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Safety in Trenches and Confined Spaces

by William Atkinson

Benjamin Franklin said the only two things for sure in life are death and taxes. When it comes to underground safety, nothing is certain, but some things are strong probabilities. For example, if a worker is buried in a trench due to a cave-in, that worker is probably going to die or if a worker enters a utility vault with insufficient oxygen, he or she will probably die, said David Dow, president of Trench-Safety & Supply, Inc. in Memphis, Tenn.

According to Dow, excavation and trenching is statistically the most hazardous work in the U.S. construction industry. Each year, more than 100 workers are killed in cave-ins. Thousands more are severely injured. Most deaths occur in trenches between five and 15 feet, where many supervisors and workers erroneously believe quick escape is possible in the event of a wall collapse.

He illustrates the fallacy of this belief. A cubic foot of dirt weighs about 100 pounds. A cubic yard weighs about 3,000 pounds. If a six-foot tall man is in a six-foot deep trench, escape may seem simple. However, how much of the time is that person going to be working standing up straight? "Most of the time, he will be bending over, squatting, or kneeling," said Dow. As such, that person could easily have two to four feet of dirt above his head. If just part of the trench wall breaks off, maybe two cubic yards—6,000 pounds—could fall on the worker. "A Ford Expedition four-wheel drive weighs about 6,000 pounds," he said. "If you're in a trench, bent over, with a Ford Expedition on your back, what are the chances you're going to be able to get out of that trench?"

The first step to trenching safety is for a "competent person" (as defined by U.S. Occupational Safety & Health Administration) to identify the type of soil where the trench will be dug. OSHA recognizes four types of soils. (See list below.) Each presents its own challenges and none is completely safe. Even rock will destabilize when it is opened up for a trench, which usually occurs with dynamite or big breakers. "Just in the process of doing the work, you're creating instability," said Dow. Most cave-ins result from a superficial inspection of a site that suggests no apparent chance for a trench collapse, such as soils with high percentages of clay. However, the majority of cave-ins actually occur in clay-based soils—more than in sandy soils, where one might expect more cave-ins to occur.

Soil Types

- **Solid Rock - Solid mineral matter that stays intact (extremely rare)**
- **Type "A" - Very cohesive, stable, not disturbed, no vibration (clay, rare)**
- **Type "B" - Moderately cohesive, relatively stable**
- **Type "C" - Least cohesive, not stable (granular, loose, or wet material)**

Two cubic yards of dirt weigh as much as a Ford Expedition, says David Dow, president of Trench Safety & Supply, Inc. Photo courtesy Trench Safety & Supply

The "competent person" needs to study soil conditions, the planned depth and width of the trench, local vibrations (such as heavy equipment working in the area), and water seepage and ground saturation. The results of the inspection and assessment will determine what type of protective system is most appropriate.

There are three alternatives available to provide a safe working environment for trench workers - sloping, shoring, and shielding. Sloping requires cutting back trench walls to an angle that will insure no collapse into the work area. This is generally the most expensive alternative, because of the costs associated with excess excavation, refilling, compaction, and reinstatement. Shoring devices pre-load the trench walls and provide positive restraint to soil movement, thus preventing cave-in hazards. Shielding devices are not designed to prevent trench wall collapse, but rather to shield workers should a cave-in occur. Most pre-assembled shoring and shielding systems are quick and easy to install.

The Fishel Co. in Roanoke, Texas, designs, builds and maintains distribution systems for electric, gas, telecom, CATV and broadband utilities throughout the United States. Trenching can be a particularly complex task when working in areas with a lot of other utility structures, especially inner city areas, where large numbers of water lines, sewer lines, gas lines, and other lines are likely to be present, said Warren Graves, regional safety manager. The company uses special bracing to preserve the integrity of these other lines. There is also the potential to be in contact with other energized systems in the ground. "This requires a lot of careful planning before the work even begins," said Graves. "It then requires constant communication while the work is being performed—communication with our customer, with the other utilities, and with the public in general."

Besides planning and communication, it is vital to have

well-trained crews and well-trained supervisors, who can make the right decisions if problems occur. "All of our workers are required to participate in at least 40 hours of safety training a year," said Graves. The training is targeted to the type of work each crew does. The company also has a mentoring program, which pairs experienced workers with new workers.

Most utilities have good confined space safety programs, Dow said. "They encourage employees not to enter these spaces unless absolutely necessary, and when they do enter, they make sure they have all the right equipment, and that it is working properly," he said. However, complacency can lead to problems. "You may have a worker who has entered confined spaces every day for 20 years with no problems, so why would he have a problem today?" he said.

Even with training, if a coworker is unable to communicate with a colleague in the confined space, he or she may automatically go in after the worker, and could also become a victim. "When the second worker sees the first worker passed out, it may not occur to that person that the first worker passed out for a reason," he said. "There are very few second chances."

Problems also occur if detection and rescue tools are not working properly. Most problems in confined spaces are due to atmospheric conditions, such as sewer gas or lack of oxygen, said Mark Swan, a consulting engineer who spent 31 years at Colorado Springs Utilities. "Some gasses may not be particularly toxic, but since they are heavier than air, they replace the oxygen in the enclosed or confined space," he said.

The best solution is to follow OSHA requirements, which means testing the environment with the appropriate equipment each time before entering a confined space. "Test for oxygen levels, test for toxic gasses, and test for flammable gasses," said Swan. Then ventilate the space if any of these are present. "It is also a good idea to ventilate anyway, just for a comfort level," he said.

OSHA also requires an attendant outside the confined space who is trained in first aid and can contact emergency services personnel.

Most of the trench work The Fishel Co. does for utilities is in the three- to five-foot range. However, it may go 15 to 25 feet deep when skirting railroads or interstate highways. On some occasions, it may reach 40 feet. "At these deeper levels, there is the potential for a bad atmosphere, such as lack of free-flowing air," said Graves. If trench work is near a busy highway or downtown area, carbon monoxide from passing vehicles might enter the trench and displace the oxygen, so it is necessary to inject air into the trenches and monitor the atmosphere as though it were a confined space. "We also monitor the air when working near an old gas station, where the tanks are still in the ground, or have been removed, but where there is still some unremediated soil in the area," he said.