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Trench Safety Strategies: All Are Safe, But Which is Best? William Atkinson

If a trench is deeper than five feet (four feet in some states), the U.S. Occupational Safety and Health Administration requires some type of protective system, except for excavations that take place entirely in stable rock, which is a very rare occurrence. OSHA also requires a protective system in trenches less than five feet, if there is a potential for a cave-in, as determined by a “competent person.”

According to OSHA, a “competent person” is required to perform at least one visual inspection and one manual test to classify the soil as the job progresses, not just at each worksite. Soil can change considerably as a contractor moves along and the pipeline is installed. The soil type is then used to select the proper protective system. “In fact, the first step in choosing a protective system is for the ‘competent person’ to classify the soil,” said David Dow, president of Memphis-based TrenchSafety & Supply Inc.

OSHA requires at least one “competent person” on the jobsite at all times. However, many utilities want everyone on the jobsite to go through “competent person” training, said Dow. “The benefit is that everyone on the jobsite is much more conscious of the importance of safety,” he said.

Excavation and trenching is some of the most hazardous work in the U.S. construction industry (Note: Actually falls from elevation are statistically the leading cause of fatalities in construction. Trenching is dangerous and some would say it is the most dangerous, but statistics don’t support that). According to the National Utility Contractors Association, approximately 50 people are killed

each year in trench cave-ins, and hundreds more are severely injured. Most deaths and injuries are caused by suffocation, being crushed, loss of circulation, or being struck by falling objects.

OSHA recognizes four types of soils:

“**Stable rock.**” Less than 2 percent of the soil in the United States is classified this way. It is difficult to determine if the rock is stable without knowing if cracks slope into or away from the trench.

“**Type A soil,**” defined as cohesive soil with an unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. Examples include various types of clays. However, no soil can be considered “type A” if it is fissured, subject to vibration (such as might result from vehicles traveling on a nearby roadway), previously disturbed, or is subject to seeping water.

“**Type B soil,**” defined as cohesive soil with an unconfined compressive strength greater than 0.5 tsf, but less than 1.5 tsf. Examples include angular gravel, silt, silt loam, previously disturbed soils (unless otherwise classified as Type C), or unstable dry rock.

“**Type C soil,**” defined as soil with an unconfined compressive strength of 0.5 tsf or less. Examples include granular

soils, sand, loamy sand, or submerged soil with freely seeping water. This is considered to be the least stable soil type.

Selecting and installing an appropriate protective system is the most important safety strategy for trenching, said George Kennedy, vice president of safety for the National Utility Contractors Association, “Failure to use a protective system is the

number one cause of fatalities and injuries in trenches,” he said. “Some crews don’t want to bother with this, though, because they’ve been in and out of trenches for years with no problems. However, it only takes one cave-in.”

Kennedy refers to the “Three S’s of Trench Safety.” These are sloping, shielding and shoring.

Sloping entails cutting back trench walls to a predetermined angle based on the soil type which will reduce the chance of a collapse into the work area. This is generally the most expensive alternative, because of the costs associated with excess excavation, refilling, compaction, and reinstatement.

If sloping is selected, OSHA has certain requirements. For stable rock, the maximum allowable slope is vertical (or 90 degrees). For type A soil, it is .75 to 1 (or 53 degrees). For type B soil, it is 1 to 1 (or 45 degrees). For type C soil, it is 1.5 to 1 (or 34 degrees).

Shielding is another option. Shielding devices are not designed to prevent trench wall collapses, but rather to shield workers should a cave-in occur. A trench shield is a structure that protects employees within the structure because it is able to withstand the force that would be imposed on it by a cave-in. Shields can be pre-manufactured or built on the jobsite in accordance with OSHA regulations. Pre-manufactured shields come in a variety of sidewall thicknesses, heights, lengths, and weights, and are usually constructed of steel or aluminum. They can also be stacked atop one another to accommodate virtually any depth and soil condition. End panels can also be used on one or both ends to provide protection in three- or four-sided excavations. “The most common trench shields today are steel or aluminum,” said Dow. “In the past, there were some fiberglass trench shields, but these are rare today.”

According to NUCA’s Kennedy, trench shields are the most commonly used form of protection today. They are easy to set, use, and move and provide a protected area

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for employees to work safely.

“Modular systems are also very popular for small jobs and repair work. They are very flexible, and they are also easy to handle and lightweight,” he said. “They are easy to assemble and take apart, and you can carry them in the back of a pickup truck or small trailer.” Also, he said, they can easily be lifted with a backhoe or mini-excavator. While they are very common, though, they are not as flexible as hydraulic shoring devices.

Shoring devices pre-load the trench walls and provide positive restraint to soil movement, thus preventing cave-in hazards. Most shoring devices are metal, and aluminum is particularly popular. Hydraulic shoring devices use rails and hydraulic cylinders. The cylinders compress the soil behind the cylinders, creating an arching effect to hold the walls in place. “According to OSHA, you can utilize timber shoring,” said Dow. “However, this is rarely done, because you can’t use 4x4s. You need 8x10s, 10x10s, or even 10x12s.”

“In the South, West, and Southwest, hydraulic shoring is a common option,” said NUCA’s Kennedy. “However, it is not as common in the Northeast.” Kennedy would like to see its popularity increase there, because it is safe, flexible, and easy to install.

Kennedy is not sure why shoring is not popular in the Northeast, but he thinks it may be due to a “bad rap” in its early years, when the water in the hydraulic systems would freeze in winter months. “These days, though, the systems have anti-freeze available,” he said.

There is also a fourth option, which is a system designed by a registered professional engineer. This is rare, though, said Dow. “It is used primarily for unique situations, such as an unusually deep excavation, or a trench that is deep and right up against a roadway, where there is going to be a lot of vibration from vehicles,” he said.

Both Dow and Kennedy prefer shoring or shielding over sloping, for cost reasons.



A “competent person,” as specified by OSHA, inspects an aluminum trench prior to use. Photo courtesy of TrenchSafety & Supply Inc.

“One problem with sloping is that, if you dig a hole six feet deep and four feet wide in type C soil, which is the most common soil, then you need to slope at 1.5 to 1,” said Kennedy. This means going out nine feet at the top on each side, which is a total of 22 feet across (including the 4-foot width of the trench itself). “If you are working in open country, that’s fine, but you may not have that much room if you are working in a more congested area, such as an urban or suburban area,” he said. Even in open country, it can be time-consuming and expensive to move that much dirt, then later replace and compact it, he said.

Dow agreed. His company calculated cost differences between trench shields and trench sloping. “In a lot of cases, trench shields can actually be less expensive than sloping,” he said. “This is especially the case when the cost of diesel fuel is really high.” It takes a lot of equipment, power and time to do sloping, which increases costs associated with the equipment, especially diesel fuel.

Dow studied two scenarios. One involved excavating a trench that is 4 feet wide and 14 feet deep, and protecting it with a trench shield. The other involved sloping that same trench at a 34-degree angle (for type C soil). “If you did this, you would have to slope it out to 45 feet wide,” he said. If the trench was 1,000 feet long, shielding would

require moving about 2,000 cubic yards of material. Sloping would require moving about 12,500 cubic yards of material.

“This would mean six times the amount of fuel to operate the equipment, plus six times the amount of time required to dig the trench,” he said. Shielding would require moving only 17 percent of the volume of soil that would have to be moved for sloping. ■

William Atkinson is a writer in Carterville, Ill., and a longtime contributor to *Public Power* magazine.

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