

WAC 296-155-66405 Appendix C—Timber shoring for trenches. (1)

Scope. This appendix contains information that can be used when timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with WAC 296-155-657 (3)(a). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in WAC 296-155-657 (2) and (3).

(2) **Soil classification.** In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of this part.

(3) **Presentation of information.** Information is presented in several forms as follows:

(a) Information is presented in tabular form in Tables N-2 through N-7 following subsection (7) of this appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(b) Information concerning the basis of the tabular data and the limitations of the data is presented in subsection (4) of this appendix, and on the tables themselves.

(c) Information explaining the use of the tabular data is presented in subsection (5) of this appendix.

(d) Information illustrating the use of the tabular data is presented in subsection (6) of this appendix.

(e) Miscellaneous notations regarding Tables N-2 through N-7 are presented in subsection (7) of this Appendix.

(4) **Basis and limitations of the data.**

(a) Dimensions of timber members.

(i) The sizes of the timber members listed in Tables N-2 through N-7 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables N-2, N-3, and N-4 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables N-5, N-6, and N-7, or have this choice under WAC 296-155-657 (3)(c), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(b) Limitation of application.

(i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in WAC 296-155-657(3).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with WAC 296-155-657.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than 3 horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(5) **Use of Tables.** The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are 6 tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A of this Part. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(6) **Examples to illustrate the use of Tables N-2 through N-4.**

(a) Example 1.

A trench dug in Type A soil is 13 feet deep and 5 feet wide.

From Table N-2, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4x4 crossbraces at 6 feet horizontally and 4 feet vertically.

Wales are not required.

Space 3x8 uprights at 6 feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement #2

Space 4x6 crossbraces at 8 feet horizontally and 4 feet vertically.

Space 8x8 wales at 4 feet vertically.

Space 2x6 uprights at 4 feet horizontally.

Arrangement #3

Space 6x6 crossbraces at 10 feet horizontally and 4 feet vertically.

Space 8x10 wales at 4 feet vertically.

Space 2x6 uprights at 5 feet horizontally.

Arrangement #4

Space 6x6 crossbraces at 12 feet horizontally and 4 feet vertically.

Space 10x10 wales at 4 feet vertically.

Space 3x8 uprights at 6 feet horizontally.

(b) Example 2.

A trench dug in Type B soil is 13 feet deep and 5 feet wide.

From Table N-3, 3 acceptable arrangements of members are listed.

Arrangement #1

Space 6x6 crossbraces at 6 feet horizontally and 5 feet vertically.

Space 8x8 wales at 5 feet vertically.

Space 2x6 uprights at two feet horizontally.

Arrangement #2

Space 6x8 crossbraces at 8 feet horizontally and 5 feet vertically.

Space 10x10 wales at 5 feet vertically.

Space 2x6 uprights at two feet horizontally.

Arrangement #3

Space 8x8 crossbraces at 10 feet horizontally and 5 feet vertically.

Space 10x12 wales at 5 feet vertically.

Space 2x6 uprights at two feet vertically.

(c) Example 3.

A trench dug Type C soil is 13 feet deep and 5 feet wide.

From Table N-4 two acceptable arrangements of members can be used.

Arrangement #1

Space 8x8 crossbraces at 6 feet horizontally and 5 feet vertically.

Space 10x12 wales at 5 feet vertically.

Position 2x6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #2

Space 8x10 crossbraces at 8 feet horizontally and 5 feet vertically.

Space 12x12 wales at 5 feet vertically.

Position 2x6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(d) Example 4.

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15

feet in depth is determined using Table N-4. Only one arrangement of members is provided.

Space 8x10 crossbraces at 6 feet horizontally and 5 feet vertically.

Space 12x12 wales at 5 feet vertically.

Use 3x6 tight sheeting.

Use of Tables N-5, N-6, and N-7 would follow the same procedures.

(7) **Notes for all tables.**

(a) Member sizes at spacings other than indicated are to be determined as specified in WAC 296-155-657(3). "Design of Protective Systems."

(b) When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least 3 inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

(c) All spacing indicated is measured center to center.

(d) Wales to be installed with greater dimension horizontal.

(e) If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds 2 1/2 feet, you must firmly embed uprights or use a mudsill. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench must not exceed 36 inches. When mudsills are used, the vertical distance must not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

(f) Trench jacks may be used in lieu of or in combination with timber crossbraces.

(g) Placement of crossbraces. When the vertical spacing of crossbraces is 4 feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is 5 feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

TABLE N-2

TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS*

SOIL TYPE A P_a - 25 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	HORIZ. SPACING (FEET)	CROSS BRACES					VERT. SPACING (FEET)	WALES		UPRIGHTS				
		WIDTH OF TRENCH (FEET)						SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
4 TO 10	UP TO 6	4 X 4	4 X 4	4 X 6	6 X 6	6 X 6	4	Not Req'd	---				2 X 6	
	UP TO 8	4 X 4	4 X 4	4 X 6	6 X 6	6 X 6	4	Not Req'd	---					2 X 8
	UP TO 10	4 X 6	4 X 6	4 X 6	6 X 6	6 X 6	4	8 X 8	4			2 X 6		
	UP TO 12	4 X 6	4 X 6	6 X 6	6 X 6	6 X 6	4	8 X 8	4				2 X 6	
10 TO 15	UP TO 6	4 X 4	4 X 4	4 X 6	6 X 6	6 X 6	4	Not Req'd	---				3 X 8	
	UP TO 8	4 X 6	4 X 6	6 X 6	6 X 6	6 X 6	4	8 X 8	4		2 X 6			
	UP TO 10	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	4	8 X 10	4			2 X 6		
	UP TO 12	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	4	10 X 10	4				3 X 8	
15 TO 20	UP TO 6	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	4	6 X 8	4	3 X 6				
	UP TO 8	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	4	8 X 8	4	3 X 6				
	UP TO 10	8 X 8	8 X 8	8 X 8	8 X 8	8 X 10	4	8 X 10	4	3 X 6				
	UP TO 12	8 X 8	8 X 8	8 X 8	8 X 8	8 X 10	4	10 X 10	4	3 X 6				
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE N-3

TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS*

SOIL TYPE B $P_a - 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	HORIZ. SPACING (FEET)	CROSS BRACES					VERT. SPACING (FEET)	WALES		UPRIGHTS				
		WIDTH OF TRENCH (FEET)						SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3		
4 TO 10	UP TO 6	4 X 6	4 X 6	6 X 6	6 X 6	6 X 6	5	6 X 8	5				2 X 6	
	UP TO 8	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	5	8 X 10	5				2 X 6	
	UP TO 10	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	5	10 X 10	5				2 X 6	
	See Note 1													
10 TO 15	UP TO 6	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	5	8 X 8	5		2 X 6			
	UP TO 8	6 X 8	6 X 8	6 X 8	8 X 8	8 X 8	5	10 X 10	5		2 X 6			
	UP TO 10	8 X 8	8 X 8	8 X 8	8 X 8	8 X 10	5	10 X 12	5		2 X 6			
	See Note 1													
15 TO 20	UP TO 6	6 X 8	6 X 8	6 X 8	8 X 8	8 X 8	5	8 X 10	5	3 X 6				
	UP TO 8	8 X 8	8 X 8	8 X 8	8 X 8	8 X 10	5	10 X 12	5	3 X 6				
	UP TO 10	8 X 10	8 X 10	8 X 10	8 X 10	10 X 10	5	12 X 12	5	3 X 6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE N-4
TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS*
 SOIL TYPE C P_a - 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	HORIZ. SPACING (FEET)	CROSS BRACES					VERT. SPACING (FEET)	WALES		UPRIGHTS				
		WIDTH OF TRENCH (FEET)						SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
4 TO 10	UP TO 6	6 X 8	6 X 8	6 X 8	8 X 8	8 X 8	5	8 X 10	5	2 X 6				
	UP TO 8	8 X 8	8 X 8	8 X 8	8 X 8	8 X 10	5	10 X 12	5	2 X 6				
	UP TO 10	8 X 10	8 X 10	8 X 10	8 X 10	10 X 10	5	12 X 12	5	2 X 6				
	See Note 1													
10 TO 15	UP TO 6	8 X 8	8 X 8	8 X 8	8 X 8	8 X 10	5	10 X 12	5	2 X 6				
	UP TO 8	8 X 10	8 X 10	8 X 10	8 X 10	10 X 10	5	12 X 12	5	2 X 6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8 X 10	8 X 10	8 X 10	8 X 10	10 X 10	5	12 X 12	5	3 X 6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE N-5
TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS*
 SOIL TYPE A P_a - 25 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **													
	HORIZ. SPACING (FEET)	CROSS BRACES					VERT. SPACING (FEET)	WALES		UPRIGHTS				
		WIDTH OF TRENCH (FEET)						SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
	UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15						CLOSE	4	5	6
4 TO 10	UP TO 6	4 X 4	4 X 4	4 X 4	4 X 4	4 X 6	4	Not Req'd	Not Req'd				4 X 6	
	UP TO 8	4 X 4	4 X 4	4 X 4	4 X 6	4 X 6	4	Not Req'd	Not Req'd					4 X 8
	UP TO 10	4 X 6	4 X 6	4 X 6	6 X 6	6 X 6	4	8 X 8	4			4 X 6		
10 TO 15	UP TO 6	4 X 4	4 X 4	4 X 4	6 X 6	6 X 6	4	Not Req'd	Not Req'd				4 X 10	
	UP TO 8	4 X 6	4 X 6	4 X 6	6 X 6	6 X 6	4	6 X 8	4		4 X 6			
	UP TO 10	6 X 6	6 X 6	6 X 6	6 X 6	6 X 6	4	8 X 8	4			4 X 8		
	UP TO 12	6 X 6	6 X 6	6 X 6	6 X 6	6 X 6	4	8 X 10	4		4 X 6		4 X 10	
15 TO 20	UP TO 6	6 X 6	6 X 6	6 X 6	6 X 6	6 X 6	4	6 X 8	4	3 X 6				
	UP TO 8	6 X 6	6 X 6	6 X 6	6 X 6	6 X 6	4	8 X 8	4	3 X 6	4 X 12			
	UP TO 10	6 X 6	6 X 6	6 X 6	6 X 6	6 X 8	4	8 X 10	4	3 X 6				
	UP TO 12	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	4	8 X 12	4	3 X 6	4 X 12			
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE N-6

TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS*

SOIL TYPE B $P_a - 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **													
	HORIZ. SPACING (FEET)	CROSS BRACES					VERT. SPACING (FEET)	WALES		UPRIGHTS				
		WIDTH OF TRENCH (FEET)						SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
	UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15						CLOSE	2	3	4
4 TO 10	UP TO 6	4 X 6	4 X 6	4 X 6	6 X 6	6 X 6	5	6 X 8	5			3 X 12 4 X 8		4 X 12
	UP TO 8	4 X 6	4 X 6	6 X 6	6 X 6	6 X 6	5	8 X 8	5		3 X 8		4 X 8	
	UP TO 10	4 X 6	4 X 6	6 X 6	6 X 6	6 X 8	5	8 X 10	5			4 X 8		
10 TO 15	See Note 1													
	UP TO 6	6 X 6	6 X 6	6 X 6	6 X 8	6 X 8	5	8 X 8	5	3 X 6	4 X 10			
	UP TO 8	6 X 6	6 X 8	6 X 8	8 X 8	8 X 8	5	10 X 10	5	3 X 6	4 X 10			
	UP TO 10	6 X 8	6 X 8	8 X 8	8 X 8	8 X 8	5	10 X 12	5	3 X 6	4 X 10			
15 TO 20	See Note 1													
	UP TO 6	6 X 8	6 X 8	6 X 8	6 X 8	8 X 8	5	8 X 10	5	4 X 6				
	UP TO 8	6 X 8	6 X 8	6 X 8	8 X 8	8 X 8	5	10 X 12	5	4 X 6				
	UP TO 10	8 X 8	8 X 8	8 X 8	8 X 8	8 X 8	5	12 X 12	5	4 X 6				
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE N-7

TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS*
 SOIL TYPE C P_a - 80 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (SIZES) AND SPACING OF MEMBERS **													
	HORIZ. SPACING (FEET)	CROSS BRACES					VERT. SPACING (FEET)	WALES		UPRIGHTS				
		WIDTH OF TRENCH (FEET)						SIZE (IN.)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
	UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15						CLOSE			
4 TO 10	UP TO 6	6 X 6	6 X 6	6 X 6	6 X 6	8 X 8	5	8 X 8	5	3 X 6				
	UP TO 8	6 X 6	6 X 6	6 X 6	8 X 8	8 X 8	5	10 X 10	5	3 X 6				
	UP TO 10	6 X 6	6 X 6	8 X 8	8 X 8	8 X 8	5	10 X 12	5	3 X 6				
	See Note 1													
10 TO 15	UP TO 6	6 X 8	6 X 8	6 X 8	8 X 8	8 X 8	5	10 X 10	5	4 X 6				
	UP TO 8	8 X 8	8 X 8	8 X 8	8 X 8	8 X 8	5	12 X 12	5	4 X 6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8 X 8	8 X 8	8 X 8	8 X 10	8 X 10	5	10 X 12	5	4 X 6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.
 ** Manufactured members of equivalent strength may be substituted for wood.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 16-09-085, § 296-155-66405, filed 4/19/16, effective 5/20/16. Statutory Authority: RCW 49.17.010, [49.17].040, [49.17].050. WSR 02-12-098, § 296-155-66405, filed 6/5/02, effective 8/1/02. Statutory Authority: Chapter 49.17 RCW and RCW 49.17.040, [49.17].050 and [49.17].060. WSR 92-22-067 (Order 92-06), § 296-155-66405, filed 10/30/92, effective 12/8/92.]