# Excavation and Trenching – Stats and Facts

## DID YOU KNOW?

U.S. Bureau of Labor Statistics (BLS) data show that 271 workers died in trenching or excavation cave-ins from 2000 through 2006. A review of multiple national databases by NIOSH researchers found that trenching and excavation hazards during construction activities resulted in 488 deaths between 1992 and 2000 – an average of 54 fatalities each year. Sixty-eight percent of those fatalities occurred in companies with fewer than 50 workers. Forty-six percent of the deaths occurred in small companies with 10 or fewer workers. Hazards associated with trench work and excavation are recognized and preventable, yet injuries and fatalities associated with these hazards continue to occur. Regulations and consensus standards describe engineering controls, protective equipment, and safe work practices to minimize hazards for workers during trench work and excavations.

Trench fatalities are a serious problem in construction. Bureau of Labor Statistics data show that about 25 workers are killed each year in trench-related mishaps. Cave-ins cause about three out of every four fatalities; the remainder are commonly due to struck-bys or electrocutions.

In 2003, the nation experienced a spike in trench fatalities (53, according to preliminary data, later reduced to 48), inviting a detailed OSHA investigation which highlighted important facts about trench dangers. Following its investigation, OSHA undertook a national emphasis campaign, distributing more information about trench hazards and stepping up enforcement. As a result, annual trench fatalities declined.

The results of OSHA's 2003 investigation are still useful in understanding why trench fatalities occur and how they can be avoided. The main reason trenches collapse is that they are not

properly protected.  Protective systems were properly employed in only 24 percent of the trenches.  In the remainder, a protective system was either improperly used (24%), available but not in use (12%) or simply unavailable (64%).

Further, despite the fact that environmental conditions were a contributing factor in 68 percent of the fatalities, the competent person was not onsite when the fatality occurred 86 percent of the time.  Most of the time (65%) the employer had not identified the soil type even though soil type is a factor in trench cave-ins.

Also, a disproportionate number of fatalities (36%) occurred on Mondays, probably because rain or other factors changed conditions over the weekend.  Under OSHA regulations, the competent person must inspect trench work in progress before each shift and after any changes in conditions.

The OSHA investigations showed that schedule time was more important than safety in 88 percent of the incidents. Seventy-two percent of the fatalities occurred in trenches less than nine feet deep.  Only nine percent occurred deeper than 15 feet.

The most commonly killed employees were construction laborers (53%), with plumbers and pipe fitters following next at nine percent.  Most (58%) were killed while installing pipe.

Fifty-six percent of these fatalities were Hispanics, and 52 percent were foreign-born.  For 44 percent, Spanish was their primary language.  At least 30 percent had been working for their employer for less than a year, and most (59%) worked for a subcontractor.

Only six percent were union members.  Since, nationwide, about 20 percent of construction work is union, the expected rate of union fatalities would be near 20 percent.  The lower rate suggests that union jobs are safer, that supervisors and workers on union sites are better trained and that the union offers the kind of protection that workers need to speak up about safety issues on the worksite.

Just over half the employers had a written safety and health

program, but, of these, only 40 percent covered trenching. Sixty-five percent provided no trench safety training. Most employers (71%) had never been inspected by OSHA, but 21 percent had been previously cited by OSHA for trench safety violations.

About three in every four fatalities occurred at residential worksites. Most companies were small; 42 percent had fewer than ten employees. Though, typically, five or less workers were present on the site when the incident occurred, most of the projects (52%) involved contracts worth $100,000 or more.

Although trench and excavation work can be very dangerous, injuries and fatalities are completely preventable. For LIUNA signatory contractors that participate in the LHSFNA, the OSH Division can provide assistance in the development and implementation of trench safety programs. For help, call the OSH Division.

OSHA is conducting a two-year-long special emphasis program to bring awareness to the hazards and risks associated with trenching and excavation. Its goal is to "by Sept. 30, 2019, increase trenching and excavation hazards abated by 10% compared to FY2017 through inspections and compliance assistance at workplaces covered by OSHA."

# KEEP IN MIND

An excavation is a hole left in the ground as the result of removing material. A trench is an excavation in which the depth exceeds the width. Trenching and excavation work is inherently dangerous. Hazards include cave-ins, struck-by injuries, electrical contact, and slips, trips, and falls.

An excavation is any man-made cut, cavity, trench or depression in the ground, formed by the removal of earth.

A trench is an excavation that is deeper than it is wide.

Without proper controls, working in or around any excavation poses many risks such as cave-ins, being struck by moving machinery,

slips, falls and exposure to hazardous substances.

Because a significant number of deaths and injuries in sewer and underground utility work are directly related to trenching, it is important to know how to work safely in and around trenches.

As an employer you must:

BEFORE you dig:

- Ensure underground utilities are located and marked.
- If the work is within 600 mm of underground utilities, inform the authority of the underground utilities before digging.
- Ensure that the utilities are properly de-energized before starting the work.
- Ensure employees follow safe operating procedures.
- Instruct supervisors and employees on the requirements of the regulations and ensure they comply.

As the work progresses:

- Ensure that the walls of an excavation or trench are supported by shoring, bracing or caging unless:
- It is less than 1.2 m deep
- It is sloped or benched to within 1.2 m of the bottom with the slope or bench not exceeding 1 m of rise for each 1 m of run
- No employees are required to enter the excavation or trench, or
- It is cut into rock that is solid and stable.
- If not stable, walls and crests must be adequately supported by rock bolts, wire mesh, shoring or another equivalent method.
- When powered mobile equipment or mobile cranes are used near the edge, any shoring, bracing or caging is adequate to support the increased pressure.
- Ensure that shoring, bracing or caging is certified by an engineer and be prepared to provide proof of the certification to an officer on request.

- Ensure employees do not enter a trench more than 1.2 m deep unless it is properly supported by shoring, bracing, or caging, or is sloped or benched.
- Ensure a ladder extends 1 m above the trench and is no more than 15 m away from the employees or other safe means of access and egress is provided.
- Employees may enter an excavation 1.2 m or more in depth to install bracing as long as they remain a distance from the face equal to or greater than the depth of the excavation.
- Ensure employees do not enter the excavation or trench to install or remove the shoring or caging.
- Ensure that excavated material is kept at least 1.2 m away from the edge of an excavation or trench.
- Ensure the excavation or trench is kept reasonably free of water.
- Ensure that air testing is carried out in trenches with hazardous atmospheres before any employee enters the trench.
- Ensure there is an employee working on the surface who is able to observe those employees working in the trench.
- Follow the specific steps when using powered mobile equipment and cranes near excavations and trenches.
- Provide adequate illumination when work is carried out in or near an excavation or trench.
- Provide warning lights or reflective materials and an adequate barrier around the area to prevent accidental entry.
- Ensure trenches and temporary protective structures are inspected for potential hazards and defects.

As an employee you must:

- Follow safe work procedures established by your employer.
- Not work inside trenches if they are not adequately protected from cave-ins and other risks.
- Wear all personal protective equipment provided by the employer, such as hard hats, safety boots and safety glasses.
- Conduct daily checks on temporary structures for possible defects.

- Be aware of all potential health and safety hazards/risks and the controls put in place to prevent them.
- Watch out for hazards in excavations including soil conditions.
- Report promptly to the supervisor any hazardous situations of equipment and work site.

**Inspections**

Sloping, shoring and trench boxes should be checked regularly.

**Hydraulic Shoring**

With hydraulic shoring, look for:

- Leaks in hoses and cylinders
- Bent bases
- Broken or cracked nipples
- Cracked, split, or broken sheathing

Report any of these conditions to your supervisor.

All shoring and bracing must be certified by an engineer.

After installation, inspect wales for signs of crushing. Crushing indicates structural problems and the need for more struts.

Always check areas near shoring where water may have seeped in. The combination of water and granular soil can lead to washout. This undermines the trench wall and has killed and injured employees on several occasions.

**Timber Shoring**

Check timber shoring before it’s installed. Discard any damaged or defective lumber.

With timber shoring, check for:

- Cracked or bowed sheathing
- Wales crushed where they join struts
- Loose or missing cleats
- Split or bowed wales

- Struts off-level

During use, check the box regularly and often to make sure that it is not shifting or settling more on one side than the other.

This can indicate the movement of soil or water underneath.

If the box is shifting or settling, get out and tell your supervisor about it.

**Trench Boxes**

Inspect trench boxes for damage, cracks in welds, and other defects.

In trench boxes, look for:

- Deformed plates
- Bent or distorted welds in sleeves and struts
- Missing struts
- Bent struts
- Holes, bends, or other damage to plates

**Ground around trenches**

The ground around trenches should be inspected for tension cracks. These may develop parallel to the trench at a distance of about one-half to three-quarters of the trench depth.

If you find cracks in the ground, alert the crew and double-check your shoring or trench box.

It’s dangerous to overlook damage or defects in protective systems.

# What is meant by a trench and an excavation?

Generally speaking, an excavation is a hole in the ground as the result of removing material. A trench is an excavation in which the depth exceeds (is bigger than) the width.

# What are the hazards associated with trenching and excavation?

Working in trenches and excavations is hazardous to both the workers who work inside them, and to workers on the surface. The hazards include:

- Cave-ins or collapses that can trap workers.
- Equipment or excavated soil falling on workers (e.g., equipment operated or soil/debris stored too close to the excavation).
- Falling into the trench or excavation.
- Flooding or water accumulation.
- Exposure to a hazardous atmosphere (e.g., gas, vapour, dust, or lack of oxygen).
- Contact with buried service lines such as electrical, natural gas, water, sewage, telecommunications, etc.
- Contact with overhead electrical lines.
- Slips, trips and falls as workers climb on and off equipment, or from inappropriate access and egress methods.
- Being struck by moving machinery, or by falling or flying objects.
- Hazards related to materials handling (e.g., lifting, struck by, crushed between, etc.).

# What is meant by soil types?

Definitions of soil types vary by jurisdiction in Canada. In addition, some jurisdictions have not defined soil types, but do require preventative measures when an excavation reaches a certain depth or proportion.

When a soil type is defined, the purpose is to try to identify or predict the potential for the soil to move and cause a collapse while the work is being done. Soil types typically use a scale of 1 to 4 where 1 is hard and dense to 4 which is loose, soft, wet or muddy soil, or a scale of A to C where A is hard and solid, and C is soft, sandy, filled or loose.

The soil type is determined by the characteristics of the soil's consistency, ease of removal, appearance, ability to excavate with hand tools vs. machine, water seepage, whether the soil has been excavated before, etc.

## What you should do before you begin an excavation?

The employer or supervisor is responsible for the work, and must take the necessary steps to identify all the hazards and risks before beginning any work. These steps include to:

- Identify the soil type(s) related to the excavation or trench you are going to dig. Soil properties often vary widely within a single trench (e.g., the soil type changes from top to bottom and along the length of a trench).
- Look for the legislative requirements that apply in your jurisdiction and the type of protective measures to be taken.
- Locate all buried services. Contact the owners of any underground utilities/services that may be in that location and ask t
- Identify and locate overhead power lines.
- Make sure these services are de-energized as necessary.
- Know all of the contact numbers of these services if there is an emergency.
- Check areas adjacent to the site for potential hazards and sources that can impact the stability of soil. Be aware that nearby vehicles and equipment can cause the soil to vibrate and then collapse.
- Determine if nearby buildings or structures and their foundations may put pressure on the soil and affect the walls of the trench.
- Test for hazardous gas, vapours, and dust before entering.
- Test for oxygen levels in the space before entering, and during the work as required.
- Plan appropriate organization of the work site, and good housekeeping practices including moving debris and excavated

soil far enough away from the excavation site.
- Remove water from the excavation.
- Protect workers from falling into the excavation.
- Identify appropriate personal protective equipment including high visibility apparel for vehicular traffic and make sure every worker wears them as required.
- Have a worker above ground when a worker is working in the trench to warn those in the trench of danger and to provide emergency help.
- Prepare work permits for work in confined spaces, as appropriate.
- Have a means of exit provided from the inside of the trench, usually no more than 8m (25 ft) away than any worker in the trench.
- Plan for adverse weather conditions (e.g. hot or cold environments, storms, etc.).
- Prepare an emergency plan and rescue procedures.
- Keep first aid boxes at the site.
- Educate and train workers about all existing and potential hazards and risks and appropriate safety measures.

## What factors determine what is the appropriate protective system to use?

In general, trenches that are 1.2 metres (4 feet) deep or greater require a protective system unless the excavation is made entirely in stable rock. The factors to consider include:

- Soil type
- Depth of cut
- Water content of soil
- Changes due to weather or climate
- Surcharge loads (e.g., spoil, other materials to be used in the trench) and
- Other operations in the area

# What are the different types of protective systems used to protect against cave-ins?

There are two basic methods of protecting workers against cave-ins:

- Sloping
- Temporary protective structures (e.g., shoring, trench boxes, pre-fabricated systems, hydraulic systems, engineering systems, etc.)

## Sloping

Sloping involves cutting back the trench wall at an angle that is inclined away from the work area of the excavation. The angle of slope required depends on the soil conditions. Benching is a similar method to sloping.

## Temporary protective structure

Saskatchewan Labour defines a temporary protective structure as “a structure or device in an excavation, trench, tunnel or excavated shaft that is designed to provide protection from cave-ins, collapse, sliding or rolling materials, and includes shoring, trench boxes, trench shields and similar structures.”

- **Shoring** is a system that supports the sides or walls. Shoring requires installing aluminum, steel, or wood panels that are supported by screws or hydraulic jacks. Some systems can be installed without the workers entering the trench. This option provides additional safety for those workers. Wherever possible, install the shoring equipment as the excavation proceeds. If there is any delay between digging and shoring, no one should enter the unprotected trench.
- **Trench Boxes** are commonly used in open areas that are away from utilities, roadways, and foundations. Trench boxes can

be used to protect workers in cases of cave-ins, but not to shore up or support trench walls. They can support trench walls if the space between the box and the trench wall is backfilled with soil and compacted properly. Otherwise, a cave-in or collapse may cause the trench box to tilt or turn over. Workers should not be present in the box when it has to be moved.
- **Other:** In some cases, the trench or excavation walls are made of rock but are not entirely stable. Support the walls by using rock bolts, wire mesh, or a method that provides equivalent support.

# What should you NOT do during an excavation?

- Do not enter an unprotected trench deeper than 1.2 metres (4 feet).
- Do not start digging before locating and de-energizing the buried services.
- Do not enter a trench before testing the air for hazardous gasses and vapours, or the lack of oxygen.
- Do not place the sections of pipes, piles of spoil, unused tools, and timber, and other materials within 1 metre from the trench’s edge.
- Do not rely on natural freezing to act as a method of soil stabilization.
- Do not work under suspended or raised loads and materials.
- Never stand behind a backing vehicle.

# What can be included in a trenching and excavation inspection checklist?

The following are some points to consider. Each circumstance will be different, so be sure to adapt the questions to suit your situation.

**Underground/Utility Services**

- Know the contact numbers?
- Located, identified and informed respective parties?
- Grounded, isolated, de-energized, or protected from unplanned release?

**Housekeeping**

- Excavated material, pipes etc. are placed 1 metre away from the edge of the excavation or trench wall?
- Are pumps available to remove water?
- Is the base and foot of the ladder secure, and free of garbage or water?
- Are materials placed on the site obstructing the worker’s or vehicle’s ability to move freely?
- Are established traffic controls used, where required, including adequate signage, personnel, and lighting?
- Has the excavation been marked to make the workers and others aware of the excavation (e.g., fence, flags, or other safeguards)?
- Are sanitary facilities available at the site, as appropriate?

**General**

- Are proper barriers or guardrails in place to protect anyone or equipment falling into the excavation or trench?
- Has the air in the excavation been tested for low oxygen, and hazardous gasses and vapours?
- Is a safe means of entry/exit provided such as a sufficiently long and secured ladder placed at appropriate distances (within 25 feet of all workers)?
- Are cracks visible in the ground around the trench or excavation that may indicate soil movement?
- Are there any signs of water seeping into the trench or excavation?
- Are workers wearing appropriate PPE (e.g., hard hats, respirators, , safety boots, hearing protection)?
- Are high visibility vests or clothing provided and worn by all exposed to vehicular traffic?
- Are first aid boxes available at the site?

- Are operators qualified to operate the heavy machinery/equipment?
- Does a competent person regularly inspect the excavation (at the start of each shift before work begins or after any event likely to have affected the strength or stability of the excavation)?
- Is there a competent person stationed at the surface of the trench to warn workers in the trench of danger and to provide emergency help?

**Sloping**

- Has the soil type been considered when determining the angle of the slope?
- Are they being sloped or benched back to a safe angle?

## Temporary protective equipment, such as:

**Timber Shoring**

- Is the shoring equipment the right equipment as required for the depth of the trench/excavation and type of soil?
- Is the equipment damaged (e.g., cracked, crushed, split, or bowed)?
- Are there loose or missing cleats?
- Are the struts off level?

**Trench Boxes**

- Are the boxes damaged or have defects?
- Are the plates deformed, bent, have holes, or show other damage?
- Are the welds cracked, bent, or distorted?
- Are there missing or missing struts?
- Are trench boxes shifting or settling to one side?

**Hydraulic Shoring**

- Are there any visible leaks in hoses or cylinders?
- Are there bent bases?
- Is any equipment cracked, split, broken or cracked?