TIMBER SHORING SYSTEMS

OBJECTIVES

Upon completion of this section, the participant should be able to:

1. Depict the different parts of a shoring system and their function.
2. Clarify the role of plywood in trenching operations.
3. Demonstrate the correct use of the timber shoring tables in designing a timber shoring system.
4. Explain the limitations on the timber shoring tables.
Introduction

The safety concept of behind timber and aluminum shoring is fundamentally different from shield systems. Recall that shielding systems were mobile and not in contact with the trench wall, and that shield protected the workers from the cave-in. Timber and aluminum shoring systems are designed to protect workers by pressing against the face of the trench and preventing the cave-in from occurring in the first place. To do this, OSHA has devised tables that determine the most effective shoring configurations. We will look at these tables shortly.

**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.

The competent person has four shoring options from which to choose:

**OPTION 1:** Use the tables, which OSHA provides. This requires soil testing.

**OPTION 2:** Use the manufacturer's tabulated data that is supplied with the shoring system.

**OPTION 3:** Use tables designed by Registered Professional Engineer.

**OPTION 4:** Use a shoring system designed by a Registered Professional Engineer.

**PARTS OF A SHORING SYSTEM**

**CROSS-BRACE**

These are horizontal members, which extend perpendicularly to each trench wall. By tightening the cross-braces, pressure is applied to the soil in the trench walls. Cross-braces are wooden, hydraulic, pneumatic or a screw brace (trench jack). Mechanical cross-braces usually have a limited span. Wide trenches will often have timber cross-braces which using wedges tighten. If mechanical cross-braces are used, they must be used within their strength range, and the manufacturer's tabulated data for this device must be present at the job site. It is also important not to over-extend mechanical cross-braces. This commonly occurs with screw braces.

**Kickout**

The accidental release of a cross brace.
**UPRIGHT**

These members are placed vertically against the trench wall. Uprights distribute the compression force generated by the cross-braces to a wider area on the trench wall and are commonly made of wood or metal. The term "upright" implies that there are gaps between individual planks. Sheeting is an upright system where there are no gaps between planks.

**Sheeting**  
The members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.
**Close sheeting** is formed when individual uprights are butted up against each other to form a solid plank wall. It's commonly used to guard against local Spalling and raveling. **Tight sheeting**, on the other hand, is used in saturated or submerged soil conditions. The edges of the uprights are a minimum of 3 inches thick and constructed in a "tongue-and-groove" fashion. When assembled, they form a watertight barrier. Steel uprights called *sheet piling* inter-lock to form a watertight wall. Commonly, the sheet pile is a permanent soil barrier that will be left behind after the construction is over.

**Can plywood be used as sheeting?** No. Can any plywood be used as a primary load-carrying member? No. Plywood can only be used to control local raveling, and regular 3/4" plywood is not approved for this task unless it has been so designated by a Registered Professional Engineer. Plywood that can be used to control local raveling is 14-ply arctic white birch (Finland Form or "inform"), 1-1/8" softwood plywood, or any other plywood configuration, which has equal or better strength and stiffness characteristics. For example, OSHA has approved the use of two sheets of 3/4" plywood screwed together with the face grain parallel to the trench line (edge of the trench) as a substitution for 3/4" informs. **Horizontal and vertical cross-brace distances are unaffected by the presence or absence of plywood.** Please refer to the article "OSHA Gives Interpretation for Plywood" in the appendix for more clarification. **NOTE:** The article only addresses the use of plywood for aluminum shoring configurations.

**WALE**

Wales (or stringers) are horizontal members that press against the uprights and distribute the compressive force of a cross-brace to those uprights which do not have their own cross-brace. This allows a compressive span between cross-braces. The space between the cross-braces permits pipes or other materials to be lowered into the trench. In some cases, wales may not be required.

**Mudsill** A wale which is placed at the bottom of the trench and is imbedded in the soil. Mudsills prevent the unsupported bottoms of uprights from being displaced into the trench.
TIMBER SHORING

Timber shoring systems are very versatile since they are custom built to fit the trench. Deep and long trenches are probably better suited to timber shoring than any other form of protective system. Obviously, it is suited well for excavations where significant time is to be spent in one area. For those applications where the working area of an excavation is constantly moving, as in laying a conduit, shield systems or trench boxes are the protective devices of choice.

Specific wood is required for use in a timber shoring system. Oak with a bending strength of 850 psi and Douglas fir with a bending strength of 1500 psi are specifically mentioned in the Standard. Manufactured components are also allowed if they possess equivalent strength and tabulated data for the device is at the job site. NOTE: The timber shoring tables are specifically designed for either oak or Douglas fir, or equivalent, and care should be exercised not to mix the wood types in a shoring system. These materials must be free from damage or defects, maintained in good condition, inspected, and removed from service if damaged.
SHORING TABLES

There are six tables, which provide construction and wood dimension direction for timber shoring systems. Each soil type has two tables, one for actual sized lumber and one for "nominal" size lumber. The actual size lumber uses oak with a minimum bending strength of 850 psi or its equivalent as its selection for timber. Nominal size tables use Douglas fir with a bending strength of 1500 psi or its equivalent as its wood of choice. Since the bending strength requirements for Douglas fir are higher, the wood dimension requirements for Douglas fir are slightly smaller than for oak in some configurations.

The tables give various options for shoring construction. If heavier lumber is available, the table allows for longer spans and greater special distances between load bearing members. If smaller dimension lumber is present, options to produce a tighter system are present as well.

The wood dimensions and construction distances are based upon the anticipated load plus a 2-foot surcharge. The designs put forth by the tables DO NOT apply when:

- A surcharge load in excess of 2-feet is placed on the soil adjacent to the trench;
- Vertical loads in excess of 240 LB are distributed on a one-foot section of the center of the cross-brace;
- Surcharge loads are present from equipment weighing 20,000 pounds or more;
- Timber shoring is mixed with sloping unless the slope is flatter than 3H: 1V or the dimensions of the shoring members are based on the total depth of the trench.
TABLE INTERPRETATION

The tables offer member spacing information as well as timber size. All distances are measured center to center. Spacing interpretations for cross-braces, uprights, and Wales can be summarized in the following diagram:

When placing a conduit on the floor of a trench, it is helpful to have the bottom cross-brace as high as possible. The Standard addresses three possible scenarios:

- If the uprights are not imbedded at the base of the trench, the lowest cross-brace can be no higher than 30 inches.
- If the uprights are imbedded, the lowest cross-brace may be no higher than 36 inches.

- If the uprights are imbedded and a mudsill is used, the lowest cross-brace may be no higher than 42 inches.
It is important to know how to space the cross-braces at the top of the trench as well, especially if the trench depth does not allow the spacing to come out even. The Standard indicates that the span from the top cross-brace to the top of the trench shall be no more than 1/2 of the vertical cross-brace spacing.

SHORING SYSTEM CONSTRUCTION

Many different techniques are used in constructing a timber shoring system. Usually, it is constructed as the trench is dug. Uprights are installed first and are usually supported by hydraulic shores until the timber cross-braces or trench jacks can be secured. Then, the hydraulic shores are removed. A few cautions on shoring construction must be voiced:

- **DO NOT ALLOW WORKERS TO WORK IN AN UNPROTECTED TRENCH WHILE CONSTRUCTING THE SHORING SYSTEM;**

- Members must be placed under load during construction. Do not wait for the trench face to move before the system is loaded. Tighten the system with wedges, trench jacks, or other devices;

- Do not overload members.

- Watch soil for signs of failure;

- Shoring members must be secured together by nailing or some other effective means.
TIMBER SHORING INSPECTION

It is critical that the competent person inspects the timber shoring before the beginning of work each day and after each hazard-increasing event. While inspecting, the competent person is allowed to climb on the shoring system. Things to watch for include:

- Tightness of members;
- Members fit tight against soil (gaps where soil has eroded);
- Signs of soil failure;
- Cross-braces perpendicular to uprights (in both axis).

TIMBER SHORING REMOVAL

Great care must be exercised when removing the shoring system. All personnel must be protected from a cave-in during support removal. The system must be removed by disconnecting the bottom first and working toward the top. Often, hydraulic systems are used to support the uprights while the timbers cross-braces are removed. Once the shoring system has been removed, backfilling should proceed as soon as possible.