

PURPOSE/APPLICATION

To provide guidance to prepare for and work with excavations and trenches. Excavations and trenches can be very dangerous and require forethought and preparation. Excavating and/or trenching is a necessary task in pipeline and facility construction. There are a number of hazards involved with trenching/excavating that need to be identified, eliminated and/or controlled, while meeting industry standards. Work conducted must be done by qualified workers who have ground disturbance training.

PPE

- CPES minimum requirements

TRAINING

- Ground Disturbance (201/101 in AB, LV2/LV1 in BC & SASK dependent on role)
- Equipment competencies

HAZARDS & CONCERNS

- Personal injury
- Falling materials
- Property damage
- Oxygen deficiency or hazardous atmospheres
- Undercutting walls
- Inadequate knowledge
- Sloughing
- Trench wall failure
- Water in trench
- Line contacts
- Vibration or transient loads



DEFINITIONS

Excavation - a dug out area of ground; not including a tunnel, underground shaft or open pit mine.

Ground Disturbance - a manmade cut, cavity, trench or depression in the earth’s surface. Examples may include excavating, digging, trenching, plowing, drilling, tunneling, auguring, backfilling, blasting, hydro-vac, topsoil stripping, land levelling, grading, clearing, fencing, soil sampling and installing rig anchors.

Shoring - a support system for excavation walls used to prevent movement of soil, underground utilities, roadways, and foundations.

Sloping - a method of forming the sides of an excavation to be inclined outward in order to prevent soil movement into the excavation. The angle of incline varies with differences in soil type and site conditions.

Trench - an elongated dug-out area of land whose depth exceeds its width at the bottom.

Trench Cage/Box - a steel support structure designed to resist the pressure from the walls of a trench and capable of being moved as a unit.

PRE-PLAN THE EXCAVATION OR TRENCH

General Preparation

- Determine excavation/trench dimensions
- Determine if the working space provided will allow enough room to accommodate bank cutbacks and spoil deposit space without encroachment. Request additional working space if necessary check for buildings or other structures close to the planned excavation/trench, whose foundations and/or supports could be affected
- Review plot plan and/or right-of-way (ROW) drawings
- Conduct a site tour walk through
- Determine if any overhead or underground lines can be shut down or re-routed

Overhead and Underground Services

Underground services must be identified and accurately located before excavation work begins. The use of provincial "One Call" will assist with this process. Ensure as a minimum standard that the following are identified and marked by their owners or owner representative:

- gas lines, pipelines, sewers and water mains
- phone, television and other communication lines
- power lines

Ensure that any proximity or crossing agreements are in place prior to working around powerlines and/or other buried facilities.

Determine Soil Conditions/Types

Before work begins, CPES supervision must determine what soil types are present at the site. Once determined they must communicate the type of sloping or shoring that will be required.

Refer to Table 1

Notifications

Alberta

- No notice required

British Columbia

- Notify the WorkSafeBC by completing a "Notice of Project (NOP)" form at least 24 hours prior to starting work if a construction project involves a trench more than 1.2 m (4 ft.) deep and over 30 m (100 ft.) in length; or a construction project which includes another type of excavation more than 1.2 m (4 ft.) deep in which a worker may be required to enter.

Saskatchewan

- The Occupational Health and Safety Division of Saskatchewan Labour must be notified if an employer wishes to dig any excavation, trench or tunnel deeper than 5 metres that workers will enter.

Manitoba

- Contractors planning to perform excavation work must register as excavation contractors with Workplace Safety and Health Division.
- Excavations that will be more than 1.5 metres (5 feet) deep must receive a serial number from the Workplace Safety and Health Division not more than 48 hours before the day that excavation work is scheduled.

Engineering Approvals

A professional engineer must oversee each of the following:

- If the excavation is more than 6 m (20 ft) deep:
 - if an improvement or structure is adjacent to the excavation
 - if the excavation is subject to vibration or hydrostatic pressure likely to result in ground movement hazardous to workers; or
 - if the ground slopes away from the edge of the excavation at an angle steeper than a ratio of 3 horizontal to 1 vertical
- Unshored excavations over 1.2 m (4 ft.) deep with sides sloped at an angle steeper than 3 horizontal to 4 vertical
- Excavations adjacent to structures which apply loads to the soil in the excavated area
- If the excavation requires or uses support structures, the excavation work must be done in accordance with the written instruction of a professional engineer
- Trench cages to be used or stacked, must be designed and certified by a professional engineer

Equipment and Protective Structures

- Before work begins, the supervisor will determine what equipment and protective structures will be needed
- Where an excavation could affect an existing foundation, the foundation must be supported by a temporary protective structure. The structure must be designed, constructed and installed in accordance with the specifications of a professional engineer

Site Layout and Organization

The employer and supervisors should carefully plan how the site will be organized. For example:

- Where will material be stored?

- Where will spoil piles be? Ensure that there will be at least 1 metre (3 feet) of space between the spoil pile and the edge of a trench
- How will loose material be removed from trench or excavation walls and nearby areas so that it cannot fall onto workers?
- How much operating room will equipment need?
- Where will exits and entrances to the trench be? Make sure there are enough ladders and ramps available. Any worker in a trench must be no further than 8 metres (25 ft.) from a ladder/stairs/exit
- Could buildings or structures be destabilized by the work?
- Where will traffic entrances and exits to the site be?

Emergency Planning

- Everyone should know what to do and who to contact if an event occurs.
- First aid and emergency plans should be reviewed and updated as required. Consider the types of emergencies that could occur and how each will be dealt with. For example:
 - Are workers adequately trained to handle workers injured in a cave-in or other accident?
 - Can responders safely get an injured worker out of a cave-in?
 - Where a worker is in a trench more than 1.2 metres deep, station a competent worker on the surface to alert workers in the trench of potentially unsafe conditions and help in an emergency.

JUST PRIOR TO EXCAVATION

Hazard Assessment & Documentation

Conduct a site-specific hazard assessment to identify all above/below ground facilities, conditions, and processes that could cause harm to people, equipment, material or the environment.

- Determine water table level, as required
- Determine if there are any springs, sand/gravel pockets, muskegs, etc
- Identify control measures to eliminate or minimize the hazard(s)
- Check all survey drawings (plot plans, alignment sheets, as-built's, etc.)
- Use and complete CF-S-15 Ground Disturbance Checklist
- Obtain a Safe Work Permit, as required
- Control traffic; post signs of expected speed (limits), set up appropriate barricades, flashing lights, etc., and use flag persons or traffic controllers
- Prior to any excavation and/or trenching operation, all underground (refer to COP-07 Ground Disturbance) and/or overhead lines (refer to SWP-24 Overhead Power Lines) must be located, well marked and exposed in accordance with applicable legislation
- Check local legislation and/or regulations

- Hydro-vac and/or hand expose as required
- Check that all excavation warning signs, barricades, fencing, etc. are readily available and installed as required

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PERFORMING THE EXCAVATION

General Sloping and Shoring Requirements

Before a worker enters any excavation over 1.2 m (4 ft.) deep or approaches closer to the side/bank than the distance equal to the depth of the excavation, CPES must ensure that the sides of the excavations are:

- supported by manufactured or prefabricated trench boxes, shoring cages, or otherwise supported as specified in writing by a professional engineer if not designed by professional engineer, supported in accordance to the minimum requirements
- sloped as specified in writing by a qualified registered professional engineer
- sloped at angles, dependent on soil conditions, which will ensure stable faces, but in no case may the slope or combination of vertical cut and slope exceed that specified in table 1
- benched (rather than excavating a flat trench face, benching leaves steps on the side of the excavation)

Sloping or Cutting Back Requirements

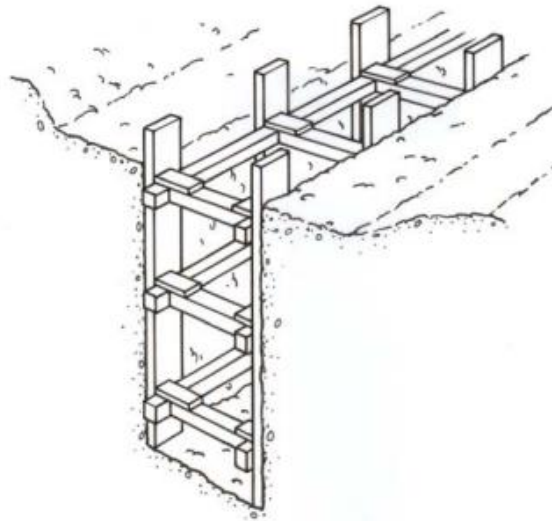
Excavation slopes must be trimmed or scaled to remove any loose material or rocks which could endanger workers.

Safe Shoring

In an excavation 3 metres or less deep, the type of temporary protective structure used is left to the discretion of the employer, as long as the structure is of sufficient strength to protect workers. In common practice, protective structures are often prefabricated from steel, or built in place from wood.

If an excavation is more than 3 metres deep, the risk of injury to workers increases dramatically. It is therefore mandatory that any temporary supporting structure be designed and certified by a professional engineer. The engineer's specifications must indicate all details related to the design, including the type and grade of materials to be used and the calculated loads the structure is designed to support.

- Shoring materials must be installed from the top down and removed in reverse order
- Workers must not enter an excavation to remove shoring materials if ground conditions have deteriorated, so as to make entry for shoring removal unsafe
- Shoring or manufactured, prefabricated support systems must be installed in firm contact with the faces of the excavation, and in a manner which ensures no loss of soil from behind or below the body, the shield or shoring
- Workers must use a ladder and install shoring, stringers or bracing downward from the top of the trench, installing each brace in descending order
- When removing shoring, stringers or bracing, workers must work in a sequence that is the reverse of the installation sequence



Safe Entry and Exit

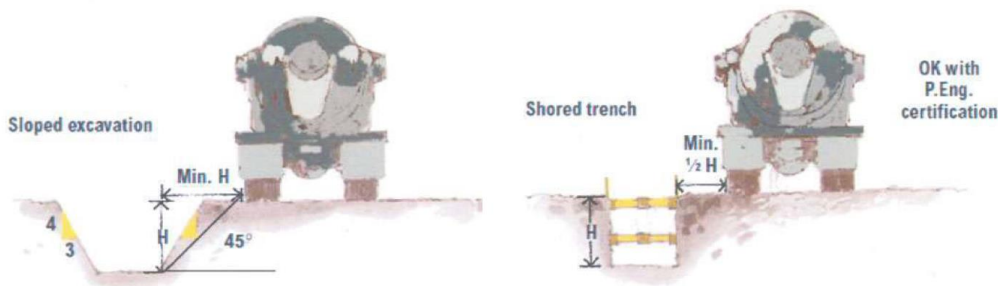
- A safe means of entering or leaving an excavation could include a ladder, scaffold or a mechanical device such as a stairway. It could also include appropriate sloping of the ground or soil so that a worker can safely walk into or out of the excavation
- Safe means of entry and exit must be provided within 8 m (25 ft) where workers are employed in trenches over 1.2 m (4 ft) deep. The excavation must be safely supported or sloped to the entry and exit location. Ladders must extend from the bottom of the excavation to 1 m (3 ft) above the ground surface

Spoil Piles

- The distance between the edge of the excavation and the leading edge of any spoil pile must be at least 1 m (1.2m 4ft In British Columbia for excavations other than trenches). The slope of the spoil pile cannot exceed 45° from the horizontal. These measures are intended to reduce the possibility of the spoil pile slumping into the excavation and loose materials rolling down the pile into the excavation. Spoil pile materials have rolled into excavations as a result of natural settling and daytime warming of frozen excavated material.
 - Under no circumstances may excavated material be piled so that it endangers workers
 - Spoil should be placed so that it channels rainwater and other runoff away from the excavation

Adjacent Loads and Traffic

The weight of machinery, vehicles, and/or heavy equipment adjacent to excavations must be accounted for in slope and shoring design. As illustrated below, to prevent the addition of lateral forces onto the excavation slope, adjacent loads should be kept back from the edge of the excavation a distance equal to the depth of the excavation.



Marking and Protecting Excavations

- All excavations are to be flagged and marked to prevent workers, wildlife or equipment from falling into the opening
- Dumping blocks are required where equipment may back into or over a dump location

3 GENERAL SOIL TYPES

For practical purposes CPES recognizes three main soil types, whose characteristics are described below. Some provinces have additional classifications and sub classifications. For additional guidance please refer to provincial legislation.

1. Hard and compact soil

- Hard, dense in compactive condition
- Extremely difficult to excavate with hand tools
- Appears Dry
- Shows no signs of water seepage
- Does not include previously excavated soil

2. Likely to crack and crumble soil

- Stiff, compact in compactive condition
- Moderately difficult to excavate with hand tools
- Appears damp after it is excavated, has low to medium natural moisture content
- Shows signs of localized water seepage
- Shows signs of surface cracking

3. Soft, sandy or loose soil

- Soft, sandy or loose soil
- Easily excavated with hand tools
- Appears solid but flows or becomes unstable when disturbed. Can be dry, running easily into a well-defined conical pile, or wet
- Is granular soil below the water table, unless the soil has been dewatered

Factors that affect soil stability:

Soil type: Never count on the soil type alone to protect you, unless it is sound and stable rock. Soil types may be mixed, always base precautions on most unstable type

Moisture content: Moisture reduces soil strength. Once a trench or excavation is opened, the walls are exposed to the elements. Moisture content and soil stability can change rapidly.

Vibration: Vibration from compaction activities, equipment operations, nearby traffic, trains and so forth often weakens soil stability. The effects increase if the soil is wet or loose.

Adjacent buildings and structures: These can undermine soil stability by putting extra pressure on the walls or disrupting soil cohesion. Likewise, trenches and excavations can cause nearby building walls to collapse.

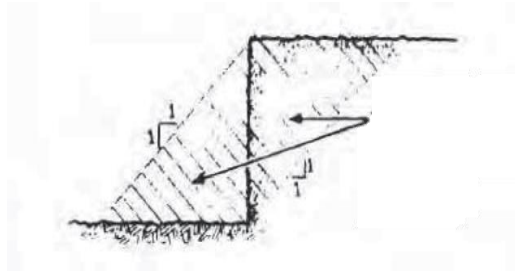


Adjacent weight (surcharge) Surcharge is a large weight or load that affects the strength of the trench walls. For example, spoil piles, mobile equipment and supplies placed near the trench put pressure on the walls. Keep surcharges as far away from the excavation or trench as reasonably practicable.

Weather: Rain, melting snow, freezing, flooding and heat from the sun reduces soil cohesion quickly. Do not use freezing as a form of soil stabilization. Do not allow water to accumulate in excavations (this can create a stabilization concern or drowning hazard)

General Zone of Exposure

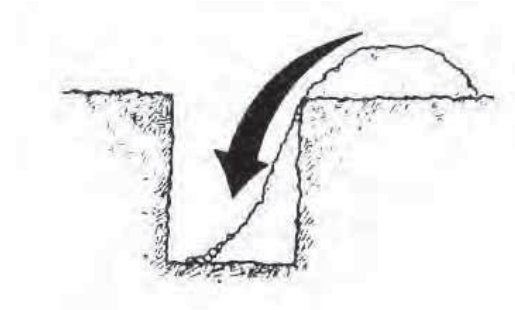
(the area where workers are exposed to mass soil or rock movement)



Types of Soil Collapse

Spoil pile slide

Improper excavating procedures occur when the excavated material is not placed far enough away from the edge of the excavation. The recommended minimum distance for location of excavated soil (spoil) from the edge of the excavation is equal to or greater than the excavation depth.



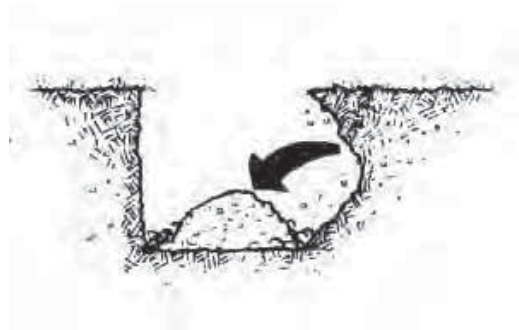
Side wall shear

This often happens in clay soils that have dried in the sun. It is also a problem in naturally frozen ground.



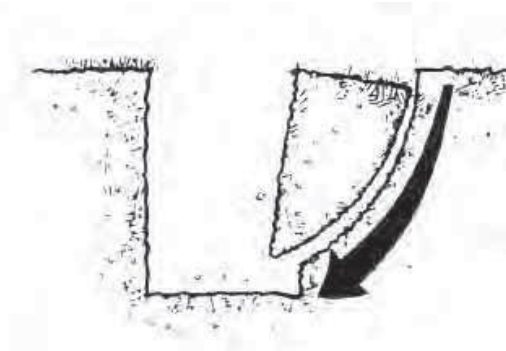
Slough-in (cave-in)

Common to previously excavated material, fill, sand, silt and sand mix and gravel mix where the water table is above the base of excavation, or where soils are organic or peat. This often happens in previously disturbed soils. It is also a problem in frozen or wet ground and mixed soils.



Rotation

Common in clay-type soils when excavation walls are too steep, or when saturated with water.



Inspections

- Excavation slopes or shoring systems must be inspected daily before entering or more frequently and must be effectively maintained
- Check the surface for tension cracks, particularly ones running parallel to the trench. These often occur before a cave-in
- Check for material that may slide
- Look for wet spots in the trench and other signs of water damage
- Water must not be allowed to accumulate and remain in excavations. Erosion of excavation faces must be controlled
- Check shoring components every day. Look for signs of crushing or bending in brace areas. Make sure all components of shoring systems are in good condition. Check hydraulic and air shoring braces for hose and cylinder leaks. Watch for bent bases and other damaged or defective parts
- Inspect trench cages (boxes) for cracks in the welds, structural damage and other defects



REFERENCES / ADDITIONAL INFORMATION

- COP-07 Ground Disturbance
- CF-S-15 Ground Disturbance Checklist
- Sloping and Timber Shoring, WorksafeBC Publications 2005 edition
- Guide for Excavation Work, Manitoba, May 2011

REGULATIONS

Alberta OHS Code – Part 32 – Excavating and Tunneling

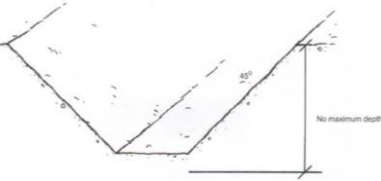
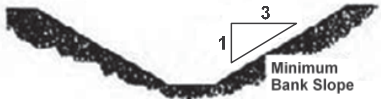


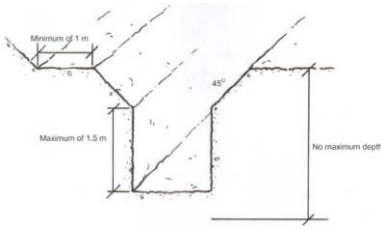

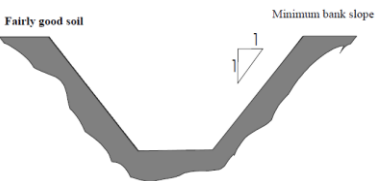

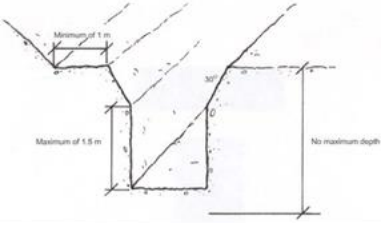
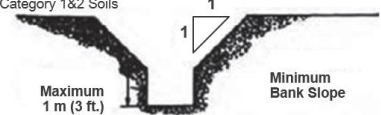
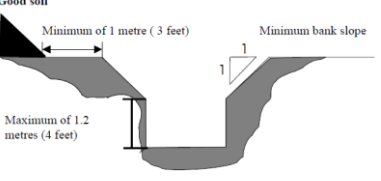
WorkSafeBC OHS Regulation – Guidelines – Part 20 – Construction, Excavation and Demolition

Saskatchewan OHS Regulations – PART 17–Excavations, Trenches, Tunnels and Excavated Shafts

Manitoba Workplace Safety and Health Act and Regulation – part 26 – Excavations and Tunnels
General Matters

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Approved by:	HSE Corporate Committee		Date:	Sept 28, 2017

Table 1: Generalized Soil Types and Sloping Requirements by Province

Alberta	Manitoba	Saskatchewan	British Columbia
Soft, Sandy, Loose Soil			
45° 	1 to 3 	1 to 3 	4 to 3 
Likely to Crack or Crumble Soil (includes previously excavated soil)			
45° 	1 to 1 	1 to 1 	4 to 3 
Hard Soil and Solid Soil (does not include previously excavated soil)			
30° 	1 to 1 Category 1&2 Soils 	1 to 1 Good soil 	1 to 3 