



### INTRODUCTION

Excavation work can be a very hazardous exposure to employees and other contractors on construction job sites. Excavation is one of the most hazardous construction operations. The most feared hazard is excavation cave-in. Most accidents occur in trenches 5-15 feet deep. There is usually no warning before a cave-in, but there are signs of potential hazards and controls that can be implemented.

In addition to cave-ins, there are other potentially dangerous exposures such as asphyxiation due to lack of oxygen, inhalation of toxic materials, moving machinery near the edge of an excavation resulting in collapse, water intrusion, and accidental severing of underground utility lines.

The safety guidelines in this bulletin are provided to assist safety efforts in identification of hazards, protective systems to be used and safety procedures to be implemented in an effort to protect all construction workers. These guidelines are for excavations of less than 20 feet. Excavation safeguards for excavations of over 20 feet should be designed by a registered professional engineer.

### SCOPE AND APPLICATION

The Occupational Safety and Health Administration's (OSHA) rules apply to all open excavations made in the earth's surface, which includes trenches. According to OSHA 1926.650(b), a trench is referred to as a narrow excavation (in relation to its length) made below the surface of the earth. 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.

**GENERAL SAFETY REQUIREMENTS****Pre-job planning**

Many of the job site accidents are a result of inadequate planning prior to work at the site commencing. Prior to arrival at the job site, key personnel should review the scope of the work to be completed, as well as identify potential site specific hazards.

- Key personnel, including identified competent persons at each job, should be involved in all planning.
- The job site planning and evaluation should include utility lines that may run through the site and who will be responsible for all utility locates to be completed prior to arrival at the job. Evaluation and plans should be made for both overhead and underground lines.
- Soil conditions should be evaluated and plans in place for specific soil types that may be encountered and where excavation will be completed.
- Protective equipment including shoring, if required, should be identified and provided at the site.
- Surface and ground water/water table should be reviewed at the site and plans established to deal with potential hazards.
- Traffic patterns should be evaluated, including proximity to the excavation site and include plans for traffic control both into and out of the site.
- Any structures on the site should be reviewed and include proximity to all excavation areas, as well as their condition.
- If blasting is to be completed, procedures and plans should be outlined and established pre-job and during construction.
- Employee training should be provided pre-job for all employees who will be involved in excavation operations.

**CONSTRUCTION JOB SITE SAFETY****Competent person(s)**

Competent persons should be identified and in place at the time the job starts. The competent person should be responsible for evaluation of soil conditions, potential hazards and methods to be implemented to control the hazards. Daily inspections should be completed by competent persons of the excavation site and adjacent areas subject to cave-in, failures of protective systems and equipment, potentially hazardous atmospheres, and other hazardous conditions. The competent person should be given authority to halt construction until adequate safeguards can be implemented.

**Reference 29 CFR 1926.651(k)**

Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

**PROTECTION OF EMPLOYEES**

Employees should be protected from cave-ins by using an adequately designed protective system. Protective systems must be able to resist all expected loads to the system. Several factors come into play when developing a total “protective system.” The design of the system itself, how materials and equipment are handled in and around the excavation, and installation and removal of protective system components are all part of the total “protective system.”

**Reference CFR 1926.652(a)**

Protective system is a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

**DESIGN OF PROTECTIVE SYSTEMS**

The employer shall select and construct slopes and configurations of sloping, benching systems, support systems, shield systems, and other protective systems.

- Sloping: Form sides of an excavation that are inclined away from the excavation.
- Shoring: Such as metal hydraulic, mechanical or timber shoring system that supports the sides.
- Shield: Can be permanent or portable. Also known as trench box or trench shield.

**Reference 1926.652, 1926.652(b), 1926.652(c)**

**Sloping/benching** are the methods of excavating the sides of a trench to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels. One method of protective employees in excavations is to slope the sides to an angle not steeper than one and one-half the horizontal to one vertical (34 degrees measured from the horizontal). This maximum allowable slope is suitable for all soil types and excavations less than 20 feet deep. Soil classifications and maximum allowable slopes for Stable Rock, Type A, B and C soils can be found in CFR 1926 Subpart P, Appendix B, Table B-1 – Maximum Allowable Slopes.

**Shoring or shielding** is used when the location or depth of the cut makes sloping back to the maximum allowable slope impractical. There are two basic types of shoring: timber and aluminum hydraulic. Contractors may use a shield or trench box that is either designed or approved by a registered professional engineer or is based on tabulated data prepared or approved by a registered professional engineer. Aluminum, timber or other suitable materials may also be used.

**Trench boxes (shielding)** are different from shoring because instead of supporting the trench face, they are mostly used to protect workers from cave-ins. The excavated area between the outside of the trench box and the face of the trench should be as small as possible. The space between the trench box and the excavation side may be backfilled (or other means may be used) to prevent lateral movement of the box. Shields may not be subjected to loads exceeding those which the system was designed to withstand. Trench boxes may be used in combination with sloping and benching. OSHA permits the use of a trench shield as long as the protection provided is equal to or greater than the protection that would be provided by the appropriate shoring system.

The employer is free to choose the protective method they feel is most appropriate for the particular circumstance. Once the protective method has been chosen, the required performance criteria should be met by that system.

The standard does not require the installation and use of protective system when an excavation is made in entirely stable rock as determined by the competent person or when the excavation is less than 5 feet deep and the competent person has determined there is no indication of a potential cave-in.

**INSTALLATION AND REMOVAL OF PROTECTIVE SYSTEMS**

The equipment members should be securely connected, safely installed and never overloaded. Excavations under the protective system should be 2 feet or less below the bottom members of the support or shield system in the trench if the system is designed to resist trench forces to the bottom of the trench and there is no indication of a possible cave-in below the bottom of the support system, while the trench is open.

As soon as work is completed, the excavation should be backfilled as the protective system is removed or dismantled. Once the excavation is cleared, the workers should slowly remove the system from the bottom up, taking care to slowly release all supporting members.

**MATERIALS AND EQUIPMENT**

The employer is responsible to ensure that all material and equipment that is used is free from material defect that could lead to a failure resulting in a trench collapse. Materials and equipment should be used following all manufacturer's recommendations and specifications. Competent persons should inspect all equipment daily to ensure that it is free of defect and suitable for continued use. Defective equipment, if identified, should be documented/tagged/removed and replaced prior to continuing excavation work.

Materials or equipment may not be returned to use unless evaluated by a registered professional engineer.

**ADDITIONAL HAZARDS****Access and egress**

The employee must provide safe access to and from all excavation sites. When employees are required to be in a trench greater than 4 feet deep or more, the employee should be provided with adequate means of exit such as ladders, steps, ramps or other safe means of access or egress. Means of access or egress should be within 25 feet of lateral travel. If ramps are used, they must be designed by a competent person or structural engineer if vehicles are used on the ramps. Structural members of ramps used for access or egress should be of uniform dimension and connected in manner so that they will not cause tripping or displacement.

**Falls and equipment**

In addition to cave-in hazards, there are other hazards associated with excavation operations. Hazards include falling loads/objects, falls from elevation and mobile equipment on site. The following precautions should be taken to protect workers from these hazards.

- Maintain materials or equipment that might fall or roll into an excavation a minimum of 2 feet from the edge of the excavation or have retaining devices or both. This would include spoil piles and equipment such as additional buckets, etc.
- Warning systems such as hand signals, barricades and stop logs can be provided to alert operators of the excavation edge.
- Scaling can be completed to remove loose rock or soil, or install protective barricades to protect employees from falling rock, soil or materials.
- Employees should not be allowed to work on faces or slopes of excavations above other workers unless workers at lower levels are adequately protected from all types of falling materials.
- Employees should be prohibited from working under loads handled by digging or lifting equipment. Employees should be required to stand away from vehicles being loaded or unloaded.

**Water accumulation**

Employees should be prohibited from working in excavations where water has accumulated, or is accumulating, unless adequate precautions have been taken. If water removal equipment is used to remove water that has accumulated, or is accumulating, the competent person should monitor the operations of the equipment to ensure proper use.

Diversion ditches, dikes or other suitable methods should be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. The competent person should inspect excavations to runoffs from heavy rains.

**Hazardous atmospheres**

A competent person should test excavations greater than 4 feet in depth, as well as ones where oxygen deficiency or a hazardous atmosphere exists or could be reasonably expected to exist before any employee enters the excavation area. If a hazardous atmosphere exists, proper personal protective equipment or ventilation must be provided. Employee training of any personal protective equipment should be documented. Controls used should be regularly evaluated by competent persons.

If hazardous atmospheres are determined to exist, the employer must provide emergency rescue equipment on site to include, but not limited to: breathing apparatus, safety harness and line, basket/stretchers, defibrillator. Training must be provided to all employees who may be designated as an emergency responder.

**Vehicle and mobile equipment traffic**

- Vehicle traffic into, around the site and exiting the site should be evaluated.
- Signing should be provided to indicate access/exit points, allowable speed limits and traffic patterns desired.
- Flagmen should be provided as determined is necessary to control the flow of vehicles at the site.
- Safety vests, which are highly visible, should be provided for all employees and contractors on site.
- Predetermined allowable distances to the edge of all excavations should be monitored and enforced.
- Traffic patterns and signage should be evaluated each day by competent persons to ensure desired controls remain in place.

**SUMMARY**

There are serious potential hazards to employees who are involved in trenching and excavation operations. The greatest risk is that of cave-in. Cave-in accidents, once they occur, are more likely to result in fatalities than other construction related accidents. By following strict rules and guidelines established by OSHA and your company, the identification of key employees and competent persons, as well as documented employee training, can help avoid these incidents.

**RELATED REFERENCES**

CFR 1926 Subpart P – Excavations 1926.650

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