertical	90°		
Type A	3/4:1	53°		
Туре В	1:1	45°		
Type C	11/2:1	34°		
Type A (short-term)	1/2:1	63°		
(For a maximum excavation depth of 12 ft)				

FIGURE V:2-13. SLOPE CONFIGURATIONS: EXCAVATIONS IN LAYERED SOILS.



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BENCHING. There are two basic types of benching, simple and multiple. The type of soil determines the horizontal to vertical ratio of the benched side.

As a general rule, the bottom vertical height of the trench must not exceed 4 ft (1.2 m) for the first bench. Subsequent benches may be up to a maximum of 5 ft (1.5 m) vertical in Type A soil and 4 ft (1.2 m) in Type B soil to a total trench depth of 20 ft (6.0 m). All subsequent benches must be below the maximum allowable slope for that soil type. For Type B soil the trench excavation is permitted in cohesive soil only.

TYPE B SOIL
Single Bench Excavation
[Permitted in cohesive soil only]

20' Maximum

4' Max.

1 4' Max.

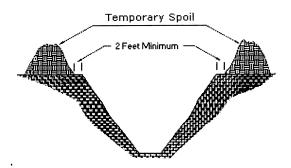
FIGURE V:2-15. EXCAVATIONS MADE IN TYPE B SOIL.

IX. SPOIL

A. **TEMPORARY SPOIL**. Temporary spoil must be placed no closer than 2 ft (0.61 m) from the surface edge of the excavation, measured from the nearest base of the spoil to the cut. This distance should not be measured from the crown of the spoil deposit. This distance requirement ensures that loose rock or soil from the temporary spoil will not fall on employees in the trench.

Spoil should be placed so that it channels rainwater and other run-off water away from the excavation. Spoil should be placed so that it cannot accidentally run, slide, or fall back into the excavation.

FIGURE V:2-16. TEMPORARY SPOIL.



B. **PERMANENT SPOIL**. Permanent spoil should be placed at some distance from the excavation. Permanent spoil is often created where underpasses are built or utilities are buried. The improper placement of permanent spoil, i.e. insufficient distance from the working excavation, can cause an excavation to be out of compliance with the horizontal-to-vertical ratio requirement for a particular excavation. This can usually be determined through visual observation. Permanent spoil can change undisturbed soil to disturbed soil and dramatically alter slope requirements.

X. SPECIAL HEALTH AND SAFETY CONSIDERATIONS.

- A. **COMPETENT PERSON**. The designated competent person should have and be able to demonstrate the following:
 - Training, experience, and knowledge of:
 - soil analysis;
 - use of protective systems; and
 - requirements of 29 CFR Part 1926 Subpart P.
 - Ability to detect:
 - conditions that could result in cave-ins;
 - failures in protective systems;
 - hazardous atmospheres; and
 - other hazards including those associated with confined spaces.
 - Authority to take prompt corrective measures to eliminate existing and predictable hazards and to stop work when required.
- B. **SURFACE CROSSING OF TRENCHES**. Surface crossing of trenches should be discouraged; however, if trenches must be crossed, such crossings are permitted only under the following conditions:
 - Vehicle crossings must be designed by and installed under the supervision of a registered professional engineer.
 - Walkways or bridges must be provided for foot traffic. These structures shall:
 - have a safety factor of 4;
 - have a minimum clear width of 20 in (0.51 m);

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- be fitted with standard rails; and
- extend a minimum of 24 in (.61 m) past the surface edge of the trench.
- C. **INGRESS AND EGRESS**. Access to and exit from the trench require the following conditions:
 - Trenches 4 ft or more in depth should be provided with a fixed means of egress.
 - Spacing between ladders or other means of egress must be such that a worker will not have to travel more than 25 ft laterally to the nearest means of egress.
 - Ladders must be secured and extend a minimum of 36 in (0.9 m) above the landing.
 - Metal ladders should be used with caution, particularly when electric utilities are present.
- D. **EXPOSURE TO VEHICLES**. Procedures to protect employees from being injured or killed by vehicle traffic include:
 - Providing employees with and requiring them to wear warning vests or other suitable garments marked with or made of reflectorized or highvisibility materials.
 - Requiring a designated, trained flagperson along with signs, signals, and barricades when necessary.
- E. **EXPOSURE TO FALLING LOADS**. Employees must be protected from loads or objects falling from lifting or digging equipment. Procedures designed to ensure their protection include:
 - Employees are not permitted to work under raised loads.
 - Employees are required to stand away from equipment that is being loaded or unloaded.
 - Equipment operators or truck drivers may stay in their equipment during loading and unloading if the equipment is properly equipped with a cab shield or adequate canopy.
- F. **WARNING SYSTEMS FOR MOBILE EQUIPMENT**. The following steps should be taken to prevent vehicles from accidentally falling into the trench:
 - Barricades must be installed where necessary.
 - Hand or mechanical signals must be used as required.
 - Stop logs must be installed if there is a danger of vehicles falling into the trench.

- Soil should be graded away from the excavation; this will assist in vehicle control and channeling of run-off water.
- G. **HAZARDOUS ATMOSPHERES AND CONFINED SPACES**. Employees shall not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with:
 - Less than 19.5% or more than 23.5% oxygen;
 - A combustible gas concentration greater than 20% of the lower flammable limit; and
 - Concentrations of hazardous substances that exceed those specified in the *Threshold Limit Values for Airborne Contaminants* established by the ACGIH (American Conference of Governmental Industrial Hygienists).

All operations involving such atmospheres must be conducted in accordance with OSHA requirements for occupational health and environmental controls (see <u>Subpart D of 29 CPR 1926</u>) for personal protective equipment and for lifesaving equipment (see <u>Subpart E, 29 CFR 1926</u>). Engineering controls (e.g., ventilation) and respiratory protection may be required.

When testing for atmospheric contaminants, the following should be considered:

- Testing should be conducted before employees enter the trench and should be done regularly to ensure that the trench remains safe.
- The frequency of testing should be increased if equipment is operating in the trench.
- Testing frequency should also be increased if welding, cutting, or burning is done in the trench.

Employees required to wear respiratory protection must be trained, fit-tested, and enrolled in a respiratory protection program. Some trenches qualify as confined spaces. When this occurs, compliance with the Confined Space Standard is also required.

- H. **EMERGENCY RESCUE EQUIPMENT**. Emergency rescue equipment is required when a hazardous atmosphere exists or can reasonably be expected to exist. Requirements are as follows:
 - Respirators must be of the type suitable for the exposure. Employees must be trained in their use and a respirator program must be instituted.
 - Attended (at all times) lifelines must be provided when employees enter bell-bottom pier holes, deep confined spaces, or other similar hazards.
 - Employees who enter confined spaces must be trained.

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- I. STANDING WATER AND WATER ACCUMULATION. Methods for controlling standing water and water accumulation must be provided and should consist of the following if employees are permitted to work in the excavation: Use of special support or shield systems approved by a registered professional engineer.
 - Water removal equipment, i.e. well pointing, used and monitored by a competent person.
 - Safety harnesses and lifelines used in conformance with 29 CFR 1926.104.
 - Surface water diverted away from the trench.
 - Employees removed from the trench during rainstorms.
 - Trenches carefully inspected by a competent person after each rain and before employees are permitted to re-enter the trench.
- J. **INSPECTIONS**. Inspections shall be made by a competent person and should be documented. The following guide specifies the frequency and conditions requiring inspections:
 - Daily and before the start of each shift;
 - As dictated by the work being done in the trench;
 - After every rainstorm;
 - After other events that could increase hazards, e.g. snowstorm, windstorm, thaw, earthquake, etc.;
 - When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur;
 - When there is a change in the size, location, or placement of the spoil pile: and
 - When there is any indication of change or movement in adjacent structures.

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XII. APPENDIX V: 2-1. SITE ASSESSMENT QUESTIONS

During first and subsequent visits to a construction or facility maintenance location, the compliance officer (or the site's safety officer or other competent person) may find the following questions useful.

- 1. Is the cut, cavity, or depression a trench or an excavation?
- 2. Is the cut, cavity, or depression more than 4 ft (1.2 m) in depth?
- 3. Is there water in the cut, cavity, or depression?
- 4. Are there adequate means of access and egress?
- 5. Are there any surface encumbrances?
- 6. Is there exposure to *vehicular traffic*?
- 7. Are adjacent structures stabilized?
- 8. Does mobile equipment have a warning system?
- 9. Is a competent person in charge of the operation?
- 10. Is equipment operating in or around the cut, cavity, or depression?
- 11. Are procedures required to monitor, test, and *control hazardous atmospheres*?
- 12. Does a competent person determine soil type?
- 13. Was a soil testing device used to determine soil type?
- 14. Is the *spoil* placed 2 ft (0.6 m) or *more from the edge* of the cut, cavity, or depression?
- 15. Is the depth 20 ft (6.1 m) or more for the cut, cavity, or depression?
- 16. Has a *registered professional engineer* approved the procedure if the depth is more than 20 ft (6.1 m)?
- 17. Does the procedure require *benching* or *multiple benching*? *Shoring*? *Shielding*?
- 18. If provided, do shields extend at least 18 in (0.5 m) above the surrounding area if it is sloped toward the excavation?
- 19. If shields are used, is the depth of the cut more than 2 ft (0.6 m) below the bottom of the shield?
- 20. Are any required *surface crossings* of the cut, cavity, or depression the *proper width and fitted with hand rails*?
- 21. Are means of *egress* from the cut, cavity, or depression *no more than 25 ft* (7.6m) from the work?
- 22. Is emergency rescue equipment required?
- 23. Is there documentation of the minimum daily excavation inspection?



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Printing Instructions

Classification of Soils for Excavations

Method no.: ID-194

Control no.: T-ID194-FV-02-0111-PM

Sample: Soil (excavated earth material).

OSHA Regulations: Earth material that is excavated must be properly sloped or supported for construction

and safety purposes. The factors and specifications that relate to this protection are outlined in 29 CFR 1926 Subpart P Appendix A (3.1). They include instructions for the proper sloping and shoring and bracing of the soil as determined by an analysis and

classification of the material.

Sample Size: A sample of approximately 1.4 kg (3 lb) or 1 L (1 qt) is preferred. All samples are

analyzed regardless of size.

Procedure: Obtain a sample by any safe means and seal it in an airtight plastic bag. Affix an official

sample identification seal on the bag. Enclose and secure the bag in a second bag for protection. Place this prepared material and required identification papers in a box for shipping by certified mail. The sample will analyzed by visual and manual tests and a

classification determined.

Date: November 2001

Chemist: Senior Soil Scientist: Alan Peck, Ph.D.

Physical Measurements Team Industrial Hygiene Chemistry Division OSHA Salt Lake Technical Center Salt Lake City UT 84115-1802

1. History

When a trench or other excavation is made in soil, the residual forces in the ground work to restore the soil to a more stable configuration. If those residual forces (gravity) are greater than those holding the trench or excavation walls where they are, a cave-in occurs. There are a number of factors which determine the stability of a given excavation wall. It is beyond the scope of this document to fully describe soil mechanics in this way. However, it has been found empirically that soil, when sloped appropriately, will resist the residual forces and remain safely stable.

Because the evaluation of soil conditions and structure is crucial to safe operation in and around excavations, an excavation standard was among the first promulgated by OSHA in 1971. In that standard, soils were classified into three types called running, unstable, and hard compact (Ref. 3.2). These terms were generally misunderstood. Later, the terms were revised and renamed granular, cohesive, granular cohesionless, and cemented (Ref. 3.1).

In 1989, it was estimated that there were 70 fatalities and more than 800 lost workday injuries annually in the United States due to excavation accidents. Responding to this high incidence rate, OSHA promulgated the current excavation standards (Ref 3.1) and it has the following requirements:

 Classification of soil and rock deposits. Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in 29 CFR 1926 Subpart P Appendix A.

- 2. Basis of classification. The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses shall be conducted by a competent person using tests described in 29 CFR 1926 Subpart P Appendix A, 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.
- 3. Visual and manual analyses. The visual and manual analyses, such as those noted as being acceptable in 29 CFR 1926 Subpart P Appendix A, 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.
- 4. Layered systems. 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.
- 5. Reclassification. 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.

As a result of the new regulations, the Bureau of Labor Statistics reported, in 1999, 44 deaths due to excavation and trenching accidents. (Ref. 3.10)

The angle of the slope depends upon the properties of the soil in which the excavation has been made. The mineral particles that constitute soil and other earth materials can bond by chemical and physical forces that oppose the force of gravity. Chemical bonding, or cohesion, refers to the chemical forces that bond mineral particles. Physical bonding refers to the bonding of the more coarse grains such as sand and gravel by frictional forces that include the interlocking of particles.

29 CFR 1926 Subpart P Appendix A is based on site and environmental conditions, and on the structure and composition of the soil deposits. The soil classification system means a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability.

- Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.
- 2. Type A means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) 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 caliche and hardpan are also considered Type A. However, no soil is Type A if:
 - a. The soil is fissured; or
 - b. The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or
 - c. The soil has been previously disturbed; or
 - 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 (4H:1V) or greater; or
 - e. The material is subject to other factors that would require it to be classified as a less stable material.

3. Type B means:

- a. Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or
- b. 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.
- c. Previously disturbed soils except those which would otherwise be classed as Type C soil.
- d. Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
- e. Dry rock that is not stable; or
- 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 (4H:1V), but only if the material would otherwise be classified as Type B.

4. Type C means:

- a. Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or
- b. Granular soils including gravel, sand, and loamy sand; or
- c. Submerged soil or soil from which water is freely seeping; or
- d. Submerged rock that is not stable, or
- e. Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal

to one vertical (4H:1V) or steeper.

In its 1989 rule making, OSHA relied heavily on a classification system developed in 1982 by the National Bureau of Standards (now the National Institute of Standards and Technology - NIST). In addition, OSHA used several other sources of information including ASTM standards. (Ref. 3.10)

In addition to these fundamental references, SLTC used The Unified Soil Classification System (Refs. 3.3 and 3.4), the Engineering Geology Field Manual of the U.S. Bureau of Reclamation (Ref. 3.5), and other documents (Refs. 3.6-3.9) in the development of this method.

OSHA Method ID-194 was developed to emphasize the performance and engineering properties of soil and is consistent with the objectives and requirements of the 1989 Federal excavation regulations. Many other methods used to classify soil provide a textural name for soil such as clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Because each of these methods specify slightly different tests, the names are similar to each other but can have a different meaning. An attempt is made to provide a textural name of the soil with this OSHA method (so that a comparison can be made with other methods) but a compete separation of all of the soil components is not performed by the tests described in this method. This could result in a textural name that is slightly different from other soil classifying methods.

2. Analytical

The analytical procedures of this method are grouped under the headings: visual, manual, and classification. Soil samples may represent a proposed excavation site or selected areas of an existing excavation. All samples are analyzed and classified by the methods outlined and described here.

Safety and health precautions include care to prevent air-born dust and the use of gloves and safety glasses when handling wet soil.

2.1 Visual (Ref. 3.1)

Copy all sample identification numbers from the sample submission report form to sample work data sheets (An example is included at the back of this method.). For analytical convenience, accountability, and continuity, record the number of each container used in analysis.

Open the soil bag and record the general characteristics of the sample, such as sand, gravel, or clay. Note and set aside any rock fragments (pieces of rock >3 in.) that may be present. Estimate the percent of the sample that is in the form of clumps between ¼ and 1 in., and identify possible structural discontinuities such as layers, lenses (discontinuous layers) and cracks or fissures. Note the presence of water or other features that are peculiar to the sample.

2.2 Manual

The manual tests include the equipment required for analysis and the procedures used to determine the specific properties and classification of the soil.

2.2.1 Equipment

- a. Bread pans of regular size for drying samples.
- b. Stainless steel bowls of at least 2- L capacity.
- c. A forced air oven that will hold and dry samples at 60°C.
- d. U.S.A. Standard 8-in. dry sieving pans #4 (4.75-mm opening), #40 (0.425-mm opening), a #200 (0.075-mm opening) and a catch pan and cover.
- e. A #200 U.S.A. Standard 8-in. wet sieving pan.
- f. A laboratory balance that will read up to 3 kg with a precision of ± 1.0 g.
- g. A standard soil pocket penetrometer (Ref. 3.2) for the measurement of the unconfined compressive strength.
- h. A fine hair bristle brush and a wire bristle brush for cleaning the test sieves.

2.2.2 Procedures

a. Unconfined Compressive Strength (Ref. 3.1)

Within five minutes after a sample of broken soil is exposed to the open air, remove one or more of the largest clumps and analyze it with a pocket penetrometer. Slice each clump with a spatula to provide a smooth surface for analysis.

Press the penetrometer cylinder against the sample and compress the soil and the calibrated spring of the instrument to the marked ring on the cylinder. Read the position of the ring on the calibrated scale of the cylinder. Record the unconfined compressive strength reading in tons per square foot (tsf) or kilograms per square centimeter (kg/cm²). Report the average of at least three readings if possible. Note all samples that break apart and do not provide a positive analysis.

b. Plasticity (Refs. 3.3 and 3.4)

Plasticity is defined as an inherent property of certain soils to mold and roll between the palms of the hands into a stable thread 0.3 cm (in.) in diameter and the tensile strength to support a 5-cm section when held at one end. To possess plasticity for classification purposes, the soil must satisfy these conditions and contain at least 15% silt and clay as determined by gradation analysis.

Determine and record the state of plasticity of the soil at the as-received water content. If plasticity is not observed, analyze the sample after it is dried using only that part of the sample that passes the #40 sieve. Add water in different amounts to obtain a wide range of water content for analysis. If the clay content is low, plasticity is not an inherent property of the soil, and it will not be identified at any water content.

c. Gradation Analysis (Ref. 3.3)

This test is used to determine the amount of gravel, sand, and total silt and clay in a soil sample. These constituents are identified using the particle size scale of the Unified Soil classification system. Silt and clay are not distinguished from each other in this test. The gradation procedures are described as follows:

Dry the soil for 2 days at 60°C to prepare the soil for analysis. Vent the air from the oven to the outside to avoid exposure to possible toxic fumes.

Tare a bowl on a laboratory balance. Add at least 100 g of a dry fine-grained sample or 200 g of a coarse-grained sample (sand and gravel) to the bowl. If that amount is not available, use as much as possible. Record the weight and cover the sample with water. Let it stand in this state for at least 2 hours and up to 24 hours.

Transfer this material to a #200 wet sieving pan and wash the fine grains of silt and clay through the sieve with running water until it is visibly clear. Wash the material that is retained on this sieve back into the bowl and decant the water and any supernatant. Dry this residue at 60°C or at any other preferred temperature.

Place the dried soil onto a nest of pans containing a #4 sieve at the top, a #200 sieve in the middle, and a pan at the bottom to catch any residual silt and clay. Tap the pans manually on a table top at least 20 times to separate the grains by size.

Report the total gravel as the weight of material retained on the top or #4 sieve and the total sand as the weight of material retained on the next or #200 sieve. The total silt and clay content is equal to the difference between the combined weight of the sand and gravel and the weight of the sample used. Silt and clay comprise the fine-grained material that is washed through the #200 sieve during analysis. Convert the weight of the material retained on the #4 sieve and the #200 sieve as the dry weight percent of the gravel and sand, respectively.

2.3 Classification

The analytical data is used to classify the soil according to the dominate texture, structure, and Type (strength), the ultimate objective of analysis. These classifications are identified according to specific conformance and performance standards and definitions outlined in 29 CFR 1926 Subpart P Appendix A and the following definitions and instructions:

2.3.1 Structural Classification

The common soils include those that correspond to a granular, cohesive, or granular cohesionless structures outlined in the Federal excavation regulations. They are identified as follows:

- Granular soil contains <15% silt and clay (>85% sand and gravel) (Ref. 3.4)
- Cohesive soil possesses the property of plasticity
- Granular cohesionless soil contains >15% silt and clay and does not possess plasticity, or otherwise, is neither granular nor cohesive. (Ref. 3.4)
- Fissures are identified visually or indirectly by the tendency of clay with a Q_u >1.5 to break into small pieces between ¼ and 1 in. due to microfissures when disturbed.

2.3.2 Type Classification:

- Granular soil is Type C
- Granular cohesionless soil is Type B
- Cohesive soil is Type C if the unconfined compressive strength, Q_u, is <0.5
- Cohesive soil is Type B if Q₁₁ is 0.5 to 1.5
- Cohesive soil is Type A if Q_U is >1.5 and not fissured
- Cohesive soil that is fissured is Type B unless the Qu dictates that it is Type C.
- Fissures may be identified visually or indirectly by the tendency of clay with a Q_u >1.5 break into small pieces between ¼ and 1 in. due to microfissures when disturbed.

A more convenient guide to classification is given in the chart on Page 7. The three soil structures appear at the top of the chart, and the appropriate definitions and properties that apply are listed below with Soil Type at the bottom. Soil Structure and Soil Type systematically unfold accordingly.

2.3.3 Textural Classification

Soil texture is based on the following definitions and instructions:

- Designate clay as the last word in the textural name of all soils that are cohesive, and designate sand or gravel as the last word for all soils that are granular.
- Modify that name with the less predominant constituents as a first name.
- Do not use either sand or gravel in the textural name if the soil contains <10% and <30% of the
 dry weight of the soil, respectively.
- An example and the most typical of all soils classified at OSHA-SLTC is sandy clay.

2.3.4 Report

The following information will be entered onto the sample report in the section titled 'Comments for Specific Analyte':

Classification:

Textural: xxxx (e.g., Sandy Clay) Structural: xxxx (e.g., Cohesive)

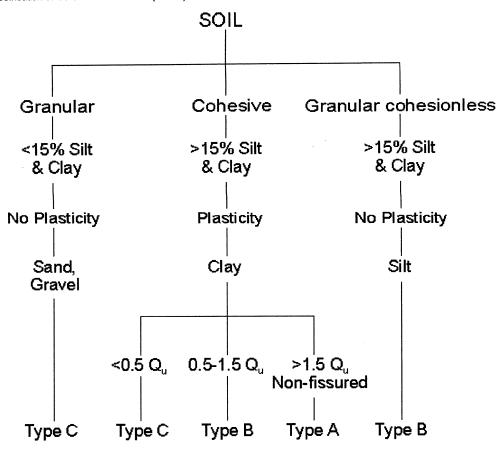
Type: x (e.g., B)

The above classification is based on visual/manual procedures described in OSHA Method ID-194.

2.3.5 Soil Reclassification

Classification of soils by this method is based upon measurement of physical properties appropriate to the OSHA excavation standard, and the condition of the sample as it is received at the Salt Lake Technical Center. Certain field conditions, such as the presence of standing water, may override this laboratory classification as mentioned in 29 CFR 1926 Subpart P Appendix A. Supplemental testing by other methods of analysis may provide a more appropriate description and classification of unusual or atypical soils.

SOIL CLASSIFICATION CHART



Note: 1) Intact cemented soils such as hardpan and caliche (a layered carbonate accretion) are classified Type A.

- 2) All fissured soils are classified cohesive and Type B.
- 3) Angular gravel and rock fragments are classified granular cohesionless and Type B.
- 4) The value of 15% in the above chart corresponds to the maximum amount of silt and clay that is permitted in a soil that is granular in structure. (Ref. 3.4)

3. References

- 3.1 Code of Federal Regulations, Title 29, Part 1926, Subpart P, 1999, pp. 372-409. U.S. Government Printing Office, Washington, D.C. 20402-9328.
- 3.2 Ibid. 1987, p. 207.
- 3.3 Earth Manual, U.S. Dept of the Interior, Water and Power Resources Service, Denver, CO, 1980, pp.1-22.
- 3.4 U.S. Bureau of Reclamation, Engineering Geology Field Manual, Volume 1. p.38. U.S. Government Printing Office, Washington, D.C. 20402-9328.
- 3.5 Fundamentals of Geotechnical Analysis, Dunn, I.S., 1980, p.33, John Wiley and Sons, Inc.
- 3.6 Materials Testing Catalogue, Soiltest Inc., Corporate Headquarters, 86 Albrecht Drive, Lake Bluff, Illinois, 60044-8004.
- 3.7 National Academy of Sciences, Compendium 13. Slopes: Analysis and Stabilization, 1980, p.141. Washington, D.C. 20402-9328.
- 3.8 Mechanics in Foundation Engineering, Wilun, Z. and Starzewski, K., p.77, 1972, Surrey Press, 450 Edgeware Rd. London.
- 3.9 Engineering Classification and Index Properties of Intact Rock, Deere, D.U., and Miller, R.P., Clearance House for Federal Scientific and Technical information, Dept. of Commerce, Washington D.C.
- 3.10 Federal Register, Vol. 54, No. 209 p45894 et seq., U.S. Government Printing Office, Washington, D.C. 20402-9328

Addendum A

The method for packaging the soil samples for shipment to the SLTC will be in a sturdy, leak-proof container, which include the following:

- a. Samples will be placed in a heavy-duty plastic bag that will not tear and secured and sealed airtight with tape. The plastic bag will be placed in a heavy-duty cotton bag for additional protection.
- b. Each soil sample will be sealed for identification with an official Form 21 seal containing a field number, sampling date and the sampler's name.
- c. If the soil sample being shipped from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry, a PPQ Form 550 will be attached to the outside of the shipping box. Copies of this form may be obtained by telephoning 801-524-7900 and asking for the Soils Laboratory. Requests for the form can also be made by e-mail to merrell.clint@dol.gov or crane.dan@dol.gov.

U.S. DEPARTMENT OF AGRICA THRE AMBAL AND PLANT REALTH INSPECTION SETTINGS BY AND CHARGANITHE 190 MAY 1

SON, SAMPLES RESTRICTED ENTRY

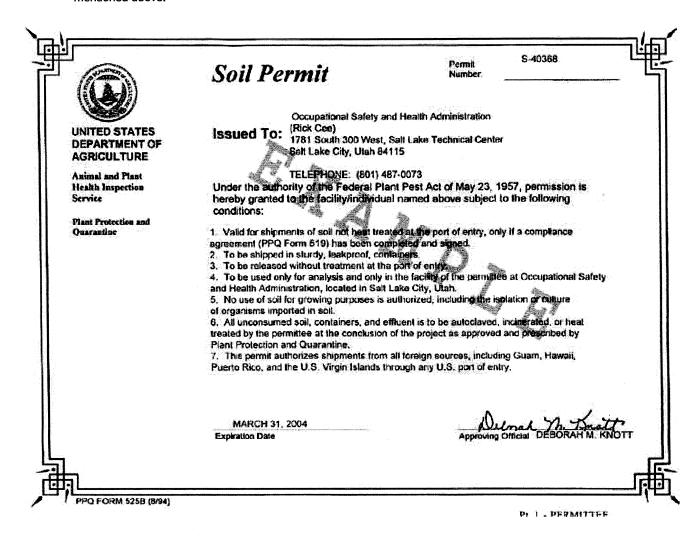
The state id Contained in this package is imposed under authority of the Foderal Plant Post Act of May 23, 1957.

For release without treetment it addresses is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 650 (MAR 96)

#U.S.GPO: 1995-621-030

Below is an example of the Soil Permit that is necessary to import soil samples into the United States. A copy of the actual permit is to be attached to the OSHA Form 91A. The permit can be obtained by contacting the persons mentioned above.



Classification of Soils for Excavations									
	Sample Work Data Sheet								
Analyst:			Sampling Number:						
CSHO ID:		Reporting ID:		Inspection Number:					
Laboratory Number:			Submission Number:						
Sample Description:	Sample Description:								
Compressive Strength (tsf) (av	/erage):								
Clumps (estimated):			Fissures:	Yes	No				
>1 in. (%):			Layers or Lenses:	Yes	No				
>¼ in.<1 in. (%):			Water Present:	Yes	No				
Drying Pan Number:									
Plasticity:	Yes No								
Graduation Bowl Number:			Sample Weight (g):						
>#4 Sieve (g):		>#200 Sieve (g)		<#200 Sieve (g):					
Gravel (%):		Sand (%):		Silt & Clay (%):					
		Cla	ssification						
Tex	tural:								
Structural:			Granular	Cohesive	Granular Cohesionless				
Ty	ype:		Α	В	С				
Notes:									

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Contact Us | Freedom of Information Act | Customer Survey
Privacy and Security Statement | Disclaimers

Occupational Safety & Health Administration 200 Constitution Avenue, NW Washington, DC 20210

Brigham Young University
Department Title: Risk Management & Safety

Title: Excavation Program
Program: 009

¥ Page 16 Revision: 3.0 Date Issued: October 10, 2006

Appendix B Excavation Checklist

Competent Person:			(Please Print)
Date: Time:			
Location: Weather	er Con	ditions	:
Item	Yes	No	Action Required
1. Is cut, cavity, depression or excavation >4 feet in depth?			
2. Is Excavation > 20 feet in depth?			
Note: if yes, an engineer must approve the protective			
system.			
3. Is a competent person in charge and present at the site?			`
4. Is there water in the excavation?			
5. Has the competent person classified the soil?			
6. Is ingress/egress adequate?			
7. Have underground utilities been identified (prior to dig)?			
8. Are there any surface hazards (i.e. power-lines)?			
9. Are procedures in place to protect against falling loads?			•
10. Is there exposure to vehicular traffic & vibration?			
11. Does mobile equipment have warning system?			
12. Is spoil placed at least 2-feet away from the excavation?			
13. Are surface crossings required?			
14. Are all employees wearing hardhats?		Ü.	
15. Are hazardous atmospheres present, or likely?			
16. Are respirators required? Users tested & trained?			
17. Does the excavation require benching? (B, or C soil?)			
18. Does the procedure require shoring/sloping/ shielding?			•
19. If provided, does the shield extend at least 18 in. above			
the surrounding excavation area?			
Mark an X between yes and no if non-applicable.			
20. If shields are used, is the depth of the cut >2 feet below			
the bottom of the shield?			
21. Are means of egress (ladders) provided no more than 25			
feet from individuals in the excavation?			
22. Is emergency rescue equipment required?			
23. Are daily excavation inspections performed and documented?			

Excavation/Trench Inspection and Entry Authorization Form

This form will be completed by the Competent Person daily (at a minimum) or when site conditions change. The completion of this form is mandatory prior to work in any excavations or trenches 4' in depth or greater. A corresponding Excavation/Trenching Plan must be accepted by the ROICC prior to work in any excavations/trenches 5' in depth or greater.

PRIME CONTRACTO	R:				SUBCO	NTI	RACTOR	 :				4
COMPETENT PERSO	N:			1	LOCAT	ION	•					
DATE:	TIME:				NUMB	ER (OF CREW	/ ME	MBERS:			······································
Dimensions Depth =						leasurement						
Top =		ength.		Solid			Type B		Penetrometer			
Bottom =		ength		Туре	Α		Type C		Thumb Penetra	tion		
HAZARDOUS CONDITI		- 1	No	PERIM	IETER C	ONS	DERATIO	NS		Yes	No	n/a
Saturated soil/standing	g or seeping water?)		Spoils	located	at le	ast 2' awa	y fro	m edge?			
Bulging walls?				Mater	ials loca	ted a	at least 2'	away	from edge?			
Rapid drying / shrinkag	ge?			Class 1	1, 2, or 3	per	imeter pro	otecti	on in place?			
Vibration from equipm	nent / traffic?			Backh	oe locat	ed a	t end of tr	ench'	?			
Cracked or fissured wa	alls?			Spotte	er worki	ng w	ith the ba	ckhoe	?			
Undercutting?				Expose	ed to th	e ger	neral publ	ic?		†		
Floor heaving?				MPM	require	ment	s comple	ed?				
Super imposed loads?	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			LADDE	ER/EGRI	ESS L	OCATION			Yes	No	n/a
Exposed utilities?				Locate	ed within	n pro	tected ar	ea?	•			
Atmospheric testing re	equired?			Locate	ed within	า 25	feet of saf	e trav	vel?			
Structures adjacent to	trench?			Extend	ds 36" al	bove	landing a	nd se	cured in place?			-
Trees or roots in the w				1		•	gle witho					
*If the hazards listed ab										and Pr	eventi	on Plan
(SSFPPP) or Confined Sp	ace Plan (CSP) mus	t be develo	ped an	d accep	ted befo	ore w	ork can c	ommo	ence.			
SHORING		Yes	No	(COLOR	ODE	FOR UTII	.ITY Λ	//ARKING based	on ANS	I Z-53	1
Manufacturer tabulated		e?		PROPOSED EXCAVATION						WHIT	E	
Shoring inspected for de	efects/damage?			ELECTRIC POWER LINES, CONDUITS, LIGHTING CA				rs, lighting cae	BLES	RED		
Trench shield in use?	`			POTABLE WATER				BLUE				
Speed shores in use?				GAS, STEAM, CONDENSATE, OIL COMPRESSED AIR					YELLO	w		
Speed shores pumped t	o design pressure?			TELECOMMUNICATIONS, ALARM OR SIGNAL LINE				OR SIGNAL LINE		ORAN	IGE	
Plywood or sheeting to be used?				TEMPORARY SURVERY MARKINGS							PINK	
SLOPING SEWER AND STORM DRAINS				GREE	N							
Type A soils at a minimum of ½:1 (53°)? RECLAIMED WATER, IRRIGATION, CHILLED LINES					PURP	LE						
Type B soils at a minimu				OTHER	?						LIGHT	BLUE
Type C soils at a minimu	um of 1 ½:1 (34°)?			EXCA	VATIO	N/T	RENCH	COM	IPETENT PERS	ON SI	GNA	ΓURE
BENCHING						•						
Type A and B soils bench				\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \								
. Max height of Type B so	oil bench 4'?			X								

Names of personnel authorized to enter the excavation/trench:

Excavation/Trench Inspection Form Association Association

Date	Job No	Location	Competent Person Gas		Gas Monito	Gas Monitor Ser No	
Inspect excavations t	nroughout the work per	iod. If conditions cha	ınge, complete	a new	inspection f	form.	
Time:	□ a.m. □ p.m.	Weather:					
∴• Time:	□ a.m. □ p.m.	Weather:			an a restaura describir de la quaer describir de l'estaura de l'estaura de l'estaura de l'estaura de l'estaura E		
Time:	□ a.m. □ p.m.	Weather:					
Time:	□ a.m. □ p.m.	Weather:					
Locates	Date:	Confirmation No: Work Practices	• .		Locates Vis	ible DY DN	
☐ Vehicle Traffic	☐ Mobile Equipment	Traffic Control:	☐ Signs	□ Cor	ies	☐ Barricades	
□ Overhead Obstructions	☐ Underground Installations	Ladders:	☐ Within 25'	☐ Exte		☐ Accumulation	
☐ Falling Loads	☐ Hazardous Atmosphere	Dewatering:	☐ CP monitors		per Operations	☐ Supplied Air	
☐ Adjacent Structures	☐ Surface Encumbrances	Atmosphere: Equipment:	☐ Ventilation ☐ > 2' from edge	☐ Mor	nitoring ning device	☐ Other	
Soil Stability		turn annual annual annual annual annual			ermanining page and part and agreement of the		
☐ Previously distribu	uted by underground st	ructures or utilities	☐ Soil subject	t to the	wing condit	ions?	
	oration from adjacent ipment used in the exc	avation?	□ Soil subject		charge from	spoils,	
Visual Test	Control of the Contro				The second secon		
	n excavator bucket in c stream?	ohesive clumps	□Y □N Particl			nate soils are ned, or gravel?	
□Y □N Soil exist in lo Layers slope	•	% Slope	□Y □N Soil is f	fissurec	ļš		
□Y □N Presence of	rock?		□Y □N Rocki	s stabl	e ș		
□Y □N Accumulati	ng runoff?		□Y □N High g	ground	water table?	?	
□Y □N Seeping from	m sides?		□Y □N Subme	erged	in surface w	ater (creeks, etc.) ?	
Manual Test							
Penetrometer Readi	ngs (Minimum of five tes	t must be completed))				
1. 2.			7. 8.). 10	i i	
Average tsf:	□ <0.5 tsf = Type C	□ 0.5 - 1.5 t	si = type в	L] >1.5 tsf = Ty	pe A	
Plasticity Test Length of 1/8" thread th	nat can be held horizontal	ly inches □ < 2" = Gr	ranular	Е] < 2" = Coh	esive	
Thumb Penetration To		TYPE C	TYPE B		TYPE A		
All tests should be rule. Large clump of s As soon as excav Later after wettire. Reclassified	oil material vated	☐ Easy☐ Molded by light finger pressure	□ Effort			ffort/not at all ly indent	
Soil Test Classification	I	Personnel Protective	System Chosen				
Results of Testing: So	ilType 🗆 A 🗆 B 🗆 C	Protection Chosen:	□ Sloping □ S	shieldir	ng 🗆 Shorin	g	
Trench Box Information	on						
□Y □N Trench box o	drawings available	□Y □N PEstamped	drawings availa	ble for	special shorin	ng	
□Y □N Stack locking	g Pins available and used	□Y □N Spreader ba	ır pin installed an	d safet	y pined		
Comments:							

Note: All unsafe conditions must be corrected before trench entry. If any hazardous conditions are observed, the trench must be immediately evacuated and no one allowed to re-enter until corrective action has been taken.

			OAVAIIOI		CTION REPOI
te & Time:	Location	: 1			
pth ⁽¹⁾ :					
t visual test(s) performed ⁽²⁾ :					
t manual tests performed ⁽²⁾ :					
SOIL ⁽¹⁾ OR ROCK TYPE		MAXIMUM A	ALLOWABLE ON LESS THA	SLOPE (AN 20 FE	H:V) ⁽⁴⁾ FOR ET DEEP ⁽³⁾
Stable Rock - No visible fissures/cracks			tical (90°)	···········	
Type A Soil - Cohesive soil with clay base		· 34H	:1V (53°) ^{(2) (5)}	(No expo	sure to vibration)
Type B Soil - Cohesive soil with a loam base (i.e., ar crushed rock, etc.)	ngular gravel,		1V (45°) ^{(2) (5)}		
Type C Soil - Granular soil including gravel and sand		1½	H:1V (34°) ⁽²⁾	(5) 	
Other - Designed by a Registered Professional En	gineer (RPE) ⁽³⁾		RPE's written locally and av		teria must be r review
her Protection Systems ⁽³⁾ cceptable Shoring: ☐ Timber ☐ Hydraulic ☐ Oth cceptable Shielding: ☐Single trench box ☐ Stacked			_ •		d 18" above grade
the soil contaminatèd:	If yes, with what	?			PPM
cavating in or near roads ⁽⁶⁾ :	If yes, has the f	Road Dept be	en notified: [] Yes [No
st all traffic control devices:			·		
ill water removal be needed: Yes No	How will water b	e removed?			:
mospheric check if over 4' deep - Name of Equip?			02 %	LFL	/ LEL %
otes: 1. Initiate inspections and take appropriate actions reg	ardless of depth wh	en soils indica	te signs of stre	ss or cave-i	n.
 Initiate inspections and take appropriate actions reg Every inspection requires at least 1 visual test and 1 Sloping or benching excavations greater than 20 fee the same state as the excavation. Shoring & shield by a registered professional engineer. H denotes horizontal, V denotes vertical. All śpoil piles, material or equipment must be a mini 	1 manual test. et deep shall be des d equipment used in	igned & appro excavations g	ved by a profes reater than 20	sional engi	neer registered with
 Every inspection requires at least 1 visual test and 1 Sloping or benching excavations greater than 20 fee the same state as the excavation. Shoring & shield by a registered professional engineer. H denotes horizontal, V denotes vertical. 	1 manual test. et deep shall be des d equipment used in imum of 2 feet from	igned & appro excavations g	ved by a profestreater than 20 excavation.	sional engi feet shall bo	neer registered with
 Every inspection requires at least 1 visual test and 1 Sloping or benching excavations greater than 20 feet the same state as the excavation. Shoring & shield by a registered professional engineer. H denotes horizontal, V denotes vertical. All spoil piles, material or equipment must be a minimal properties. 	1 manual test. et deep shall be des d equipment used in imum of 2 feet from eveloped and on site	igned & appro excavations g	ved by a profestreater than 20 excavation. within 15 feet or	sional engi eet shall be	neer registered with

Reference: Contractor Safety Manual Distribution: Posted at the each Excavation KM Inspector File Daily

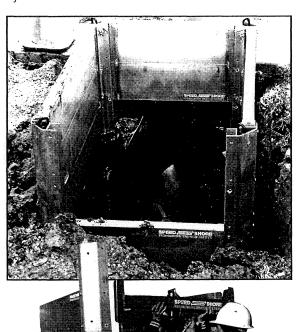
Page 1 of 1

odular Shields

Speed Shore's Modular Aluminum Panel Shield (MAPS) system is engineered for high strength, ultra-low weight, and ease of handling. Modular panels, end-members, and adjustable spreaders are light enough for transport by pickup, and can be quickly configured for 2, 3 or 4-sided applications. A two-man crew can readily assemble the system by hand for rapid placement in the trench by a rubber-tired backhoe.

The foam-filled, double-wall aluminum panels are available in a full range of standard sizes to 12 feet in length. Extruded end-members, available in lengths from 2 to 10 feet, allow easy pin-and-keeper connection of panels and spreaders in various combinations, forming the exact configuration required at the work site. Various spreader options are available, to include adjustable telescoping steel spreaders, and screw jacks.

The MAPS system is ideal for utility maintenance and repair, cable splice pits, plumbing repairs, gas, sewer and water taps, and other light utility installations—including trenchless technology entry and exit pits. Speed Shore's Modular Aluminum Panel system is the preferred choice for municipalities, contractors and utilities seeking an extremely versatile, lightweight trench safety system.



MAPS Systems Offer Optimum Versatility in a Lightweight Shield.

- Aluminum Alloy Construction for extremely high strength-to-weight ratios and superior corrosion resistance.
- Narrow Double-Wall Panels minimize excavation width while maximizing interior work space.
- Lightweight Modular Components
 afford easy handling and options of 2, 3, or 4-sided shield configurations.
- Dual-Purpose End Members connect both panels and spreaders in multiple configurations.
- Adjustable Spreaders allow for rapid field modification of shield width.
- Foam-Filled Smooth Walls prevent accumulation of water, dirt and debris.
- Tongue & Groove Panel Design aids in assembly and helps secure panels in place.
- Pin and Keeper System
 allows for rapid assembly and disassembly by hand, with no need for special tools.



odular Shield Specifications

Modular Aluminum Panels

MODEL NO DIMENSIONS WEIGHT CAPACITY ALLO					ALLOW	ALLOWABLE DEPTH (Ft.) by soil type				
MODEL NO.	4			(Lbs.) (Psf.)		В	C(60)	, C		
MAPS-0204	2	4 .	51	6400	50	50	50	50		
MAPS-0206	2	6	79	2700	50	50	45	34		
MAPS-0208	2	8	106	1500	50	33	25	19		
MAPS-0210	2	10	134	960	36	21	16	12		
MAPS-0212	2	12	162	660	24	14	11	8		
MAPS-0214	2	1,4	180	570	21	13	10	8		
MAPS-0216	2	16	205	420	15	10	7	5		

^{**}Prior to use, refer to OSHAS 29 CFR, Part 1926 (subpart P) and Manufacturer's Tabulated Data for detailed explanation of soil types and product application. Type A soil not to exceed 25 PSF per foot of depth; Type B soil not to exceed 45 PSF per foot of depth; Type C(60) soil not to exceed 60 PSF per foot of depth.

Adjustable Spreaders* (Telescoping)

The second secon	MODEL NO.	OPERATING RANGE(In.)	WEIGHT (Lbs.)
	MAPS - SPR - 036	27 - 36	38
	MAPS - SPR - 048	35 - 48	50
	MAPS - SPR - 060	40 - 60	56
	MAPS - SPR - 084	52 - 84	74
	MAPS - SPR - 096	60 - 96	91

Adjustable Spreaders* (Screw Jack)

MODEL NO.	OPERATING Range(In.)	WEIGHT (Lbs.)
MAPS - SJ - 042	30 - 42	25
MAPS - SJ - 060	36 - 60	29
MAPS - SJ - 084	60 - 84	43
MAPS - SJ - 108	84 - 108	59

^{*} Four pins and keepers are included with each spreader.

End Members

MODEL NO.	LENGTH (Ft.)	WEIGHT (Lbs.)
MAPS-E-02	2	14
MAPS-E-04	4	28
MAPS-E-06	6	42
MAPS-E-08	8	56
MAPS-E-10	10	70

Accessories

MODEL NO.	DESCRIPTION	WEIGHT (Lbs.)
MAPS-PIN	Connecting Pin	0.3
MAPS-PIN-K	Pin Keeper	N/A
P-SLP-2	Spreader Pin	6
MAPS-LL	Lifting Lug	2

Pioneer of the World's Most Advanced Trench Safety Systems



Shoring Shields ®

Modular Alum. Panel Systems Trench Shields

Shields

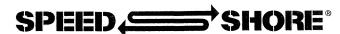
Manhole Shields

Shields

Systems

Systems

Boxes



PIONEERING TRENCH SAFETY

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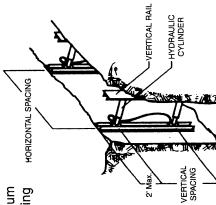
Authorized Distributor

Note: Allowable depths are limited to 50 feet for practical purposes. Contact Speed Shore for applications exceeding posted allowable depths.

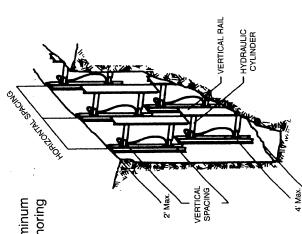
SPEED SHORE ALUMINUM **HYDRAULIC SHORING**

Typical Installations

Hydraulic Shoring Vertical Aluminum (Spot Bracing)



Vertical Aluminum Hydraulic Shoring (Stacked)



Note: Always install shoring from the top down and remove from the bottom up.

Table VS-1 Type "A-25" Soil

SPEED SHORE

Sheeting (Note 3) (Note 2) 2" dia. (1) 2" dia. (1) 12 to 15 Width of Excavation 2" dia. (1) 8 to 12 2" dia. HYDRAULIC CYLINDERS 0 to 8 2" dia. 2" dia. Vertical Spacing (Note 6) (FEET) Maximum Spacing (FEET) Maximum Horizontal ω Depth of Excavation FEET 0 to 15 0 to 25

Table VS-2 Type "B-45" Soil

	Sheeting (Note 3)		(Note 2)	(Note 2)	(Note 7)
	ation	12 to 15	2" dia. (1)	2" dia. (1)	2" dia. (1)
0	Width of Excavation FEET	0 to 8 8 to 12 12 to 15	2" dia.	2" dia. (1) 2" dia. (1)	2" dia. (1) 2" dia. (1)
YLINDER	Width	0 to 8	2" dia.	2" dia.	2" dia.
HYDRAULIC CYLINDERS	Maximum Vertical Spacing	(Note 6) (FEET)	4	4	4
	Maximum Horizontal	Spacing (FEET)	8	9	5
	Depth of Excavation FEET		0 to 15	0 to 20	0 to 25

Table VS-3 Type "C-60" Soil

		HYDRAULIC CYLINDERS	YLINDER	4S		
Depth of Excavation	Maximum	Maximum	Widt	Width of Excavation	ation	Sheeting
FEET	Horizontal	Vertical Spacing		FEET		(Note 4)
	Spacing (FEET)	(Note 6) (FEET)	0 to 8	0 to 8 8 to 12 12 to 15	12 to 15	
0 to 10	6' (Note 5)	4	2" dia.	2" dia.	2" dia. (1)	(Note 2)
0 to 20	4	4	2" dia.	2" dia. 2" dia. (1) 2" dia. (1)	2" dia. (1)	(Note 7)
0 to 25	4	4	2" dia.	2" dia. 2" dia. (1)	N/A	(Note 7)

Notes to Tables VS-1, VS-2, VS-3

- 3.5×0.1875 inches extension (installed over the aluminum oversleeve extension) or a steel tube oversleeve 3 x 3 x 0.1875 inch extension (installed without the aluminum oversleeve) Two inch diameter cylinders shall have a structural steel tube oversleeve $3.5\,\mathrm{x}$ that extends the full retracted length of the cylinder.
 - there is an indication of a possible loss of soil from behind the support system, sheeting The bottom of the sheeting shall extend within 2 feet of the bottom of the excavation. If must extend to the bottom of the excavation. 3
 - Four feet wide sheeting is required at each Vertical Shore if raveling or sloughing of the excavation face appears likely to occur. ල
 - Four feet wide sheeting shall be used.
- When 4 feet horizontal spacing is exceeded, the open spaces between the sheeting must be monitored for sloughing and raveling of the excavation face. **4 0**
 - The bottom hydraulic cylinder shall be a maximum of 4 feet above the bottom of the 9
- Sheeting shall extend to the bottom of the excavation. 6

SOIL CLASSIFICATION

Type A-25 Soil:

greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and sandy clay Cohesive soils with an unconfined, comprehensive strength of 1.5 ton per square foot (tst) or loam. Cemented soils such as caliche and hardpan are also considered Type A.

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 5000
 - 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 horizontal to one vertical (4H:1V) or greater, or
- The material is subject to other factors that would require it to be classified as a less stable (2)

Type B-45 Soil:

- Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than \in
- 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. (Z
- Previously disturbed soils except those which would otherwise be classed as Type C soil.
 - Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to variation; or ® 4
- Dry rock that is not stable; or
- 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 (4H:1V), but only if the material would otherwise be classified as Type B. (9)

Type C-60 Soil:

- Moist, cohesive soil or a moist dense granular soil which does not fit into Type A or Type B classification, and is not flowing or submerged. \equiv
 - This material can be cut with near vertical sidewalls and will stand unsupported long enough to allow the vertical shores to be properly installed. (7)
- The competent person must monitor the excavation for signs of deterioration of the soil as indicated by, but not limited to, freely seeping water or flowing soil entering the excvation around or below the sheeting. (3)
 - An alternate design for less stable Type C soil will be required where there is evidence of deterioration 4

Type C-80 Soil:

- Cohesive soil with an unconfined compressive strength or 0.5 tsf or less; or
 - Granular soils including gravel, sand, and loamy sand; or
- Submerged soil or soil from which water is freely seeping; or
 - 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 horizontal to one vertical (4H:1V) or steeper.

TESTING

(Minimum: One visual and one manual test are required.)

excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the fisual Tests: Visual analysis is conducted to determine qualitative information regarding the open excavation, and the soil taken as samples form excavated material.

- Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil Observe samples of soil that are excavated and soil in the sides of the excavation. that is primarily composed of fine-grained material is cohesive material. Æ
- Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular. œ
- excavation. Crack-like openings such as tension cracks 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 side of the opened excavation and the surface area adjacent to the ပ
- existing utility and other underground structures, and to identify previously disturbed soil. Observe the area adjacent to the excavation and the excavation itself for evidence of Observe the opened side of the excavation to identify if layers slope toward the \Box نىا
 - 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 location of the level of the water table. ш
- 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. ശ്

as qualitative properties of soil and to provide more information in order to classify soil properly. Manual Tests: Manual analysis of soil samples is conducted to determine quantitative as well

- as thin as 1/8-inch in diameter. Cohesive material can be successfully rolled into threads Plasticity. Mold a moist or wet sample of soil into a ball and attempt to roll it into threads without crumbling. For example, if at least a two inch length of 1/8-inch thread can be held on one end without tearing, the soil is cohesive. Ä
- strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated Thumb penetration. The thumb penetration test can be used to estimate the unconfined by the thumb only with very great effort. Type C soils with an unconfined compressive compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. യ
- clumps can only be broken up with difficulty, it may be clay in any combination with gravel, individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If and which can only be broken with difficulty, and there is no visual indication the soil is the soil is dry and falls into clumps which break up into smaller clumps, but the smaller sand or silt. If the dry soil breaks into clumps which do not break up into small clumps Dry strength. If the soil is dry and crumbles on its own or with moderate pressure into fissured, the soil may be considered unfissured. ပ

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	* B - Dense	A - Hard	>30
	C - M edium	A - Very Stiff	15-30
	C - Medium Loose	B or A - Stiff	8-15
	C - Loose	B - Medium	4-8
	C - Very Loose	C - Soft	0-4
	Granular Soil	Cohesive Soil	Blows Per Foot
		J SOIL REPORTS	Other available options using SOIL REPORTS