

Stoughton Utilities

600 South Fourth Street
P.O. Box 383
Stoughton, WI 53589-0383

Serving Electric, Water & Wastewater Needs Since 1886

STOUGHTON UTILITIES POLICIES APPROVED BY THE STOUGHTON UTILITIES COMMITTEE AND THE STOUGHTON COMMON COUNCIL

October 22, 2002

Stoughton Utilities Excavation Program



Office 608-873-3379

Fax 608-873-4878

stoughtonutilities.com



Stoughton Utilities



EXCAVATION/TRENCHING PROGRAM

City name: Stoughton Utilities	
Program name: Excavation/Trenching	
Prepared by: MEUW SCRSC Chris Belz	Date: 9-21-2009
Revised by: MEUW SCRSC Chris Belz	Date: 9-8-2010
Coordinator: Wastewater System Supervisor Water System Supervisor Utilities Operations Superintendent	
Assisting Coordinator: MEUW SCRSC Chris Belz	

Table of Contents

Introduction.....	3
Responsibilities.....	3
Definitions.....	3
General Requirements.....	5
Procedures.....	5
Inspections.....	5
<i>Soil Types</i>	5
Testing Methods.....	6
Visual Test.....	6
Manual Tests	6
Thumb Penetration Test.....	6
Dry Strength Test.....	6
Plasticity or Wet Thread Test	6
Spoils.....	7
Surface Crossing of Trenches.....	7
Ingress and Egress	7
Exposure to Vehicles.....	7
Exposure to Falling Loads	8
Guarding	8
Night Guarding.....	8
Solitary Employment	8
Warning Systems for Mobile Equipment.....	8
Hazardous Atmospheres and Confined Spaces.....	9

Testing for Atmospheric Contaminants.....	9
Standing Water and Water Accumulation.....	9
Benching, Sloping and Shielding Requirements	10
Sloping	10
Benching	11
Shielding (Trench Box)	11
ATTACHMENT A	13
ATTACHMENT B	15
Standard Number: 1926.650	15
ATTACHMENT C	19
Regulations (Standards - 29 CFR).....	19
Specific Excavation Requirements. - 1926.651.....	19
ATTACHMENT D	26
Requirements for protective systems. - 1926.652	26
ATTACHMENT E	35
Comm 32.38 Specific excavation requirements [29	35
ATTACHMENT F.....	36
Tabulated Data	36
ATTACHMENT G.....	42
Program Evaluation	42

Introduction

Stoughton Utilities recognizes that trenching and excavation work presents potentially serious risks to all workers involved in the process. The greatest risk, and one of primary concern, is that of a cave-in. Furthermore, when cave-in accidents occur, they are much more likely to result in worker fatalities than other excavation-related accidents. Strict compliance with all sections of this policy will prevent or greatly reduce the risk of cave-ins as well as other excavation-related accidents.

Therefore, in an effort to safeguard personnel from injury or death while working in underground trenches and excavations, as well as to maintain conformance with applicable State and Federal regulations, Stoughton Utilities hereby establishes this Excavation/Trenching Safety Program that must be followed by all Stoughton Utilities personnel.

Responsibilities

The Department Heads shall be responsible for:

- Ensuring that appropriate equipment and safety equipment are provided to employees involved in trenching and excavation.
- Ensuring that applicable training has been provided to employees.

The Supervisors shall be responsible for:

- Enforcing regulatory safety practices in all excavation operations.
- Ensuring at least one competent person is on-site at all times.
- Ensuring the guidelines outlined in the excavation policy are followed.

The Competent Person shall be responsible for:

- Classifying soil type prior to work and as changing conditions warrant.
ATTACHMENT A
- Completing the trenching/competent person checklist. *ATTACHMENT A*

Definitions

Aluminum Hydraulic Shoring: An engineered shoring system comprised of aluminum hydraulic cylinders (cross braces), used in conjunction with vertical rails (uprights) or horizontal rails (walers). Such a system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

Benching: A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in: The separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure or immobilize a person.

Competent Person: One who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. A competent person should have and be able to demonstrate the following:

- Training, experience, and knowledge of:
 - Soil analysis,
 - Use of protective systems, and
 - Requirements of 29 CFR 1926 Subpart P and Department of Commerce 32.38. *ATTACHMENTS B-E*
- Ability to detect:
 - Conditions that could result in cave-ins,
 - Failures in protective systems,
 - Hazardous atmospheres, and
 - Other hazards including those associated with confined spaces.
- Authority to take prompt corrective measures to eliminate existing and predictable hazards and to stop work when required.

Excavation: Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Shield (shield system): A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees with the structure. Shields can be permanent structure or can be designed to be portable and moved along as work progresses. Also known as a trench box or trench shield.

Shoring (shoring system): A structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sloping (sloping system): A method of protecting employees from cave-ins by excavating to form sides of an excavation that is inclined away from the excavation so as to prevent cave-ins. The angle of incline varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Trench (trench excavation): 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 is not greater than 15 feet. If forms or other structures are installed or constructed in an excavation as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet or less, the excavation is also considered to be a trench.

General Requirements

All excavations shall be made in accordance with the rules, regulations, requirements, and guidelines set forth in 29 CFR 1926.650, .651, .652 and Com 32.38: (*ATTACHMENTS B-E*) the Occupational Safety and Health Administration's and the Department of Commerce standards for Excavations.

Procedures

A competent person shall be placed in charge of all excavations. Underground utilities must be located and marked before excavation begins. Employees are not allowed in the excavation while heavy equipment is digging.

Inspections

The competent person shall conduct inspections:

- Daily and before the start of each shift.
- As dictated by the work being done in the trench.
- After every rainstorm.
- After other events that could increase hazards, such as snowstorm, windstorm, thaw, earthquake, dramatic change in weather, etc.
- When fissures, tension cracks, sloughing, undercutting, water seepage, bulging at the bottom, or other similar conditions occur.
- When there is a change in the size, location, or placement of the spoil pile.
- When there is any indication of change or movement in adjacent structures.

NOTE: For excavations 4 feet or greater in depth, a trench inspection form (*ATTACHMENT A*) shall be filled out for each inspection.

Soil Types

Type A – Most stable: clay, silty clay, and hardpan (resists penetration). No soil is Type A if it is fissured, is subject to vibration of any type, has previously been disturbed, or has seeping water.

Type B – Medium stability: silt, sandy loam, medium clay and unstable dry rock; previously disturbed soils unless otherwise classified as Type C; soils that meet the requirements of Type A soil but are fissured or subject to vibration.

Type C – Least stable: gravel, loamy sand, soft clay, submerged soil or dense, heavy unstable rock, and soil from which water is freely seeping.

Layered geological strata (where soils are configured in layers) – The soil must be classified on the basis of the soil classification of the weakest soil layer. Each layer may

be classified individually if a more stable layer lies below a less stable layer, i.e. where a Type C soil rests on top of stable rock.

Testing Methods

The competent person in charge of the excavation shall be responsible for determining whether the soil is Type B or C. The competent person shall use a visual test coupled with one or more manual tests.

Visual Test

In addition to checking the items on the trench inspection form, the competent person should perform a visual test to evaluate the conditions around the site. In a visual test, the entire excavation site is observed, including the soil adjacent to the site and the soil being excavated. The competent person also checks for any signs of vibration.

During the visual test, the competent person should check for crack-line openings along the failure zone that would indicate tension cracks, look for existing utilities that indicate that the soil has been previously disturbed, and observe the open side of the excavation for indications of layered geologic structuring.

This person should also look for signs of bulging, boiling, or sloughing, as well as for signs of surface water seeping from the sides of the excavation or from the water table.

In addition, the area adjacent to the excavation should be checked for signs of foundations or other intrusions into the failure zone, and the evaluator should check for surcharging and the spoil distance from the edge of the excavation.

Manual Tests

Thumb Penetration Test

Attempt to press the thumb firmly into the soil in question. If the thumb penetrates no further than the length of the nail, it is probably Type B soil. If the thumb penetrates the full length of the thumb, it is Type C. It should be noted that the thumb penetration test is the least accurate testing method.

Dry Strength Test

Take a sample of dry soil. If it crumbles freely or with moderate pressure into individual grains it is considered granular (Type C). Dry soil that falls into clumps that subsequently break into smaller clumps (and the smaller clumps can only be broken with difficulty) it is probably clay in combination with gravel, sand, or silt (Type B).

Plasticity or Wet Thread Test

Take a moist sample of the soil. Mold it into a ball and then attempt to roll it into a thin thread approximately 1/8 inch in diameter by two inches in length. If the soil sample does not break when held by one end, it may be considered Type B.

A pocket penetrometer, shearvane, or torvane may also be used to determine the unconfined compression strength of soils.

Spoils

Temporary spoil shall be placed no closer than 2 feet from the surface edge of the excavation, measured from the nearest base of the spoil to the cut. This distance should not be measured from the crown of the spoil deposit. This distance requirement ensures that loose rock or soil from the temporary spoil will not fall on employees in the trench.

Spoil should be placed so that it channels rainwater and other run-off water away from the excavation. Spoil should be placed so that it cannot accidentally run, slide, or fall back into the excavation.

Permanent spoil should be placed some distance from the excavation.

Surface Crossing of Trenches

Surface crossing of trenches should not be made unless absolutely necessary. However, if necessary, they are only permitted under the following conditions:

- Vehicle crossings must be designed by and installed under the supervision of a registered professional engineer.
- Walkways or bridges must:
 - have a minimum clear width of 20 inches,
 - be fitted with standard rails, and
 - extend a minimum of 24 inches past the surface edge of the trench.

Ingress and Egress

Trenches 4 feet or more in depth shall be provided with a fixed means of egress (ladder or ramp).

Spacing between ladders or other means of egress must be such that a worker will not have to travel more than 25 feet laterally to the nearest means of egress.

Ladders must be secured and extend a minimum of 36 inches above the landing.

Metal ladders should be used with caution, particularly when electric utilities are present.

Exposure to Vehicles

Employees exposed to vehicular traffic shall be provided with and required to wear reflective vests or other suitable garments marked with or made of reflectorized or high-visibility materials.

Trained flag persons, signs, signals, and barricades shall be used when necessary.

Exposure to Falling Loads

All employees on an excavation site must wear hard hats.

Employees are not allowed to work under raised loads.

Employees are not allowed to work under loads being lifted or moved by heavy equipment used for digging or lifting.

Employees are required to stand away from equipment that is being loaded or unloaded to avoid being struck by falling materials or spillage.

Equipment operators or truck drivers may remain in their equipment during loading and unloading if the equipment is properly equipped with a cab shield or adequate canopy.

Guarding

A standard railing as specified in 29 CFR 1926.502 (b) or other approved guard or barricade shall be provided at or near the edge of an excavation as soon as possible, except where the installation of the safeguard will interfere with the excavation or other work.

Night Guarding

All excavations to which persons may be exposed at night shall be provided with yellow warning lights placed at un-barricaded points and along the exposed side where the excavation adjoins a public thoroughfare or sidewalk.

Solitary Employment

No person may work in any trench, shaft, tunnel, caisson or appurtenance over 4 feet in depth without another person being present at the surface.

Warning Systems for Mobile Equipment

The following steps should be taken to prevent vehicles from accidentally falling into the trench:

- Barricades must be installed where necessary
- Hand or mechanical signals must be used as required

- Stop logs must be installed if there is danger of vehicles falling into the trench
- Soil should be graded away from the excavation; this will assist in vehicle control and channeling of run-off water
- Trenches left open overnight must be fenced and barricaded

Hazardous Atmospheres and Confined Spaces

Employees shall not be permitted to work in hazardous and/or toxic atmospheres. Such atmospheres include those with:

- Less than 19.5% oxygen,
- A combustible gas concentration greater than 20% of the lower flammable limit, and,
- Concentrations of hazardous substance that exceed those specified in the Threshold Limit Values for airborne contaminants established by the ACGIH (American Conference of Governmental Industrial Hygienists).

All operations involving such atmospheres must be conducted in accordance to this policy.

Testing for Atmospheric Contaminants

If there is any possibility that the trench or excavation could contain a hazardous atmosphere, atmospheric testing must be conducted prior to entry. Conditions that might warrant atmospheric testing would be if the excavation was made in a landfill area or if the excavation was crossed by, was adjacent to, or contained pipelines containing a hazardous material (for example, natural gas lines).

Testing should be conducted before employees enter the trench and should be done regularly to ensure that the trench remains safe. The frequency of testing should be increased if equipment is operating in the trench.

Testing frequency should also be increased if welding, cutting, freezing using CO₂ or burning is done in the trench.

If hazardous atmospheres are located inside the trench/excavation, the employee will use ventilation to control or eliminate the hazard. If control/elimination of the hazard is not possible the employee will not enter the excavation.

Some trenches qualify as confined spaces (i.e. when gas/sewer lines are exposed in a trench or a water main break where the excavation could fill with water). When this occurs, compliance with the Stoughton Utilities Confined Space Program is also required.

Standing Water and Water Accumulation

Methods for controlling standing water and water accumulation must be provided and should consist of the following if employees must work in the excavation:

- Use of special support or shield systems approved by a registered professional engineer.
- Water removal equipment, such as well pointing, used and monitored by a competent person.
- Safety harnesses and lifelines used in conformance with Stoughton Utilities written Fall Protection Program. Harnesses and lifelines need to be used when retrieval of employee may be needed in cases of emergency (i.e. employee is overcome by a toxic gas).
- Employees removed from the trench during rainstorms.
- Trenches carefully inspected by a competent person after each rain and before employees are permitted to re-enter the trench.

Benching, Sloping and Shielding Requirements

All excavations or trenches 4 feet or greater in depth shall be appropriately benched, shored, or sloped according to the procedures and requirements set forth in OSHA's Excavation standard, 29 CFR 1926.650, .651, .652 **ATTACHMENTS B-D**.

Excavations or trenches 20 feet deep or greater must have a protective system designed by a registered professional engineer.

Excavations under the base footing of a foundation or wall requires a support system designed by a registered professional engineer.

Sidewalks and pavement shall not be undermined unless a support system or another method of protection is provided to protect employees from their possible collapse.

Sloping

Maximum allowable slopes for excavations less than 20' based on soil type and angle to the horizontal are as follows:

SOIL TYPE	HEIGHT/DEPTH RATIO	SLOPE ANGLE
Type B	1:1	45 degrees
Type C	1 ½:1	34 degrees

A 10-foot-deep trench in Type B soil would have to be sloped to a 45-degree angle, or sloped 10 feet back in both directions. Total distance across a 10-foot-deep trench would be 20 feet, plus the width of the bottom of the trench itself. In Type C soil, the trench

would be sloped at a 34-degree angle or 15 feet back in both directions for at least 30 feet across, plus the width of the bottom of the trench itself.

Benching

There are two basic types of benching, single and multiple, which can be used in conjunction with sloping.

In Type B soil, the vertical height of the benches must not exceed 4 feet. Benches must be below the maximum allowable slope for that soil type. In other words, a 10-foot deep trench in Type B soil must be benched back 10 feet in each direction, with the maximum of a 45-degree angle.

Benching alone is not allowed in Type C soil.

Shielding (Trench Box)

Shielding is used when the location or depth of the cut makes sloping back to the maximum allowable slope impractical.

However, if shielding is used; it must meet the requirements of 29 CFR 1926.650, .651, and .652. **ATTACHMENTS B-D.**

Shielding is generally used in open areas, but they also may be used in combination with sloping and benching.

Shield systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or employee falling hazards.

Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

Any modifications to the shielding must be approved by the manufacturer.

Materials and equipment used for shielding shall be free of defects or damage that might impair its proper function. If damage is found a competent person must inspect the shield to determine if the shield is able to support the intended loads and remove the shield from service if deemed unsafe. A registered professional engineer shall approve the shield before returned to service.

Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields. Employees shall use a ladder to enter and exit shield.

Employees may not remain in the shield while it is being installed, removed or moved vertically.

Tabulated data must be on each job site where the trench shield is used.

Excavated earth material to a level not greater than 2 feet below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

ATTACHMENT A

SOILS ANALYSIS/TRENCHING LOG CHECKLIST

This checklist must be completed when soils analysis is made to determine the soil type(s) present in the excavation. A separate analysis must be performed if the excavation (trench) is stretched over a distance where soil type changes.

Site Location:	Work Order #
Date:	Time: Competent Person:
Excavation Depth:	Excavation Width: Excavation Length:

VISUAL TEST	
Particle Type:	Fine Grained (cohesive) _____ Granular (sand/silt or gravel): _____
Water Conditions:	Wet _____ Dry _____ Seeping Water _____ Surface Water Present _____ Submerged _____
Previously Disturbed Soils:	Yes _____ No _____
Underground Utilities:	If yes, what type? Yes _____ No _____
Overhead Lines:	Yes _____ No _____
Layered Soils?	Note: The less stable layer controls soil type. Yes _____ No _____
Excavation Exposed to Vibrations:	If Yes, from what? Yes _____ No _____
Excavated Material stored 2 ft or more from edge of excavation	Yes _____ No _____
Crack-like openings or spalling observed:	Yes _____ No _____
Conditions that may create a hazardous atmosphere:	Yes _____ No _____
If yes, identify conditions and source:	
Surface encumbrances: i.e. trees, curb, utility poles, etc.	Yes _____ No _____
If yes, what type?	
Work to be performed near public vehicular traffic:	Yes _____ No _____
Possible confined space exposure:	Yes _____ No _____

MANUAL TEST	
Plasticity:	Cohesive _____ Non-Cohesive _____
Dry Strength:	Granular (crumbles easily) _____ Cohesive (broken with difficulty) _____
Wet Shake:	Water comes to surface _____ Surface remains dry _____ (granular material) (clay material)

Comments:

OVER

NOTE: The following unconfined compressive strength tests should be performed on undisturbed soils.

Thumb Test: used to estimate unconfined compressive strength of cohesive soil:

Test Performed:	Yes _____	No _____
_____ Type A – soil indented by thumb with very great effort		
_____ Type B – soil indented by thumb with some effort		
_____ Type C – soil easily penetrated several inches by thumb with little or no effort. If soil is submerged, seeping water, subjected to surface water, runoff, exposed to waiting		

Note: Type A – no soil is type A, if soil is fissured, subject to vibration, has been previously disturbed, or is layered dipping into excavation on a slope of 4H:1V.

SOIL CLASSIFICATION			
Stable Rock _____	Type A _____	Type B _____	Type C _____
SELECTION OF PROTECTIVE SYSTEM			
Protective System:	Sloping _____	Specify Angle _____	
_____ Aluminum Shoring			

Air Quality Readings (mandatory if deeper than 4 feet)

	Top	4'	6'	8'	10'
Oxygen (>19.5%)	_____	_____	_____	_____	_____
CO (<35 ppm)	_____	_____	_____	_____	_____
H ₂ S (<10 ppm)	_____	_____	_____	_____	_____
Combustibility (<10%)	_____	_____	_____	_____	_____

Mechanical Ventilation: Yes _____ No _____

Ladder used (must extend 3' above trench or protective system and within 25 ft of workers): Yes _____ No _____

General Safety Checklist:

Barricades:	Yes _____	No _____
Fencing:	Yes _____	No _____
Plating Material:	Yes _____	No _____
Cones:	Yes _____	No _____

Competent Person: _____
(Signature)

ATTACHMENT B

The following documents (attachments c-f) have been taken verbatim from OSHA and the Wisconsin Department of Commerce: Regulations (Standards - 29 CFR)

Scope, application, and definitions applicable to this subpart. - 1926.650 • Part Number: 1926

- Part Title: Safety and Health Regulations for Construction

- Subpart: P

- Subpart Title: Excavations

Standard Number: 1926.650

- Title: Scope, application, and definitions applicable to this subpart.

1926.650(a)

Scope and application. This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

1926.650(b)

Definitions applicable to this subpart.

"Accepted engineering practices" means those requirements which are compatible with standards of practice required by a registered professional engineer.

"Aluminum Hydraulic Shoring" means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (wales). Such system is designed specifically to support the sidewalls of an excavation and prevent cave-ins.

"Bell-bottom pier hole" means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

"Benching (Benching system)" means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

"Cave-in" means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its

sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

"Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

"Cross braces" mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

"Excavation" means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

"Faces" or "sides" means the vertical or inclined earth surfaces formed as a result of excavation work.

"Failure" means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

"Hazardous atmosphere" means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

"Kickout" means the accidental release or failure of a cross brace.

"Protective system" means 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.

"Ramp" means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

"Registered Professional Engineer" means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

"Sheeting" means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

"Shield (Shield system)" means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

"Shoring (Shoring system)" means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

"Sides". See "Faces."

"Sloping (Sloping system)" means a 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.

"Stable rock" means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

"Structural ramp" means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

"Support system" means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

"Tabulated data" means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

"Trench (Trench excavation)" means 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 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

"Trench box." See "Shield."

"Trench shield." See "Shield."

"Uprights" means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or interconnected to each other, are often called "sheeting."

"Wales" means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

ATTACHMENT C

Regulations (Standards - 29 CFR)

Specific Excavation Requirements. - 1926.651

- Part Number: 1926
- Part Title: Safety and Health Regulations for Construction
- Subpart: P
- Subpart Title: Excavations
- Standard Number: 1926.651
- Title: Specific Excavation Requirements.

1926.651(a)

Surface encumbrances. All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

1926.651(b)

Underground installations.

1926.651(b)(1)

The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

1926.651(b)(2)

Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

1926.651(b)(3)

1926.651(b)(3)

When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

1926.651(b)(4)

While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

1926.651(c)

Access and egress -

1926.651(c)(1)

Structural ramps.

1926.651(c)(1)(i)

Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

1926.651(c)(1)(ii)

Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

1926.651(c)(1)(iii)

Structural members used for ramps and runways shall be of uniform thickness.

1926.651(c)(1)(iv)

Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

1926.651(c)(1)(v)

1926.651(c)(1)(v)

Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

1926.651(c)(2)

Means of egress from trench excavations. A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

1926.651(d)

Exposure to vehicular traffic. Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

1926.651(e)

Exposure to falling loads. No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with 1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

1926.651(f)

1926.651(f)

Warning system for mobile equipment. When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

1926.651(g)

Hazardous atmospheres -

1926.651(g)(1)

Testing and controls. In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50 - 1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

1926.651(g)(1)(i)

Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in

excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

1926.651(g)(1)(ii)

Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

1926.651(g)(1)(iii)

Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

1926.651(g)(1)(iv)

1926.651(g)(1)(iv)

When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

1926.651(g)(2)

Emergency rescue equipment.

1926.651(g)(2)(i)

Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

1926.651(g)(2)(ii)

Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a lifeline securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

1926.651(h)

Protection from hazards associated with water accumulation.

1926.651(h)(1)

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 employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

1926.651(h)(2)

1926.651(h)(2)

If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

1926.651(h)(3)

If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

1926.651(i)

Stability of adjacent structures.

1926.651(i)(1)

Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

1926.651(i)(2)

Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

1926.651(i)(2)(i)

A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

1926.651(i)(2)(ii)

The excavation is in stable rock; or

1926.651(i)(2)(iii)

1926.651(i)(2)(iii)

A registered professional engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity; or

1926.651(i)(2)(iv)

A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

1926.651(i)(3)

Sidewalks, pavements and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

1926.651(j)

Protection of employees from loose rock or soil.

1926.651(j)(1)

Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

1926.651(j)(2)

1926.651(j)(2)

Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

1926.651(k)

Inspections.

1926.651(k)(1)

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.

1926.651(k)(2)

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.

1926.651(l)

Fall protection.

1926.651(l)(1)

Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with 1926.502(b) shall be provided where walkways are 6 feet (1.8 m) or more above lower levels.

ATTACHMENT D

Regulations (Standards - 29 CFR)

Requirements for protective systems. - 1926.652

- Part Number: 1926
- Part Title: Safety and Health Regulations for Construction
- Subpart: P
- Subpart Title: Excavations
- Standard Number: 1926.652
- Title: Requirements for protective systems.

1926.652(a)

Protection of employees in excavations.

1926.652(a)(1)

Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

1926.652(a)(1)(i)

Excavations are made entirely in stable rock; or

1926.652(a)(1)(ii)

Excavations are less than 5 feet (1.52 m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

1926.652(a)(2)

Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

1926.652(b)

1926.652(b)

Design of sloping and benching systems. The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3); or, in the alternative, paragraph (b)(4), as follows:

1926.652(b)(1)

Option (1) - Allowable configurations and slopes.

1926.652(b)(1)(i)

Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

1926.652(b)(1)(ii)

Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

1926.652(b)(2)

Option (2) - Determination of slopes and configurations using Appendices A and B. Maximum allowable slopes, and allowable configurations for sloping and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

1926.652(b)(3)

Option (3) - Designs using other tabulated data.

1926.652(b)(3)(i)

Designs of sloping or benching systems shall be selected from and in accordance with tabulated data, such as tables and charts.

1926.652(b)(3)(ii)

The tabulated data shall be in written form and shall include all of the following:

1926.652(b)(3)(ii)(A)

1926.652(b)(3)(ii)(A)

Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

1926.652(b)(3)(ii)(B)

Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

1926.652(b)(3)(ii)(C)

Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

1926.652(b)(3)(iii)

At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

1926.652(b)(4)

Option (4) - Design by a registered professional engineer.

1926.652(b)(4)(i)

Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

1926.652(b)(4)(ii)

Designs shall be in written form and shall include at least the following:

1926.652(b)(4)(ii)(A)

The magnitude of the slopes that were determined to be safe for the particular project;

1926.652(b)(4)(ii)(B)

1926.652(b)(4)(ii)(B)

The configurations that were determined to be safe for the particular project;

1926.652(b)(4)(ii)(C)

The identity of the registered professional engineer approving the design.

1926.652(b)(4)(iii)

At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

1926.652(c)

Design of support systems, shield systems, and other protective systems. Designs of support systems, shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

1926.652(c)(1)

Option (1) - Designs using appendices A, C and D. Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

1926.652(c)(2)

1926.652(c)(2)

Option (2) - Designs Using Manufacturer's Tabulated Data.

1926.652(c)(2)(i)

Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

1926.652(c)(2)(ii)

Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

1926.652(c)(2)(iii)

Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

1926.652(c)(3)

Option (3) - Designs using other tabulated data.

1926.652(c)(3)(i)

Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

1926.652(c)(3)(ii)

The tabulated data shall be in written form and include all of the following:

1926.652(c)(3)(ii)(A)

Identification of the parameters that affect the selection of a protective system drawn from such data;

1926.652(c)(3)(ii)(B)

1926.652(c)(3)(ii)(B)

Identification of the limits of use of the data;

1926.652(c)(3)(ii)(C)

Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

1926.652(c)(3)(iii)

At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

1926.652(c)(4)

Option (4) - Design by a registered professional engineer.

1926.652(c)(4)(i)

Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

1926.652(c)(4)(ii)

Designs shall be in written form and shall include the following:

1926.652(c)(4)(ii)(A)

A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

1926.652(c)(4)(ii)(B)

The identity of the registered professional engineer approving the design.

1926.652(c)(4)(iii)

1926.652(c)(4)(iii)

At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

1926.652(d)

Materials and equipment.

1926.652(d)(1)

Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

1926.652(d)(2)

Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

1926.652(d)(3)

When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

1926.652(e)

Installation and removal of support -

1926.652(e)(1)

General.

1926.652(e)(1)(i)

Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

1926.652(e)(1)(ii)

1926.652(e)(1)(ii)

Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

1926.652(e)(1)(iii)

Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

1926.652(e)(1)(iv)

Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

1926.652(e)(1)(v)

Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

1926.652(e)(1)(vi)

Backfilling shall progress together with the removal of support systems from excavations.

1926.652(e)(2)

1926.652(e)(2)

Additional requirements for support systems for trench excavations.

1926.652(e)(2)(i)

Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

1926.652(e)(2)(ii)

Installation of a support system shall be closely coordinated with the excavation of trenches.

1926.652(f)

Sloping and benching systems. Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

1926.652(g)

Shield systems -

1926.652(g)(1)

General.

1926.652(g)(1)(i)

Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

1926.652(g)(1)(ii)

Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

1926.652(g)(1)(iii)

Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

1926.652(g)(1)(iv)

1926.652(g)(1)(iv)

Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

1926.652(g)(2)

Additional requirement for shield systems used in trench excavations. Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

ATTACHMENT E

Comm 32.38 Specific excavation requirements [29 CFR 1926.651]. These department rules are in addition to 29 CFR 1926.651:

(1) GUARDING. A standard railing as specified in 29 CFR 1926.502 (b) or other approved guard or barricade shall be provided at or near the edge of an excavation as soon as possible, except where the installation of the safeguard will interfere with the excavation or other work.

(2) NIGHT GUARDING. All excavations to which persons may be exposed at night shall be provided with yellow warning lights placed at unbarricaded points and along the exposed side where the excavation adjoins a public thoroughfare or sidewalk.

(3) SOLITARY EMPLOYMENT. No person may work in any trench, shaft, tunnel, caisson or appurtenance over 4 feet in depth without another person being present at the surface.

History: Cr. Register, February, 1999, No. 518, eff. 3-1-99; CR 04-009: am. (1) Register August 2004 No. 584, eff. 9-1-04.

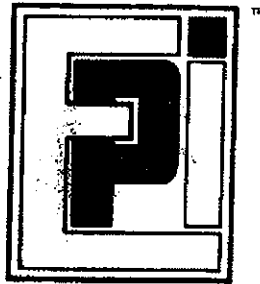
ATTACHMENT F

Tabulated Data

EFFICIENCY PRODUCTION, INC.

**BUILD-A-BOX
MODULAR TRENCH SHIELD
SYSTEMS**

TABULATED DATA



**EFFICIENCY
PRODUCTION, INC.**

MARCH 1993

Nov 2000

EFFICIENCY PRODUCTION, INC.

BUILD-A-BOX MODULAR TRENCH SHIELD SYSTEMS

TABULATED DATA

1. General Information

- a. BUILD-A-BOX MODULAR TRENCH SHIELD SYSTEMS Tabulated data has been prepared in accordance to the OSHA Safety requirements defined in 29 CFR, Part 1926, Subpart P - Excavations and Trenches.
- b. This data is to be used by a soils engineer, or a competent person. The competent person shall be experienced and knowledgeable of trench and excavation procedures, the use of modular trench shield systems, soils identification and the OSHA standards.
- c. The competent person shall continually monitor the excavation for signs of deterioration such as seepage of water or flowing soil into the excavation. Changing soil conditions may require adjustments to the modular trench shield systems.
- d. The tabulated data shall be used only for those soil conditions indicated. The depth ratings in the data are not considered adequate when additional loads imposed by structures, equipment, and stored materials adjacent to the trench are present. More severe conditions require the services of a soils engineer to determine the lateral soil pressure.
- e. The tabulated data PSF Ratings and Depth Certification are based on short term exposure with the Modular Trench Shield System used in one position for 24 hours or less. Consult the shield manufacturer for recommendations should long term exposure be required.
- f. No vertical or horizontal loads shall be applied to the adjustable strut or static braces except as specified by the manufacturer.

2. SOILS CLASSIFICATION

- a. The soil descriptions for OSHA Type "A", "B" & "C" soils are based on Appendix A to Subpart P of Part 1926.
- b. **Type "A" Soil** - Equivalent weight effect of 25 psf per foot of depth.
Description: Cohesive soil (i.e. clay, silty clay, sandy clay or clay loam) with an unconfined compressive strength of 1.5 tsf or greater; or cemented soils such as caliche and hardpan. No soil is Type "A" if the soil is fissured; subject to vibration from heavy traffic, pile driving or similar effects; has been previously disturbed; or 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.

- c. **Type "B" Soil** - Equivalent weight effect of 45 psf per foot of depth.

Description: Cohesive soil with an unconfined compressive strength greater than .5 tsf but less than 1.5 tsf; and granular cohesionless soils including angular gravel, silt, silt loam, sandy clay loam, and in some cases, silty clay loam and sandy clay loam; previously disturbed soils except those which would otherwise be classed as Type C; soil that meets requirements for Type A, but is fissured or subject to vibration; dry rock that is unstable; and material that is part of a layered system where layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

- d. **Type "C" Soil** - Equivalent weight effect of 60 psf per foot of depth.

Description: Cohesive soil with an unconfined compressive strength of .5 tsf or less; moist cohesive soil or moist dense sand which is not flowing or submerged; when cut with near vertical sidewalls, soil can stand with unsupported sidewalls long enough for shield installation; granular soils including gravel, sand and loam sand; soil in a sloped system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper may be Type C. Submerged soil is material with water freely seeping and entering the trench, but only part of the depth of the retained soil is submerged. Conditions more severe would require dewatering or sealing four sides of the excavation and pumping the trench. Such severe conditions would require the services of a soils engineer to establish the design pressure. Consult the manufacturer for pressures exceeding tabulated values.

3. DATA LIMITATIONS

- a. When the shield is to be used in a sloped excavation with an angle steeper than three horizontal to one vertical (3H:1V), the allowable depth of excavation shall be measured from the top of the overall trench and not the toe of the sloped portion.
- b. In sloped excavations, the top of the shield must be a minimum of 18 inches above the bottom of the slope and the top struts/braces must be located below the bottom of the slope.
- c. BUILD-A-BOX Modular Trench Shield Systems shall be used with EPI adjustable struts and static braces pinned in place with two (2) 5/8" diameter pins. See guidelines and limitations on page 5.
- d. BUILD-A-BOX Modular Trench Shield Systems shall be assembled and installed as shown and in accordance with manufacturer's instructions.
- e. BUILD-A-BOX Modular Trench Shield Systems shall be handled by using the lifting lugs installed in holes provided in each panel or corner post.
- f. The bottom of the BUILD-A-BOX shall be located no more than two feet from the bottom of the excavation in soil Types A, B and C. Proper benching of trench wall is required. (For Type C soils, the BUILD-A-BOX shall extend to the bottom of the excavation.)

EFFICIENCY PRODUCTION, INC.

BUILD-A-BOX MODULAR TRENCH SHIELD SYSTEMS

SELECTION GUIDE

SECTIONAL CORNER POSTS

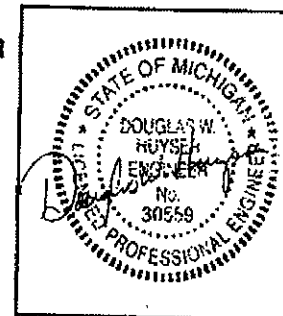
PANEL SELECTION CHART		DEPTH CHART FOR 2-SIDED BOX			
Model (Ht. x Lg. in Ft.)	Weight Each (in Lbs.)	Shield Capacity (PSF)	Depth of Cut (Ft.) Soil		
			A	B	C
23 BBP	40	4300	172	95	72
24 BBP	52	3200	128	71	53
26 BBP	76	2150	86	48	36
28 BBP	100	1300	52	29	22
210 BBP	124	820	32	18	14
212 BBP	148	550	20	12	9

DEPTH CHART FOR 3- OR 4-SIDED BOX				
Width x Length (in Ft.)	PSF ratings	Depth of Cut (Ft.) Soil Type		
		A	B	C
4X4	3200	128	71	53
4X6	2075	83	47	35
4X8	1175	47	26	20
4X10	750	30	17	13
4X12	540	21	12	9
6X6	1975	79	44	33
6X8	1125	45	25	19
6X10	725	29	16	12
6X12	540	21	12	9
8X8	1075	43	24	18
8X10	675	27	16	12
8X12	500	20	11	8
10X10	650	26	15	11
10X12	450	18	10	8
12X12	450	18	10	8

NOTES:

- (1) NUMEROUS OTHER COMBINATIONS OF PANELS, CORNER POSTS, AND STRUTS, OTHER THAN THOSE SHOWN ON PAGE 5, ARE PERMISSIBLE WITH APPROVAL OF MANUFACTURER.
- (2) BUILD-A-BOX MODULAR TRENCH SHIELD SYSTEMS, ARE DESIGNED TO BE USED WITH EPI ADJUSTABLE STRUTS AND STATIC BRACES.

DATA PREPARED BY: INNOVATIVE ENGINEERING ASSOCIATES



EFFICIENCY PRODUCTION, INC.
BUILD-A-BOX MODULAR TRENCH SHIELD SYSTEMS
SELECTION GUIDE
FULL LENGTH CORNER POSTS

PANEL SELECTION CHART		DEPTH CHART FOR 2-SIDED BOX			
Model (Ht. x Lg. in Ft.)	Weight Each (in Lbs.)	Shield Capacity (PSF)	Depth of Cut (Ft.) Soil		
			A	B	C
23 BBP	40	2520	100	56	42
24 BBP	52	1920	77	43	32
26 BBP	76	1300	52	29	22
28 BBP	100	1000	40	22	17
210 BBP	124	820	32	18	14
212 BBP	148	550	20	12	9

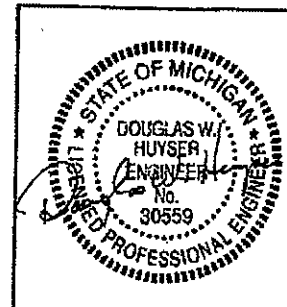
DEPTH CHART FOR 3- SIDED BOX *				
Width x Length (in Ft.)	PSF ratings	Depth of Cut (Ft.) Soil Type		
		A	B	C
4X4	1920	77	43	32
4X6	1300	52	29	22
4X8	1000	40	22	17
4X10	750	30	17	13
4X12	540	21	12	9
6X6	1300	52	29	22
6X8	1000	40	22	17
6X10	820	33	18	9
6X12	540	21	12	9
8X8	1000	40	22	17
8X10	675	27	16	12
8X12	500	20	11	8
10X10	650	26	15	11
10X12	450	18	10	8
12X12	450	18	10	8

* For 4-sided box refer to page 3 of 5

NOTES:

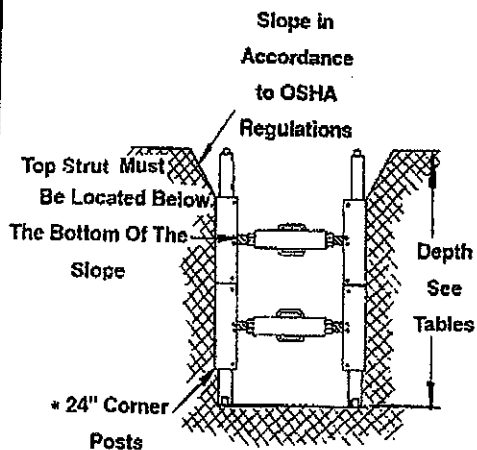
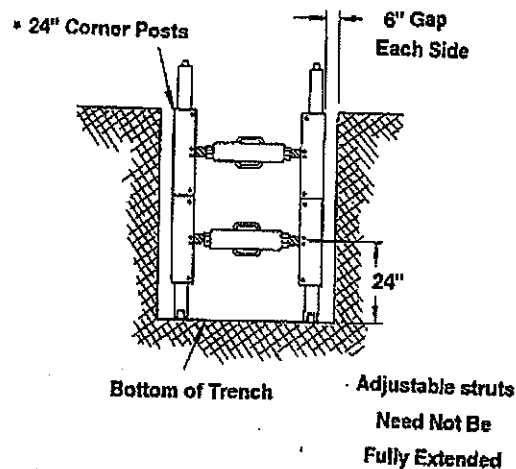
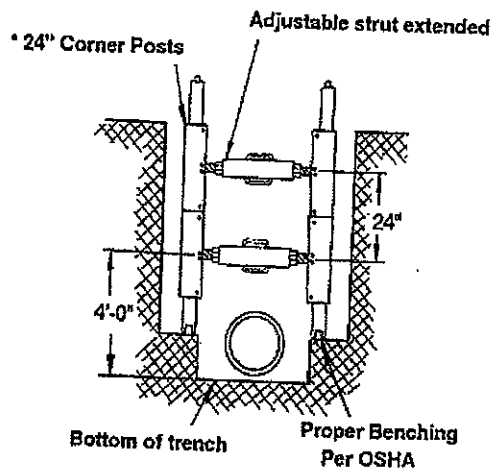
- (1) NUMEROUS OTHER COMBINATIONS OF PANELS, CORNER POSTS, AND STRUTS, OTHER THAN THOSE SHOWN ON PAGE 5, ARE PERMISSIBLE WITH APPROVAL OF MANUFACTURER.
- (2) BUILD-A-BOX MODULAR TRENCH SHIELD SYSTEMS, ARE DESIGNED TO BE USED WITH EPI ADJUSTABLE STRUTS AND STATIC BRACES.

DATA PREPARED BY: INNOVATIVE ENGINEERING ASSOCIATES

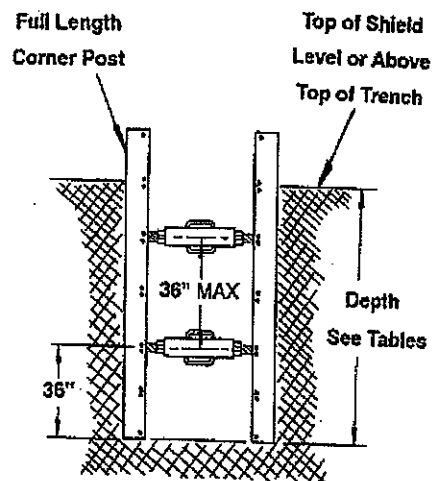


BUILD-A-BOX EXAMPLES OF TYPICAL INSTALLATIONS

Sectional Corner Posts



Full Length Corner Post



NOTE: Alternate installation and trenching methods shown on sectional corner posts also apply

* WHEN Sectional corner posts are used an Adjustable strut is required at each panel joint. Specifications are available from manufacturer.