

## GROUND DISTURBANCE, TRENCHING, & EXCAVATING SAFE WORK PRACTICE

### 1.0 PURPOSE

The purpose of the development of a standard excavation and shoring policy, practice and procedure is to enhance the level of care and safety for all workers through the implementation of a standard system for work undertaken in excavations.

The nature of excavation work and the diversity of methods available for excavation safety require that standards be established and followed by all workers involved.

### 2.0 RESPONSIBILITIES

**Senior Field Supervision** It will be the Responsibility of the Senior Field Supervisor to take reasonable and practical measures to have site equipment and materials made available and maintained in accordance with the applicable regulations and manufacturer's specifications.

**Supervisor / Foreman** It will be the responsibility of the Foreman to take reasonable and practical measures to have site equipment serviced, maintained and operated by qualified personnel. The Foreman is responsible to ensure workers have received proper instruction and training in the safe use of related equipment and personal protective equipment prior to performing this type of activity.

**Worker** It will be the responsibility of the Worker(s) to adhere to the safety requirements regarding this specific task. The Worker will advise the Foreman of any damage, deviation in operation, excessive wear, etc., prior to using equipment or related materials.

### 3.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

| PPE / Equipment   | Mandatory | Assessment Dependant |
|---|-----------|----------------------|
| CSA/ANSI approved hardhat   | ✓         |                      |
| CSA/ANSI approved footwear  | ✓         |                      |
| CSA/ANSI approved eye protection  | ✓         |                      |
| CSA/ANSI approved hi-vis safety vest or clothing displaying reflective materials meeting regulatory standards.            | ✓         |                      |
| Protective clothing – where workers need protection from temperatures, moisture, chemicals, vapours or static electricity | ✓         |                      |
| CSA/ANSI approved hearing protection - muffs or plugs   |           | ✓                    |
| Hand protection (work gloves)   |           | ✓                    |

## 4.0 SAFE WORK PRACTICE

### 4.1. Definitions

- a. **Trench** is defined as an excavation having a depth which exceeds its width at the bottom.
- b. **Excavation** is defined as a man-made cavity or depression in the earth's surface formed by earth removal, and includes a trench, deep foundation, tunnel, shaft, or open excavation, but does not include borrow pits, gravel pits and quarries.
- c. **Open Excavation** means an excavation where the width is equal to or greater than the depth.
- d. **Spoil Pile** is defined as "the material excavated from an excavation or trench."
- e. **Temporary protective structure** is defined as a structure or device designed to provide protection in an excavation, or trench from cave-ins, collapses or sliding or rolling materials, and includes shoring, bracing, piles, planking or cages.
- f. **Shoring** means a construction procedure used specifically to maintain the stability of the walls of an excavation and provide protection to workers who may enter the excavation.
- g. **Qualified person** means a person, who has sufficient knowledge, is suitably trained and experienced to work safely and properly as defined by the employer.

### 4.2. Standards / Hazard Prevention

- a. All workers will be trained in ground disturbance as required by the local utility owners.
- b. Prior to starting any ground disturbance, regardless of the depth of the ground disturbance, in any area likely to have underground utility services (i.e. oil, gas, steam, water, sewer, electrical lines, etc.) the **location of such services must be accurately determined**. Where possible, the location and alignment of these services is to be marked in the work area.
- c. Underground hazards, such as utilities or similar hazards must be assessed and exposed prior to excavation of the ground with powered equipment. Refer to drawings, as-built drawings, surveys, etc., or call the power authority.
- d. When working in close proximity of underground services (within 1 m / 3 ft.), all work shall be done with hand tools or, where the utility owner permits, hydrovac. Probing with sharp, or pointed tools, to determine the location of underground services, such as gas or electrical, is not permitted.
- e. No worker shall enter any excavation greater than 1.5 m (5 feet) in depth unless;
  - i) The sides of the excavation have been sloped to a safe angle, or
  - ii) The sides have been supported by the use of sheet piling, shoring, or bracing
  - iii) Meeting or exceeding the local government safety regulation
  - iv) The workers are protected by other effective means (i.e. Engineering Certification)
- f. Excavation projects undertaken by NORSEMAN HDD UNDERGROUND SOLUTIONS, occurring on or adjacent to roadways or alleys, crews must ensure

that adequate signage, barricades and/or road closures are in place to ensure the safety of the crews, motorists and the public.

- g. A clear area, of at least two feet in width, must be maintained on each side of the excavation. Trees, poles, or any other objects, which may be undermined, or made unstable by the excavation process must be removed, supported, or otherwise protected from the excavation process.
- h. Crews are reminded to always “LOOK UP” at excavation sites to ensure that equipment related to the excavation site is not in close proximity to overhead power lines or other hazards.
- i. In all excavations, other than those which are sloped to a safe angle, the side walls shall be “trimmed” or “scaled” to remove any loose materials, rocks, or other objects, which might endanger workers.
- j. Heavy equipment (i.e. excavators, backhoes, dump trucks, Vac trucks, etc.) must not be placed close to the edge of an excavation unless additional bracing has been installed or where permitted as per a professional engineer’s certification.
- k. In all excavations greater than 1.5 m (5 feet) in depth, a ladder shall be provided in the immediate area where workers are employed. The ladder must extend from the bottom of the excavation at least 1 m (3 feet) above the ground level.
- l. As a minimum, all spoil piles must be maintained at a minimum of 2 feet away from the excavation’s edge or more so depending on the size of the excavation.
- m. Harmful Atmospheres: Prior to entering any excavation, be alert to the possibility that the atmosphere in the excavation may be hazardous due to large amounts of dust, vapours, or gases, or a reduction of oxygen in the excavation.
- n. If, at any point, it is felt that a harmful atmosphere may exist in an excavation, DO NOT ENTER, or immediately exit the excavation and contact the supervisor or safety officer.
- o. In any excavation work adjacent to roadways, or other locations where vehicle traffic may be a factor, a determination as to whether the traffic may constitute a vibration hazard must be made. If it is determined that vibration could be a factor, the excavation must be reviewed and certified by a professional engineer.

#### **4.3. Excavations Near Underground Utilities**

**The following is to be used when working in areas near buried utilities.**

##### Utility Strike Mitigation Plan

- a. Always request underground locations before engaging in any form of ground disturbance from one/first call services, locate contractors, local municipalities, near-by property owners, and the client/owner. Even if you are sure there are no utilities in the area, call to confirm it.
- b. If there are no locates agencies in the area a third party locates company must be contacted for locates.
- c. Obtain as-built drawings to identify utility infrastructure not provided by locates agencies.

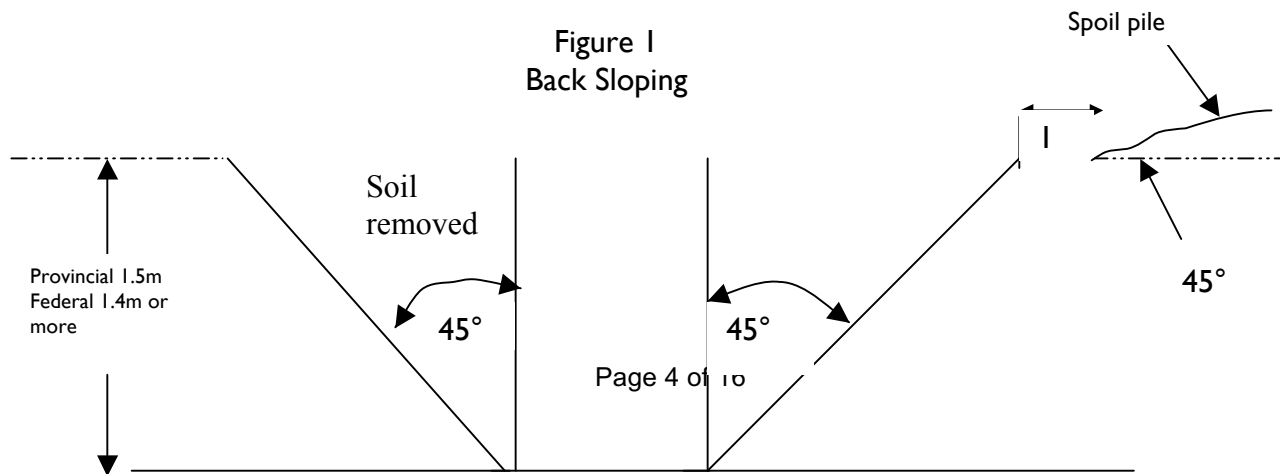
- d. Conduct a site walkthrough to identify hazards as part of the field level hazard assessment process prior to commencing ground disturbance. Look for obvious signs of underground utilities when conducting a hazard assessment of the work area. Examples are utility hole covers, signage, and utility buildings near-by.
- e. Identify markers or other indicators of utilities in the area and their routes including any conflicts with information obtain from locates.
- f. Communicate the locates information with all workers that need to know.
- g. Ensure the equipment operator has all the locates information in his/her possession and clearly understands the locates information.
- h. Use spotters to guide equipment and tools used near identified utility areas.
- i. Hand locations, or hydrovac where permitted by utility owner, must be performed when working within 1 metre of buried utility lines or greater as requested by the utility owner.

In the event of a strike:

- a. If a utility line is struck, stop work immediately and act to control the risks to people and property. Control may mean isolating the area from persons and equipment until the authorities arrives.
- b. Have the utility company notified.
- c. If the damage has the potential of being serious, contact the dispatcher who will contact the local government agency having jurisdiction or any other authorities required.
- d. Document the damage by taking pictures and making notes of the situation. If the utility line damaged appears to be in an incorrect location, collect any information that could be used to resolve the dispute. (i.e. elevations, alignment, etc.).
- e. Complete a company incident report, include a diagram. Forward the report to management as so as possible.

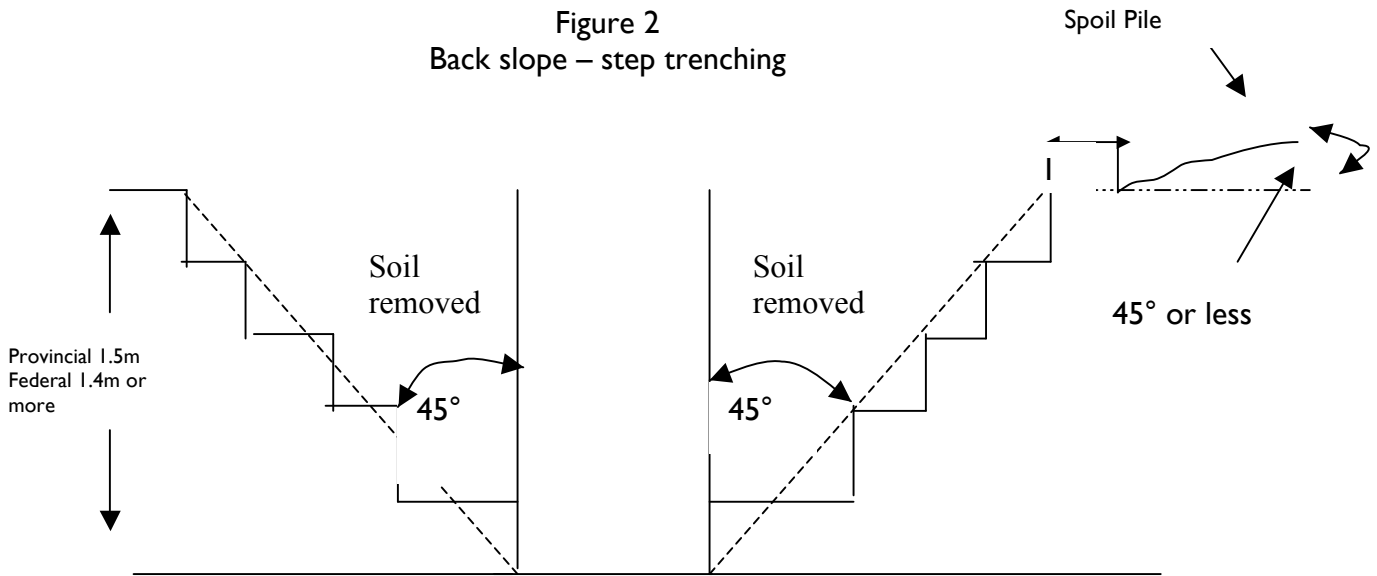
#### 4.4. Protective Structures

- a. Before work can begin in an excavation or trench deeper than the Provincial/Federal standards and closer to the side wall than the depth or regardless of depth when conditions create a hazardous condition, the employee shall be protected from cave-ins or sliding materials by: back sloping the walls, back sloping the wall by stepping, shoring or shielding, or a combination back sloping, shoring and/or shielding.
- b. All back sloping shall be 45° or more from the vertical sidewalls. (see Figure 1)



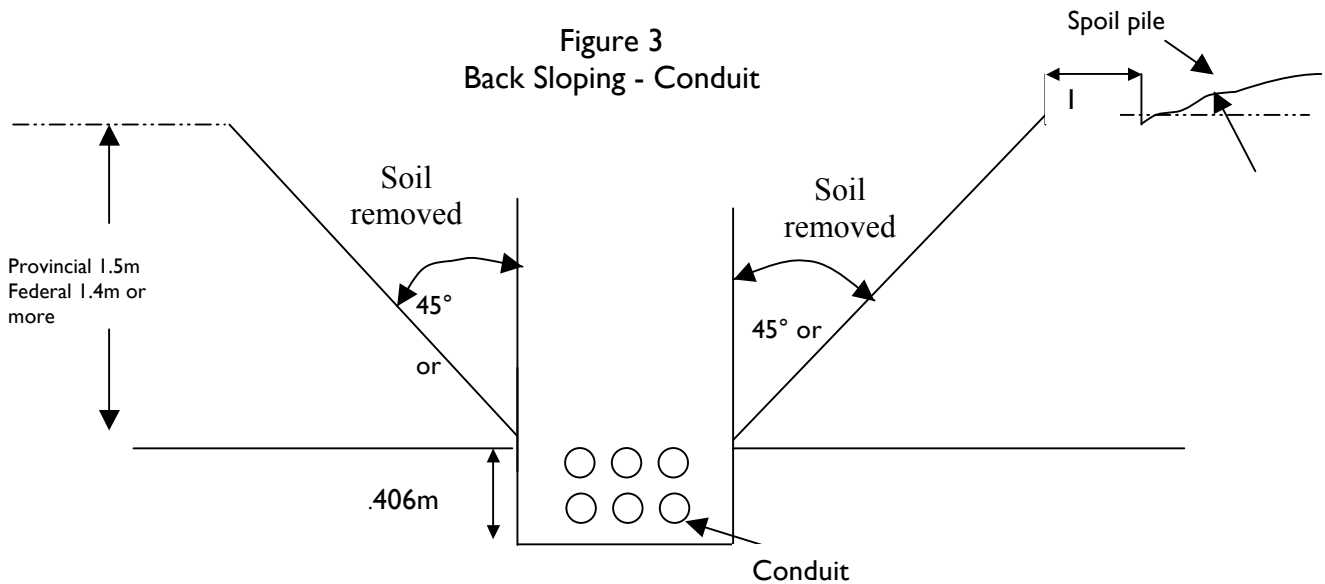


- c. All back sloping using stepping shall be at 45° or more measured from the step outside edges. (see Figure 2)

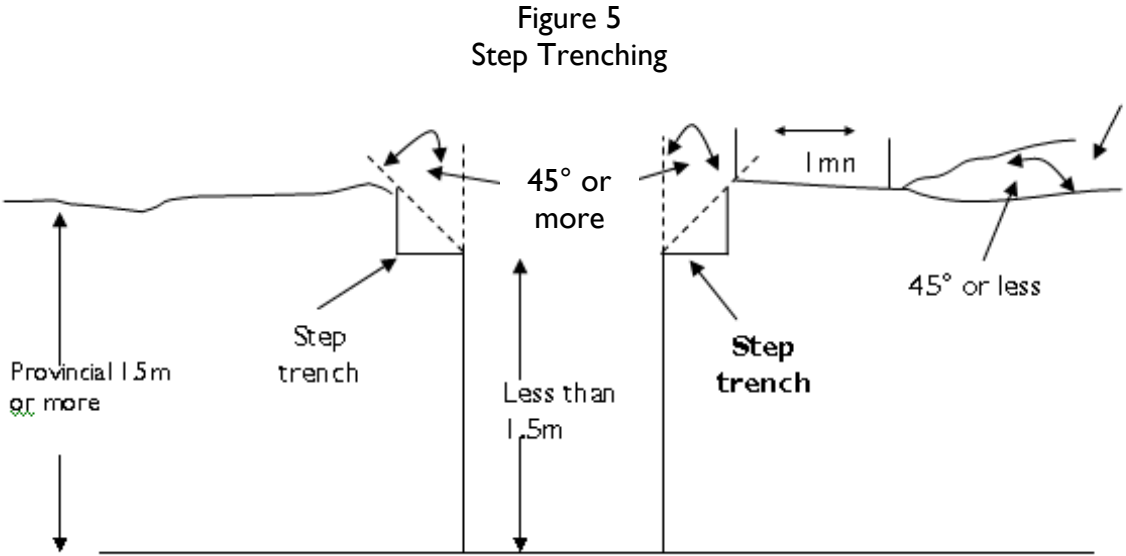
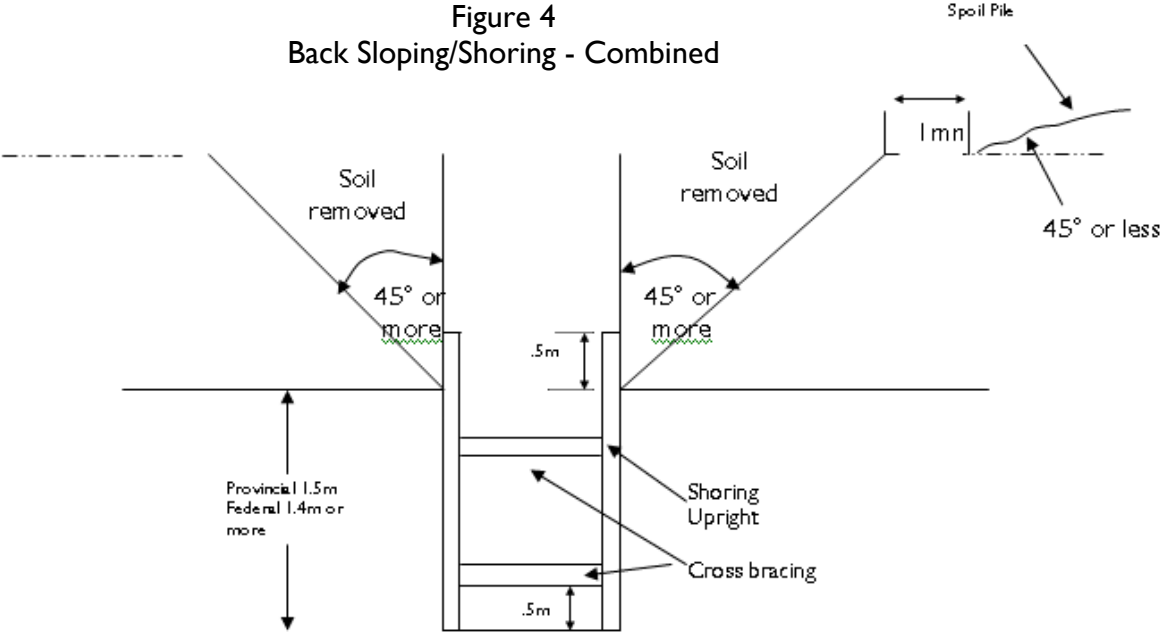


**Note:** Where plating is to be used for covering the excavation or trench the shoring and/or shielding may be cut or placed level with the top of the trench or excavation.

- d. For conduit systems of six (6) way or less a vertical rise of .406 metres, then back sloping at 45° or more is acceptable. (see Figure 3)



- e. When combining back sloping and shoring/shielding, in an excavation, or trench, the shoring and/or shielding shall extend a minimum of .5 metres above the vertical walls. This will protect the worker from falling materials. (see Figure 4)



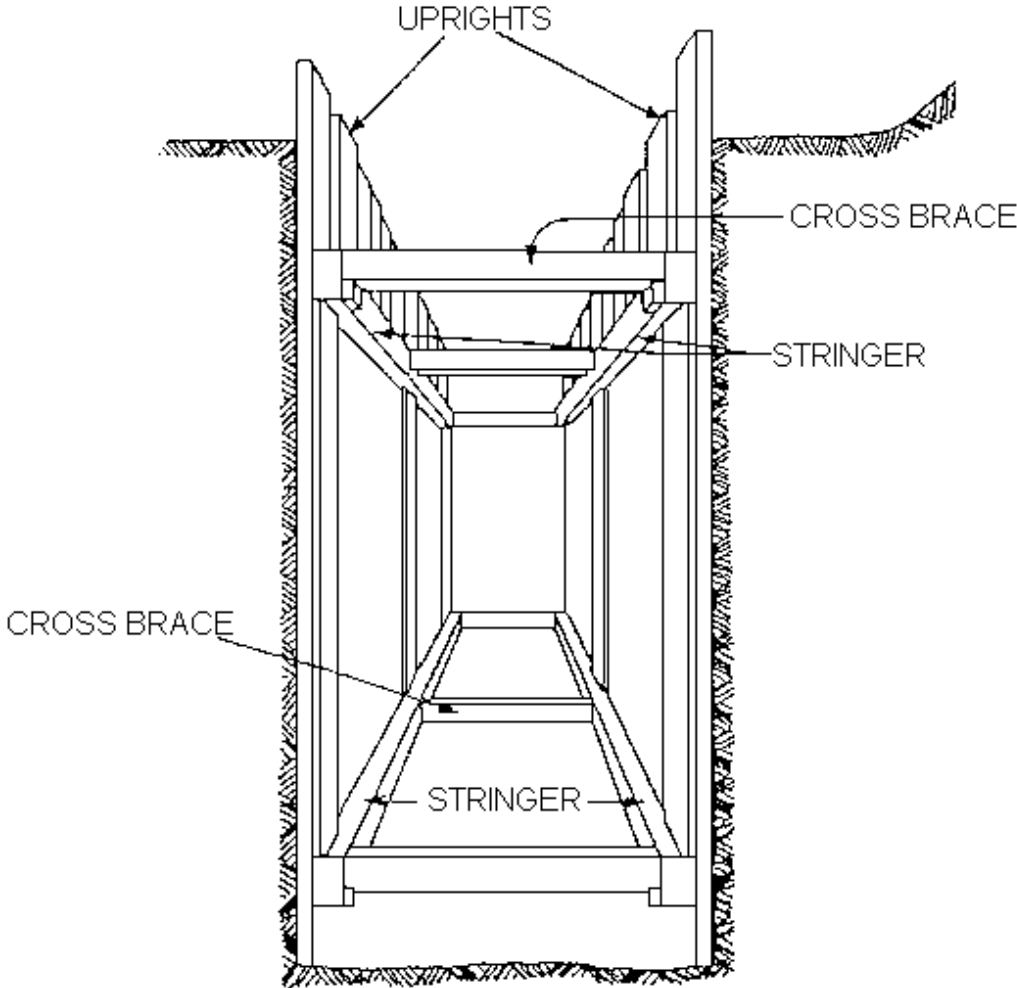
#### 4.5. Wood Shoring

- a. Wood Shoring consists of uprights, stringers and cross braces used to support the walls of excavations and trenches. Additional support such as plywood sheeting may be used to supplement the uprights, stringers and cross braces.
- b. Spruce construction grade 2 lumber or better shall be used for building temporary protective structures.
- c. All lumber shall be inspected to ensure good, quality materials. Previously used lumber which is cracked, fatigued or stressed and could fail shall not be used.
- d. Uprights are placed against the vertical sidewalls of the trench or excavation. They prevent materials from falling into the trench or excavation and in close sheeting applications they prevent spilling from the sidewalls. Uprights extend a minimum of .5 metres above the sidewalls and are spaced horizontally according to Table "A-1, A-2"
- e. Stringers are placed against the uprights in close sheeting applications. They will support the uprights once the cross braces have been installed. Stringers are spaced vertically according to Table "A-1, A-2" and are optional in hard compact soil (type "A") when the trench depth is less than 2.4 metres.
- f. Cross braces are placed against uprights or stringers to hold them in place. When in place they actually provide the support for the vertical sidewalls of the trench or excavation. Cross braces are placed vertically and horizontally according to Table "A". A minimum of 2 cross braces; one just below ground level and one at or just above the trench floor are required.

**NOTE:** The 2 cross braces are normally positioned at:

- 0.5 m (approximately) below ground level.
  - 0.5 m (approximately) above the trench floor, but may be adjusted according to job site conditions.
- g. Side Loading is caused by heavy objects such as equipment, materials, spoil piles, vehicles, etc. being placed too close to the edge of an excavation or trench. The weight of these items can place pressure on the sidewalls of an excavation or trench causing them to collapse. All heavy items must be placed a minimum distance, which is equal to the depth of the excavation from the sidewall of the excavation or trench.
  - h. Vibrations from compressors, pumps, jack hammers, etc. will loosen the soil around an excavation or trench. Where possible, always place such items away from a trench or excavation area.
  - i. Housekeeping - items which could fall into an excavation or trench shall be secured or placed at least one (1) metre from the excavation or trench edge. Items include tools, machinery, and material such as timber, spoil piles, etc.





NOTE: REFER TO TABLE A FOR SPECIFICATIONS

**Table A-1: Temporary Protective Structures – Metric Measurements**

| Condition of Soil          | Depth of Trench         | Uprights                |                                | Stringers               |                          | Cross Braces                     |                   | Maximum Spacing (metres) |            |
|----------------------------|-------------------------|-------------------------|--------------------------------|-------------------------|--------------------------|----------------------------------|-------------------|--------------------------|------------|
|                            |                         | Minimum Dimensions (mm) | Maximum Horizontal Spacing (m) | Minimum Dimensions (mm) | Maximum Vertical Spacing | Minimum Dimensions (Millimetres) |                   |                          |            |
|                            |                         |                         |                                |                         |                          | Less than 1.8 Metres             | 1.8 to 3.7 Metres | Vertical                 | Horizontal |
| Hard and Compact           | 1.5 up to 3.0           | 38 x 235                | 1.8                            | 89 x 140                | 1.2                      | 89 x 89                          | 140 x 140         | 1.2                      | 1.8        |
|                            | More than 3.0 up to 4.5 | 38 x 235                | 1.2                            | 89 x 140                | 1.2                      | 89 x 140                         | 140 x 140         | 1.2                      | 1.8        |
|                            | More than 4.5 up to 6m  | 38 x 235                | 0.01                           | 140 x 140               | 1.2                      | 140 x 184                        | 140 x 184         | 1.2                      | 1.8        |
| Likely to crack or crumble | 1.5 up to 3.0           | 38 x 235                | 1.2                            | 89 x 140                | 1.2                      | 89 x 140                         | 140 x 140         | 1.2                      | 1.8        |
|                            | More than 3.0 up to 4.5 | 38 x 235                | 0.9                            | 140 x 140               | 1.2                      | 140 x 140                        | 140 x 184         | 1.2                      | 1.8        |
|                            | More than 4.5 up to 6m  | 38 x 235                | 0.01                           | 140 x 184               | 1.2                      | 140 x 184                        | 140 x 184         | 1.2                      | 1.8        |
| Soft, Sandy or Loose       | 1.5 up to 3.0           | 38 x 235                | 0.01                           | 140 x 140               | 1.2                      | 140 x 140                        | 140 x 184         | 1.2                      | 1.8        |
|                            | More than 3.0 up to 4.5 | 38 x 235                | 0.01                           | 140 x 184               | 1.2                      | 140 x 184                        | 184 x 184         | 1.2                      | 1.8        |
|                            | More than 4.5 up to 6m  | 38 x 235                | 0.01                           | 184 x 184               | 1.2                      | 140 x 184                        | 184 x 235         | 1.2                      | 1.8        |

**NOTE:**

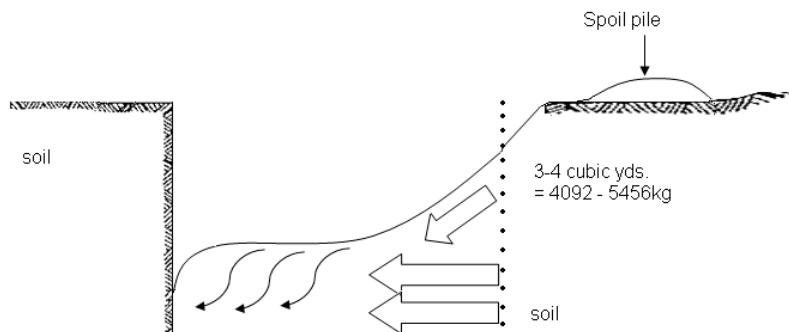
- a) Hard & compact “refers to soil that can only be excavated by machinery” no sign of cracking after excavation.
- b) “Likely to crack or crumble” refers to soil that can be excavated with hand tools, shows signs of cracking after excavation and possesses a low to a medium moisture content.
- c) “Soft, sandy or loose” refers to soil that is easily excavated with hand tools and will run or shift if unsupported.

**Table A-2: Temporary Protective Structures – Imperial Measurements**

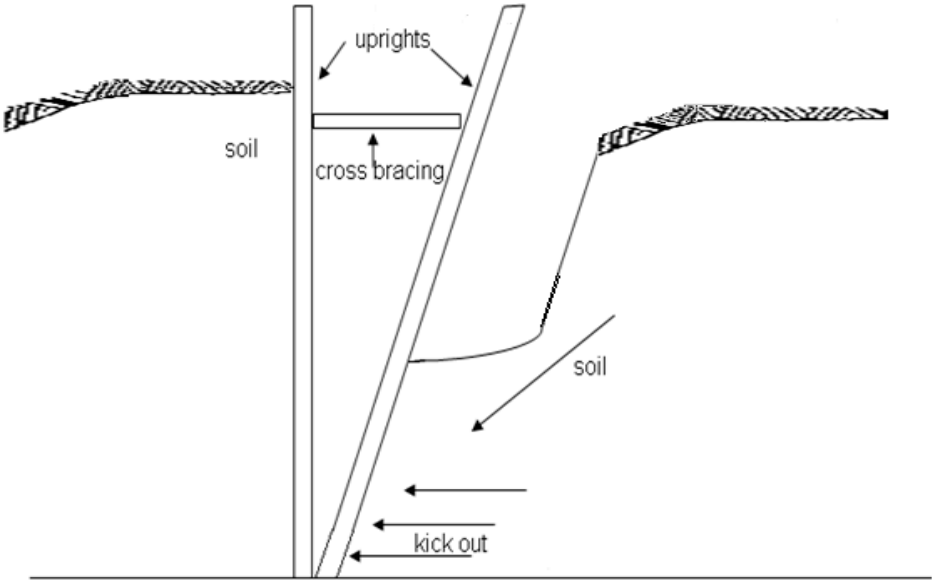
| Condition of Soil          | Depth of Trench         | Uprights                    |                                   | Stringers                   |                          | Cross Braces                |           | Maximum Spacing (feet) |            |
|----------------------------|-------------------------|-----------------------------|-----------------------------------|-----------------------------|--------------------------|-----------------------------|-----------|------------------------|------------|
|                            |                         | Minimum Dimensions (inches) | Maximum Horizontal Spacing (feet) | Minimum Dimensions (inches) | Maximum Vertical Spacing | Minimum Dimensions (inches) |           |                        |            |
|                            |                         |                             |                                   |                             |                          | Less than 6'                | 6' to 12' | Vertical               | Horizontal |
| Hard and Compact           | 5' up to 10'            | 2 x 10                      | 6'                                | 4 x 6                       | 4'                       | 4 x 4                       | 6 x 6     | 4'                     | 6'         |
|                            | More than 10' up to 15' | 2 x 10                      | 4'                                | 4 x 6                       | 4'                       | 4 x 6                       | 6 x 6     | 4'                     | 6'         |
|                            | More than 15' up to 20' | 2 x 10                      | < ½ -                             | 6 x 6                       | 4'                       | 6 x 8                       | 6 x 8     | 4'                     | 6'         |
| Likely to crack or crumble | 5' up to 10'            | 2 x 10                      | 4'                                | 4 x 6                       | 4'                       | 4 x 6                       | 6 x 6     | 4'                     | 6'         |
|                            | More than 10' up to 15' | 2 x 10                      | 3'                                | 6 x 6                       | 4'                       | 6 x 6                       | 6 x 8     | 4'                     | 6'         |
|                            | More than 15' up to 20' | 2 x 10                      | < ½ -                             | 6 x 9                       | 4'                       | 6 x 5                       | 6 x 8     | 4'                     | 6'         |
| Soft, Sandy or Loose       | 5' up to 10'            | 2 x 10                      | < ½ -                             | 6 x 6                       | 4'                       | 6 x 6                       | 6 x 8     | 4'                     | 6'         |
|                            | More than 10' up to 15' | 2 x 10                      | < ½ -                             | 6 x 9                       | 4'                       | 6 x 8                       | 8 x 8     | 4'                     | 6'         |
|                            | More than 15' up to 20' | 2 x 10                      | < ½ -                             | 8 x 8                       | 4'                       | 6 x 8                       | 8 x 10    | 4'                     | 6'         |

**4.6. Excavation and Trenching Failures**

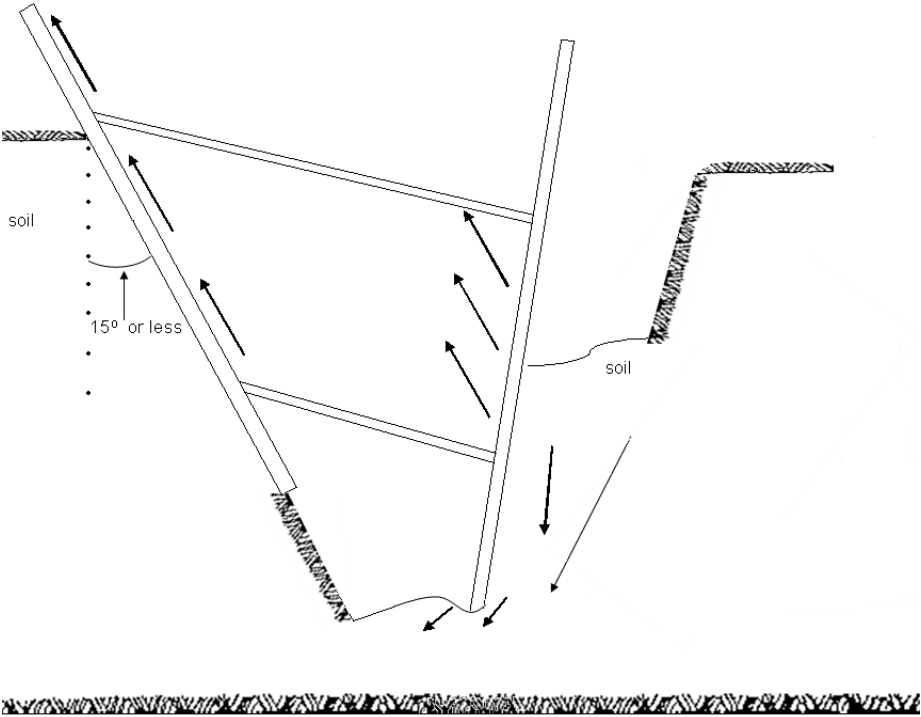
- a. Cave-in is the falling or sliding of rock and soil from the side of the excavation or trench. It is of sufficient amounts and by it it's sudden movement could trap, bury and injure a worker



**NOTE:** 1 cu yd. Of soil weighs more than 11364 kg. (3000lbs). The average cave-in consists of 3-4cu. yds. Weighing more than 4092-5556 kg (9000-12000)



b. Kick out - failure to secure braces can cause uprights to collapse



c. Vertical dislodgement – Failure of a sidewall, which is sloped more than 15° from the vertical, could cause the shoring system to be pushed out of the excavation or trench. Sidewalls must be cut to less than 15° from the vertical.

#### 4.7. Commercial Shoring and Shielding

- a. Commercial shoring and shielding is designed and manufactured to withstand cave-ins and to protect the workers within the structure. Some of these are hydraulic shoring, screw jacks, trench boxes and cages.
  - i) Trench boxes and cages must be designed by a professional engineer
  - ii) Must be used in the manner prescribed by the manufacturer.
  - iii) Maximum distance between a trench box or cage and the wall of an excavation or trench shall be 0.3 metres.

#### 4.8. Excavation Requirements

- a. To comply with local government safety regulation, NORSEMAN HDD UNDERGROUND SOLUTIONS will ensure an adequate support structure or sloping to be provided in an open excavation exceeding 2.4 metres in depth and in all other excavations exceeding 1.8 metres in depth.
- b. Common practice in the construction industry is to construct a safe excavation for workers entering the trench by providing a combination slope and vertical face for wall stability. A minimum 1 metre vertical face and 45° slope is required for all trench excavations exceeding 1.8 metres in depth. Sloping or shoring excavations less than 1.8 metres in depth is required only when soil consists of predominately cohesion-less material (i.e. sand or gravel) and/or where unstable soil conditions exist

#### 4.9. Soil Classifications

- a. Definitions and Descriptions of Soil
  - i) Soil is any unconsolidated material composed of different solid particles with gases or liquid between. It is a natural aggregate of mineral grains often containing organic matter.
- b. Descriptions
  - i) Stable rock is a natural solid mineral material that can be excavated with vertical sides and remain intact when exposed.
  - ii) Cemented soil is a soil in which a chemical agent, such as calcium carbonate, holds the particles together. A hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.
  - iii) Cohesive soil is fine-grained soil, like clay or soil with a high clay content, which binds together well.
  - iv) Cohesive soil does not crumble, can be excavated with vertical side slopes, and is moldable when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clay, silt, sandy lay, silty clay and organic clay.
  - v) Granular soil is coarse-grained soil, like gravel, sand, or silt, with little or no clay content.
  - vi) Granular soil does not bind together well; therefore it has no cohesive strength.
  - vii) Granular soils will exhibit some cohesion when moist. Granular soil cannot be molded when moist and crumbles easily when dry.

- viii) Fissured soil is a condition where the soil has a tendency to break along definite levels with little resistance, or a material that exhibits cracks, such as tension cracks, in an exposed surface.
- ix) Layered soil is a condition where two or more distinctly different soil or rock types are arranged in layers. Weakened levels in rock or shale are considered layered.
- x) Plasticity is a property of soil, which allows the soil to be molded without cracking, or appreciable volume change.
- xi) Dry soil does not exhibit visible signs of moisture content.
- xii) Moist soil is a condition in which a soil looks and feels damp. Moist cohesive soil can easily be molded into a ball or rolled into small diameter threads before crumbling.
- xiii) Moist granular soil that contains some cohesive material will exhibit signs of binding between particles.
- xiv) Wet soil is a condition where the soil contains significantly more liquid than moist soil. Soil in this range exhibits cohesive properties, but will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.
- xv) Saturated soil is a condition where all the voids in the soil are filled with water. Saturation does not require flow.
- xvi) Submerged soil is a condition where the soil is actually below the water table or is freely seeping.

#### 4.10. Classification of Soil and Rocks

**Soils and Rocks are classified as Stable Rock, Type A, B or C soils.**

a. Type 'A' Soil

- i) Cohesive, with a minimum unconfined compressive strength of 1.5 tsf (tons per square foot) or 144 kPa. (kilo Pascal's). Examples of type "A" soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as hardpan and calich are also considered type "A" soil.
- ii) Not soil is type 'A' if:
  - The soil is fissured.
  - The soil is subject to vibration from heavy traffic, pile driving, or similar effects.
  - The soil has been previously disturbed.
  - The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater.
  - The material is subject to other factors that would require it to be classified as a less stable soil.

b. Type "B" Soil

- i) Cohesive, with an unconfined compressive strength between 0.5 tsf (48kPa) and 2.5 tsf (144 kPa). Examples of type "B" soils include granular co-hesionless soils, angular gravel (similar to crushed rock), silt, silty loam, sandy loam and, in some cases, silty clay loam and sandy clay loam. Previously disturbed soils except those that would otherwise be classed as

type "C" soil. Soil that meets the unconfirmed compressive strength for type "A", but is fissured or subject to vibration. Dry rock that is not stable.

- ii) Soil that meets the unconfirmed compressive strength for type "A", but is fissured or subject to vibration. Dry rock that is not stable.
- iii) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V) but only is the material would otherwise be classified as type "B"

c. Type "C" Soil

- i) Cohesive, with an unconfined compressive strength of 0.5 tsf (48 kPa) or less. Examples of type "C" soils include granular soils such as gravel, sand, and loamy sand. Submerged soil or soil from which water is freely seeping. Submerged rock that is not stable. Material is a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper.

#### 4.11. Soil Testing

**Soil tests are used to determine the protection requirements by identifying types of soil being removed.**

| Type                 | Description  |
|----------------------|--|
| A (hard – very hard) | - Thumbnail will not indent soil                     |
| B (firm)             | - Thumb will indent soil approximately 1/4" (6 mm)   |
| C (soft – very soft) | - Thumb will penetrate soil approximately 1" (25 mm) |

a. Observation

- i) Visual
  - Identify previously disturbed soils e.g. existing buried facilities, roadbed or allowances, etc.
    - Identify types of soils from an excavation - (e.g.: type A, B or C).
    - Examine sides of excavations e.g. Fissured soils, layered soils.
    - Examine ground in excavation or trench e.g. water flow.
    - Observe area e.g. vehicle traffic, other machinery, which may affect soil, conditions.
- ii) Manual
  - Thumb Test - Table B
    - Note:** Test on an undisturbed soil sample such as a large clump of earth.
- iii) Dry test used to help determine the granular properties of soil and whether fissures are present.
  - Soil that is dry and crumbles on its own or with moderate pressure into individual grains or fine powder is said to be granular.
  - Soil that breaks into clumps and can only be broken with difficulty may be considered un-fissured, if there is no visual indication of fissures.

## 4.12. Soil Layering

- a. Soil layering in an excavation should be noted and evaluated. Soil layers that slope 4 horizontal to 1 vertical (4H:1V) or greater can become very unstable and increase the risk of a cave-in. Soils of greater stability layered over less stable soils, an example being a layer of clay over sand, must be excavated and shored using the method applicable to the least stable soil.

