

North Dakota State University

Trenching & Excavation

I. Introduction

NDSU employees are continually exposed to construction projects in various stages. Each project brings unique challenges and duties to staff. By outlining and following the recommended safe operating procedures, we learn to prevent injury and safeguard ourselves and coworkers against a job related injury or death.

II. Purpose

To reduce the risk of work related injury or death by maximizing personal safety during construction and mechanical operations.

III. Goals

To ensure all employees know and understand the safe operating procedures involved with construction and mechanical operations.

IV. Procedures

NDSU employees may on occasion be exposed to open excavations or trenches made in the earth's surface, on or near campus. It is necessary to understand the safe operating procedures for working in and around excavations and trenches.

A. Definitions

1. **Competent Person** - one who is capable of identifying both existing and predictable hazards in the surroundings, and working conditions which are unsanitary, hazardous, or dangerous to employees. One who has authorization to take prompt, corrective measure to eliminate them. Daily excavation inspections are to be done by the job site's competent person. Inspections must also always be done after a rain storm or other hazard- increasing occurrence.
2. **Excavation** - any man-made cut, cavity, trench, or depression in an earth surface which is formed by earth removal.
3. **Protective System** - a method of protecting employees from cave-ins of material (that could fall or roll from an excavation face) and from the collapse of adjacent structures. Protection could include sloping, shoring, benching, or shielding.
4. **Sloping** - the system or method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.
5. **Trench** - a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 ft.

B. General Requirements

1. Prior to Excavation

- a. Prior to opening an excavation, effort shall be made to determine whether underground installations (sewer, telephone, water, fuel, electric line, etc.) will be encountered. If so, the exact locations shall be determined by the appropriate utility company.
- b. Local utility companies must be contacted, with their requested period of time, prior to any excavation.
- c. Be alert to hazards from overhead wires and underground utilities rupture of underground gas mains, and careless smoking or other sources of ignition. All surface encumbrances must be removed or supported, as necessary, to safeguard employees.
- d. All subcontractors performing excavation work and excavations performed by the company must have a “competent person” on the site to determine safe slopes for all excavations.
- e. The competent person must be able to recognize the existing and unpredictable hazards in the workplace which are or could be dangerous to employees or create an unsanitary condition.
- f. The competent person has the authorization to take prompt action to eliminate any hazards. On-going, daily inspections of excavations, the adjacent areas, and protective systems must be made by a competent person.
- g. Employees exposed to public vehicular traffic must be provided with, and wear, warning vests.
- h. Employees must wear protective helmets on the jobsite when exposed to the hazards of falling objects, electric shock, or burns.

2. Egress

- a. Safe means of access and egress must be located in trench excavations of 4 ft. in depth or more so as to require no more than 25 ft. of lateral travel for employees.
- b. Ladders used to egress an excavation must extend at least 3 ft. above the surface of the trench.

3. Equipment Use

- a. No employee shall be permitted underneath loads handled by lifting or digging equipment. Use tag lines to control or guide suspended loads.
- b. When mobile equipment is used near an excavation, a warning system is required when the operator’s vision is obstructed, or when the operator does not have a direct view, or work is necessary at the rear of the equipment. When mobile equipment is allowed adjacent to an excavation, stop logs or barricades shall be installed.

4. Site Specific Hazards

- a. Air in the excavation shall be tested in all locations where oxygen may

be deficient, gaseous conditions are possible, or where other hazardous atmospheric conditions may exist or could reasonably be expected to exist. Proper respiratory protection or ventilation is required in oxygen deficient areas. When one or more of the conditions are found to be present, the *NDSU Safe Operating Procedure - Confined Space Entry* shall be initiated.

- b. Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect the employees against the hazards posed by water accumulation. The precautions needed to protect the employees will vary with each situation.
- c. Support systems must be provided where the stability of adjacent structures is endangered by excavation operations.
- d. Adequate protection shall be provided to protected employees from loose rock or soil by placing or keeping spoil piles and other materials at least 2 ft. from the edge of excavations, or by the use of retaining devices.
- e. Substantial walkways or bridges with standard guardrails shall be provided where employees are required to cross over excavations.
- f. Employees shall not be allowed in a trench over four feet deep that is not sloped to the correct angle of repose or otherwise protected.
- g. Trenches less than four feet deep shall be effectively protected when examination of the ground indicates that hazardous ground movement may be expected.
- h. Inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person prior to the start of work and as needed throughout the shift.
- i. 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.
- j. Use ladders to enter or leave trenches. Spacing between ladders in a trench shall be no more than 25 ft. apart and must extend 3 ft. above the surface of the trench.
- k. RUN TOWARD THE CAVE IN, TRY TO GET ON TOP OF THE DIRT

Trenches can cave-in and kill in less than 2/100th of a second.

C. SOIL CLASSIFICATIONS

1. **TYPE A** - cohesive soils (clay or soil with a high clay content, does not crumble) with unconfined compressive strength of 1.5 tons of pressure per square foot or greater. No soil is Type A if the soil is fissured, subject to vibration, has been previously disturbed or part of a sloped layered system where layers dip into the excavation on a slope of 4:1.
2. **TYPE B** - cohesive soil with an unconfined compressive strength greater than

0.5 tons but less than 1.5 tons of pressure per square foot. Is not previously disturbed soil (native prairie).

3. **TYPE C** - cohesive soils with an unconfined compressive strength of 0.5 tons of pressure per square foot or less. Most soil in North Dakota is of this type.

D. SLOPES

1. For excavations 0 to 20 feet deep:
 - a. Slope the sides - prevent a cave in
 - b. Shore (brace) - prevent a cave in
 - c. Shield (use of trench box) - protects employees from a cave in, does not prevent the cave in.
 - d. Registered Professional Engineer is required to sign off on the system used.
2. For excavations 20 feet or greater:
 - a. Registered Professional Engineer is required for the design of the system used.

Maximum allowable slopes for excavations **less than 20 ft. deep:**

- | | |
|-----------------|-----------------------|
| 1) Stable Rock: | Vertical (90 degrees) |
| 2) Type A: | 3/4: 1 (53 degrees) |
| 3) Type B: | 1:1 (45 degrees) |
| 4) Type C: | 1-1/2: 1 (34 degrees) |

V. TRAINING

The department supervisor is responsible for providing training to their employees, on a regular basis, to enable them to recognize and prevent hazards associated with trenching and excavation.