

Fire Engineering®

Construction Concerns: Trenching and Excavating

Article and photos by Gregory Havel

December 8, 2014

By Gregory Havel

Construction work in excavations and trenches is more hazardous to workers than work on level ground or on established floors. It is hazardous enough that the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has extensive regulations and standards under which this type of work must be done. Rescues of workers trapped in trenches and excavations by cave-ins are extremely hazardous to the rescuers, are time consuming, often become body recoveries, and are considered a part of “technical rescue” operations. Whatever the end result, they are newsworthy, very public, and can result in legal action.

The regulations governing excavations and trenching are located in OSHA 29 CFR Subpart P, sections 650-652, plus six appendices. These are located online at www.osha.gov. (Click on the tab “Regulations” or “Standards,” then on “Construction,” and scroll down to Subpart P.)

OSHA definitions from 29 CFR 1926.650(b) follow:

- Excavation: Any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.
- Trench: A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 meters).
- Trench shield (photo 1): A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with 1926.62(c)(3) or (c)(4). Shields used in trenches are usually referred to as “trench boxes” or “trench shields.”

December 8, 2014



(1) Photos by author.

OSHA classifies soils according to their stability and requires more protection for workers as the stability of the soil decreases. In decreasing order of stability, the soil types follow:

- Stable rock: Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.
- Type A soil: Cohesive soils such as clay soils and hardpan.
- Type B soil: Less cohesive soils such as silts, loams, and some gravels.
- Type C soil: Soils less cohesive than Type B including sand, gravel, and some loams; any soil that is submerged or from which water is seeping; soils that are layered and sloped; and any soil that does not meet the requirements of stable rock, Type A or B.
- For the details of soil classification, see Appendix A of Subpart P of 29 CFR 1926.

OSHA requires more protection for workers in the excavation or trench as the soils become less stable, especially in excavations more than five feet (1.525 m) deep. In

large excavations, it is common that the sides are sloped or benched as per the following OSHA requirements:

- In stable rock, the sides of the excavation are permitted to be vertical.
- In Type A soil, the sides of the excavation must be sloped or benched with a maximum slope of $\frac{3}{4}: 1$ (53°).
- In Type B soil, the sides of the excavation must be sloped or benched with a maximum slope of $1: 1$ (45°).
- In Type C soil, the sides of the excavation must be sloped or benched with a maximum slope of $1.5: 1$ (34°).

In neighborhoods with existing structures and in roadways, excavations and trenches are usually shored with vertical sides to prevent cave-ins. In trenching, trench shields (trench boxes) are pulled along the trench as it is excavated, giving the workers a relatively safe place from which to work in laying pipe or cable. The trench box in photo 1 is more than eight feet (2.44 meters) high and weighs several tons.

Photos 2 and 3 show the end of the construction of a sanitary sewer line through Type C soil of loose sand and gravel. The trenching and pipe-laying started from the background of the photos at a depth of about six feet (1.83 meters). Although the sewer pipe sloped upward toward the foreground, the surface of the ground sloped upward more rapidly. At the manhole in the foreground, the trench was about 15 feet (4.58 meters) deep. A second, wider trench box was set in the trench above the lower trenchbox, resting on benches on the sides of the trench to reduce the width that would have been needed for this trench in this type of soil.



(2)



(3)

The excavating machine that was used to dig the trench and set the manhole in the foreground was moved to the left to remove the trenchbox so that the trench could be backfilled. This machine did not have enough power to pick up the trench box while reaching over the manhole. Because of the sloping and benching of the sides of the trench, it was unable to lift the trench box from this position.

This problem was anticipated by the plumbing and excavating contractor, who had a second excavating machine at the job site. Photo 3 shows the two machines working together to successfully remove the trench box. This method eliminated an extremely hazardous practice: working without cave-in protection in a trench while dismantling a trenchbox so that it can be removed in pieces when the work is complete.

Other OSHA requirements include notifying local emergency services; locating all underground utilities and structures before work begins; providing access and egress to the trenchbox or shored area by ladder or ramp without the worker leaving the protected area; protection from falling objects (hardhats); and following the plans for the excavation and for the sloping, benching, or shoring systems.

The OSHA regulations are a minimum standard that must be followed to protect workers from the effects of the law of gravity. If the regulations are not followed, gravity is likely to cause a cave-in, resulting in worker injuries and fatalities. The OSHA regulations are also a minimum standard for emergency services workers at the scene of a cave-in. In addition, trenches can be classified as permit-required confined spaces under OSHA's 29 CFR 1910.146.

December 8, 2014

Construction and emergency services workers, rescue teams, and anyone else who has not had the specialized training required for these operations should never enter excavations, trenches, or permit-required confined spaces.



Gregory Havel is a member of the Town of Burlington (WI) Fire Department; retired deputy chief and training officer; and a 30-year veteran of the fire service. He is a Wisconsin-certified fire instructor II, fire officer II, and fire inspector; an adjunct instructor in fire service programs at Gateway Technical College; and safety director for Scherrer Construction Co., Inc. Havel has a bachelor's degree from St. Norbert College; has more than 30 years of experience in facilities management and building construction; and has presented classes at FDIC.

[CLICK HERE](#) for more 'Construction Concerns' articles!

MORE CONSTRUCTION CONCERNS

- [Fire-Resistive Floor-Ceiling Assemblies](#)
- [Door Reinforcements](#)
- [Electrical Needs](#)
- [Hazard Communication in Construction](#)
- [Firewall Penetrations](#)
- [Roofing Materials Test](#)
- [Fire Extinguisher Testing](#)
- [Foamed-In-Place Insulation](#)
- [Wood Framing: Sill Plate Anchors](#)
- [Metal Roofs](#)
- [Hybrid Buildings](#)
- [Contractor Hazards](#)