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## Constructing a better trench rescue

The fire service is borrowing new technologies from the construction industry to develop a method for safer and more efficient rescues.

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**O**SHA statistics are riddled with cases of rescuers killed in failed attempts to save buried or partially buried victims. In fact, as many as 65% of all deaths from trench cave-ins are of would-be rescuers. In addition to being dangerous, trench collapses are one of the most time-consuming and labor-intensive technical rescues. The victim must be completely uncovered before he or she can be removed from the trench. A single cubic foot of dirt can weigh as much as 145 pounds, and a typical small cave-in can involve about 1.5 cubic yards of dirt, or approximately 4,000 pounds.

Inspired by these statistics, the fire service is employing innovative technologies from the construction industry to develop a method for safer and more efficient trench rescue operations. Recent training sessions conducted between private sector contractors and Mutual Aid Box Alarm System Division No. 12, located in suburban DuPage County, Ill., has proved to be beneficial. This joint effort has resulted in the development of new rescue-friendly equipment, safety devices and operating procedures to facilitate rescue needs.

### Tool transitions

Time is the enemy for victims of a trench collapse. The longer the patient is trapped, the higher the potential for developing Crush Syndrome. Many times in addition to internal traumatic injuries, hypothermia, which is considered a slow killer, may occur.

More than 10 years ago, the fire service was using massive, heavy timbers for shoring operations at trench collapse sites. This equipment was difficult and

time consuming to work with due to the weight and inherent amount of required timbers.

More recently, we have been using 5-gallon buckets and garden and army shovels in rescue operations. This process obviously is very slow, as the average trench rescue takes 4 to 10 hours, and rescuers need to be rotated a minimum of every 15 to 20 minutes because they may be digging on their hands and knees for extended periods of time. Additionally, these rescuers are exposed to the potential of a secondary toe collapse.

We then drew from the construction industry as we noticed they were using hydraulic and pneumatic shores. These shores are much quicker, safer and less labor-intensive, and they are considered part of the conventional trench-rescue equipment cache.

Today, a new chapter is being written in trench rescue operations. The fire service has begun to adopt two tools for trench

collapse operations that the construction industry has used for years:

- 1) Air reduction tools to pulverize the soil, and
- 2) Vacuum excavation for soil removal.

Dig time can be reduced up to 80% with the use of these tools.

### Soil reduction

Pneumatic tools like the Air Spade, which have been used by arborists for years, can be used for landmine and unexploded ordnance removal without damaging tree roots or underground phone, electric or gas lines. They operate from trailer-mounted air compressors common to the construction industry at 100psi and 150-185cfm.

The Air Spade has a guarded trigger, fiberglass barrel and a specially designed tip that discharges the air at Mach 2 but exhibits a force of only 10.2psi. This high velocity of air is what pulverizes and



Air tools pulverize the soil for vacuum excavation.

moves the soil. Through hundreds of hours of testing, we have found that the air reduction tools will work up to 85% of the time.

Concept Engineering Group, Verona, Pa., is the manufacturer of Air Spade and, to date, the only manufacturer with an approved trench rescue operator's manual. The manufacturer states that the victim's head and bare skin should always be protected, and rescuers should try to blow the loosened soil from around the victim into a sump pit.

Pressure washers are another soil-reduction tool, but they should be used only when there is no possibility of striking any victims, rescuers, or any type of gas lines or underground cables. The construction industry considers 2,000psi or greater to be destructive to underground cables. Some manufacturers of pressure washers make available gloves and boots to protect the operator from electrocution.

### Phase tools & equipment

After hand digging and filling 5-gallon buckets, the next level of soil removal available is the use of backhoes and hydraulic equipment. This type of removal is dangerous for the victim as well as the rescuers and shouldn't be used. Even the most skilled backhoe operator can't feel the difference between the human body and soil. Hydraulic equipment also causes vibration and undesirable superimposed loads.

The fire service also now is drawing from the construction industry in the area of rapid soil removal through vacuum excavation. For years this technology has been used for cleaning out sewers, digging piers, locating non-destruction utilities and removing slurries from directional boring operations.

Vacuums are considered air-conveyance equipment. The amount of air that is moving in cubic feet per minute directly relates to the quantity of product that can be transported. Air is considered the transporting medium.

There are three types of vacuum systems available to the fire service. The first unit is handheld and operates off of an air compressor. This device, which uses a 3-

inch hose with a 265cfm rating, is lightweight and maneuverable.

The second unit typically is used with directional boring. It is also lightweight and maneuverable, with a 3- or 4-inch hose that has a 500- to 850cfm rating. These units are manufactured by Vac-Tron Equipment and are equipped with 200- to 1,000-gallon debris tanks. These two smaller units are ideal for sand, gravel and hopper conditions; they don't work well with clumpy soil.

The final unit is the typical municipal sewer cleaning truck, which uses an 8-inch hose and has a 2,600- to 8,000cfm rating. This larger unit will move a substantial amount of dirt quickly and is available through most municipalities. This unit is manufactured by Vector in Streator, Ill.

Serious injury has occurred with the use of straight open pipe. The large vacuum removes dirt at an exceptional rate and is an excellent adjunct to our arsenal of trench rescue equipment. However, it should be used only with proper safety procedures and approved trench rescue kits.

We have developed a trench rescue kit that includes a vacuum safety tip, relief valve and 8-inch hoses that connect to these municipal trucks. The kit is now available to the public.

### General guidelines

A 300-foot vibration-free zone should be established and enforced, and dig operations by rescuers in the trench shouldn't begin until shoring operations are complete. Vacuum trucks may be brought up to a safe distance from the trench after shoring is complete. As these vacuum trucks can weigh a considerable amount, care should be taken not to create an unwanted superimposed load on the lip of the trench.

Establish a dig sector early in the incident. This will facilitate the accumulation of necessary resources, such as personnel, vacuum trucks, air compressors, air tools and approved vacuum kits. Realistically, you should have approximately 30 to 60 minutes to set up while shoring is being used to stabilize the

trench.

After completion of shoring, a vacuum and air-reduction tool should be used to evacuate a sump pit area in front of the victim. The next objective is to remove the dirt from the victim's chest and face, which will facilitate expansion of the chest allowing immediate medical intervention.

After the sump area is excavated and shored, the vacuum tip is kept in the sump area to clear material blown in from the air tool. The air tool is then used to blow the dirt from around the victim into the sump. Care must be taken not to point or aim the air tool at any person during the operation, and the victim should receive appropriate protection at all times.

As the fire service continues to develop, the technical rescue teams also have the opportunity to employ new and innovative technologies. This technology can be used for trench rescue collapses and should also be considered for vertical parallel-shaft rescue operations.

Before the emergency arises, training should be conducted between both rescue and private sector individuals. Contact your local municipalities and private contractors and set up a resource list of vacuum trucks, air compressors and other similar equipment.

Develop a positive, cooperative relationship with your local municipality by initiating prearranged responses. Contact your public works division to determine the availability of resource equipment. They also need to know what will happen in the event of an emergency and will benefit greatly from training and working with you. The result will be a safe and efficient rescue operation. **FEPN**

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