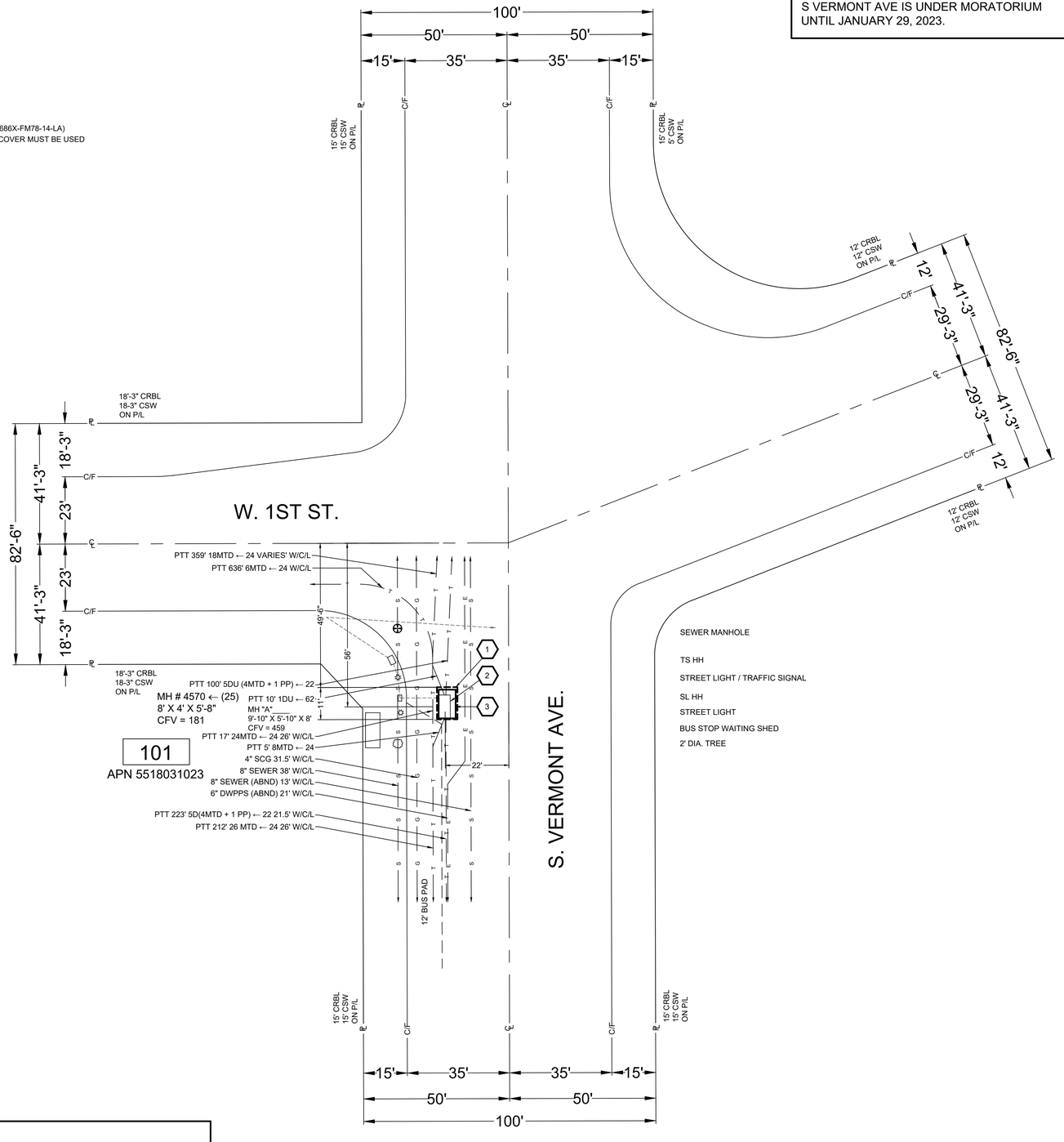
PLACEMENT DATA

1. DIG 11' X 7' MANHOLE PIT
   LOCATE EXISTING MH # 4570
   R/C 4R
2. BREAK AND REMOVE EXISTING MH # 4570
   PLACED IN 1925
   8' X 4' X 5'-8"
   R/C 4X
3. PL. MH "A" ____
   70"W X 118"L X 96"H T-2 OR INTERSET T-2
   E/W SB 30" F&C (STREET LID)
   CFV = 249
   R/C 4C
   JENSEN PRECAST UTILITY VAULT MODEL NUMBER (K4686X-FM78-14-LA)
   APPROVED VEHICULAR TRAFFIC RATED MH FRAME & COVER MUST BE USED
   MODEL NUMBER AKA (NONE)

NOTE:
S VERMONT AVE IS UNDER MORATORIUM
UNTIL JANUARY 29, 2023.



NOTE:
ONLY THOSE EXISTING SUBSTRUCTURES WITHIN
10-FT OF THE PROPOSED WORK AREA ARE SHOWN

STREET LIGHTING NOTES TO CONTRACTOR

The contractor shall protect and maintain all street lighting facilities existing in the work area. Should any damage to the street lighting system occur, the contractor shall immediately notify the Bureau of Street Lighting, Field Operations Division, by telephoning (323) 913-4743. After 4:30 PM Monday through Thursday, or 3:30 PM on Friday, contact the Electric Trouble Board of the Department of Water and Power by telephoning (800) 821-5278 from the (213) area code, or (800) 821-5279 from the (818) area code.

The contractor shall arrange for the immediate repair and restoration of the damaged street lighting system at no cost to the City. A licensed electrical contractor is required to make all repairs necessary to the street lighting facilities.

The contract shall install all proposed facilities 12 inches clear of the street lighting foundations, pullboxes, and conduits, except where otherwise stated herein. Two business days prior to working near the street lighting circuit the contractor shall arrange for the presence of a City of Los Angeles, Public Works inspector, (213) 580-5080 or (818) 374-1188, to verify all clearance requirements are met. Where a conflict exists between the street lighting facilities and the proposed improvements, approval for relocation of the street lighting facilities may be obtained by contacting the Street Lighting Engineer at (213) 847-1817.

The contractor shall proceed with extreme caution when working near the high voltage series circuit. Unauthorized work on the series circuit can result in severe injury or death. The contractor shall notify the Bureau of Street Lighting, Field Operations Division (323) 913-4743 two business days prior to working near the street lighting circuit.

This plan has been reviewed by the Bureau of Street Lighting and approved for the encroachment of new utilities within the Bureau of Street Lighting easement as specified hereon and within this plan:

# of vault locations: _____ # of conduit locations: _____

linear footage of conduit: _____ lft

Approved by:

_____ _____
Director, Bureau of Street Lighting Date

CITY OF L.A. STREET LIGHTS INFORMATION

SEE C.P. DRAWING FOR LOCATION & TIES
OF STREET LIGHTS IN THE NEW CONSTRUCTION AREA

ENGINEERING
CITY OF LOS ANGELES
U-PERMIT
CENTRAL DISTRICT
Bureau of Engineering
APPROVED
BY C. DINH DATE 9/28/2022
REF. # 2022010763 PERMIT # U-2250-4314

MUST CALL FOR INSPECTION 213-485-5080 BEFORE, DURING, AND AFTER CONSTRUCTION

1" 2"
20' 40'

J5 INFRASTRUCTURE PARTNERS

at&t
600 E. GREEN ST ROOM # 300
PASADENA, CA 91101

48 HOURS BEFORE YOU DIG
CALL
UNDERGROUND SERVICE ALERT
of Southern California
1-800-422-4133

CONSTRUCTION REQUIREMENTS

1. MAINTAIN MINIMUM COVER OF 36" BELOW FLOW LINE.
2. VERIFY EXISTING SUBSTRUCTURES PRIOR TO EXCAVATION.
3. ALL 4" TO CONFORM TO PTS.-77 OR EQUIVALENT.
4. ALL 2" TO CONFORM TO PTS.-66 OR EQUIVALENT.
5. BACKFILL SHALL BE CEMENT SLURRY.
6. DO NOT BACKFILL OVER ANY TELEPHONE BURIED SPLICE LOCATIONS UNTIL AUTHORIZED BY TELEPHONE COMPANY INSPECTOR.
7. PLACE # 6 TINNED GROUND WIRE AT BONDING POINTS. (SEE BONDING DETAIL)
8. PLACE PULL ROPE IN NEW CONDUIT.
9. DO NOT CUT CURB & GUTTER.
10. ALL SURFACES AND LANDSCAPES WHICH HAVE BEEN REMOVED OR DAMAGED IN THE COURSE OF CONSTRUCTION SHALL BE RECONSTRUCTED OR REPLACED TO AT LEAST EQUAL OR BETTER THAN THE PREVIOUS OR ADJACENT SURFACE.
11. ALL TRAFFIC CONTROL TO BE IN ACCORDANCE WITH THE CALIFORNIA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) LATEST EDITION.
12. PER AT&T GUIDELINES, ALL HANDHOLES, SPLICE BOXES, AND MANHOLES TO BE PURCHASED FROM THE APPROVED VENDOR DETERMINED BY CONTRACT ADMINISTRATOR.

THIS PROJECT REQUIRES EXCAVATION. CONSTRUCTION WILL UTILIZE AND IMPLEMENT ALL BEST MANAGEMENT PRACTICES (BMP's) AS REQUIRED TO ENSURE COMPLIANCE WITH AT&T POLICY LETTER ISSUE FEBRUARY 21, 2003 AND REVISED IN OCTOBER 2005 BY ENVIRONMENTAL MANAGEMENT CONCERNING STORM WATER PERMITTING AND STORM WATER POLLUTION PREVENTION PLANS (SWPPP's) AND IN ACCORDANCE WITH THE CLEAN WATER ACT (1972) AND EPA REGULATIONS PUBLISHED IN 1990 AS MODIFIED BY THE PHASE II RULE IN 1999.

LOCATION:
S. VERNMONT AVE, W/S OF STREET, 53' S/O C/L OF W. 1ST ST.

DESCRIPTION:
DIG 11' X 7' MANHOLE PIT, BREAK AND REMOVE EXISTING MH 4570. PLACE NEW MH (T-2).

TRENCH WIDTH AND DEPTH (TRENCH WIDTH = 12" AND DEPTH TO SUBGRADE = 3'-6").

TRENCH BACKFILL AND A/C PAVEMENT RESURFACING SHALL FOLLOW THE LATEST VERSION OF LA CITY STANDARD PLAN S-477-2

STREET TYPE	SOIL CLASS	PROPOSED BACKFILL
MAJOR	N/A	N/A
SECONDARY	N/A	N/A
LOCAL	N/A	N/A
ALLEY	N/A	N/A

CONDUIT RECORD:
G204C141
VERMONT AVE.
1ST ST. TO 2ND ST.

SUB MAP #: 100-11 & 100-6

STREET NAME N/A

MATERIAL N/A

LINEAR FEET N/A

N

EXCAVATION DATA	
CITY OF:	LOS ANGELES (CENTRAL)
PLACING:	T-2 & PIT
EXCAVATION IN CONCRETE SIDEWALK	
EXCAVATION IN ASPHALT STREET	11' X 7' = 77 SQ FT
EXCAVATION IN ASPHALT ALLEY	
EXCAVATION IN DIRT	
TOTAL EXCAVATION:	77 SQ FT

RESURFACING DATA	
RESURFACING CONCRETE	
RESURFACING ASPHALT	11' X 7' = 77 SQ FT
TOTAL RESURFACING:	77 SQ FT
NUMBER OF CUTS:	1

	DATE	ATTID
DRAWN	09/08/2022	J5 / S.L.
CHECKED		
APPROVED	9/14/22	aa737q

DATE	REVISIONS

LAYOUT ENGINEER: ALFREDO ARTEAGA
TELEPHONE NUMBER: 626-319-2325
EMAIL ADDRESS: aa737q@att.com
FACILITY ENGINEER: MARTIN GUEVARA
TELEPHONE NUMBER: 626-297-3016
GEOCO: G2-04
CENTRAL OFFICE: RAMPART
UNDERGROUND CONSTRUCTION PROJECT NUMBER: A01S9CZ

SCALE: 1" = 20'
THOMAS GUIDE: 634-A1
FILENAME: G204 A01S9CZ REL 0-1.dwg
DRAWING: 1/1

TABULATED DATA

VERTICAL ALUMINUM HYDRAULIC SHORING

2018

CER, Inc.
Construction Engineering Resource, Inc.
1837 Wright St.
Santa Rosa, CA 95404

Effective Date: April 15, 2012

Corporate Office

Trench Shoring Company
206 N. Central Ave.
Compton, CA 90220

310-327-5554
TrenchShoring.com

TRENCH SHORING™ COMPANY

"Commitment To Safety & Service"
Since 1973

Contents

About Trench Shoring Safety Vertical Aluminum Hydraulic Shore Tabulated Data

Vertical Aluminum Hydraulic Shores were first developed in the late 1950's and early 1960's. To this day, the shores are built practically the same as they were then. There are several major manufacturers all with similar parts and their own version of manufacturer's tabulated data. Some parts are also interchangeable. Due to the interchangeability and variety of tabulated data available, Trench Shoring has developed this set of universal tabulated data under;

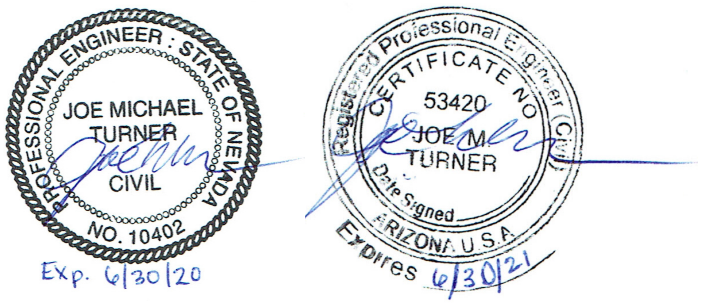
> Federal OSHA 29CFR, Part 1926, Subpart P-Excavations and Trenches
>
> 1926.652(c)(3)-**Option (3)** - Designs Using other Tabulated Data.
>
> 1926.652(c)(3)(i) -Design of support systems, shield systems, or other protective systems shall be in accordance with tabulated data, such as tables and charts.

Note that **manufacturer's** tabulated data is developed under;

> 1926.652(c)(3)-**Option (2)** - Designs Using Manufacturers Tabulated Data.

Federal OSHA 29CFR also has tabulated data for vertical hydraulic shores under;

> 1926 Subpart P-**Appendix D**-Aluminum Hydraulic Shoring for Trenches



Federal OSHA 29CFR only allows use of Appendix D when Option 2 is not available. Appendix D tabulated data is more restrictive than manufacturer's tabulated data in two major ways;

1. There is no category for OSHA Type C soil
2. The tables only allow trench depths to 20 ft deep

Use of this Trench Shoring Universal Vertical Aluminum Hydraulic Shore tabulated data will result in selection of a system that, at a minimum, conforms to manufacturers tabulated data developed by;

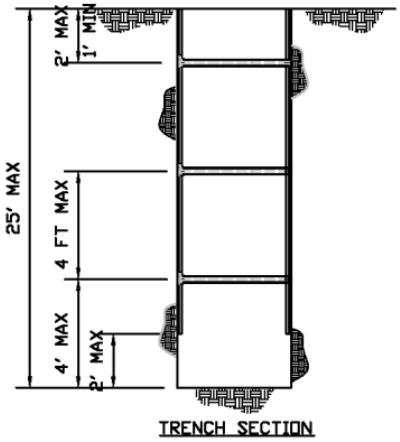
- Allied Tren-Shore
- Cerda
- Efficiency Corporation
- GME Corporation
- Kundle Tren-Shore
- Pacific Shoring, LLC
- Quick Shore
- Safety Shore
- Speed Shore Corporation

In some cases, this tabulated data will be more restrictive than the manufacturers version; however it is always less restrictive than the OSHA Appendix D version. The competent person utilizing this tabulated data should have a clear understanding that he is selecting a shoring system under Option 3, Designs Using other Tabulated Data.

Vertical Aluminum Hydraulic Shoring Quick Use Guide

This quick use guide provides a step-by-step methodology for determining the proper configuration of a vertical aluminum hydraulic shoring system. Proper use of this process will result in a system constructed in accordance with the tabulated data presented here. To be in conformance with this tabulated data, all of the information presented in this document shall be read and understood by the person utilizing this data.

1) VERTICAL SPACING



2) HORIZONTAL SPACING

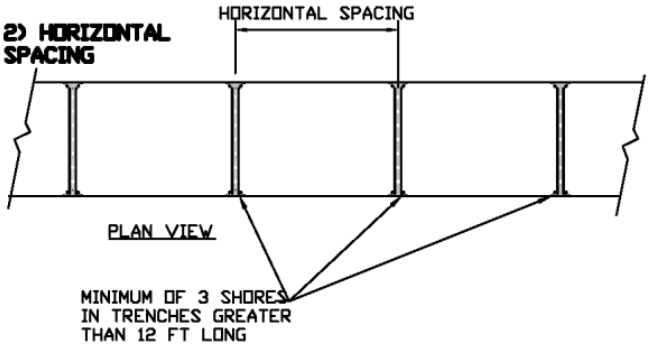
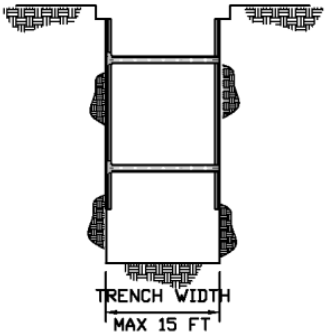


Table 5-HORIZONTAL SHORE SPACING			
Depth	OSHA Soil Type		
ft	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	6	4
over 15 to 20	8	6	4
over 20 to 25	6	4	3

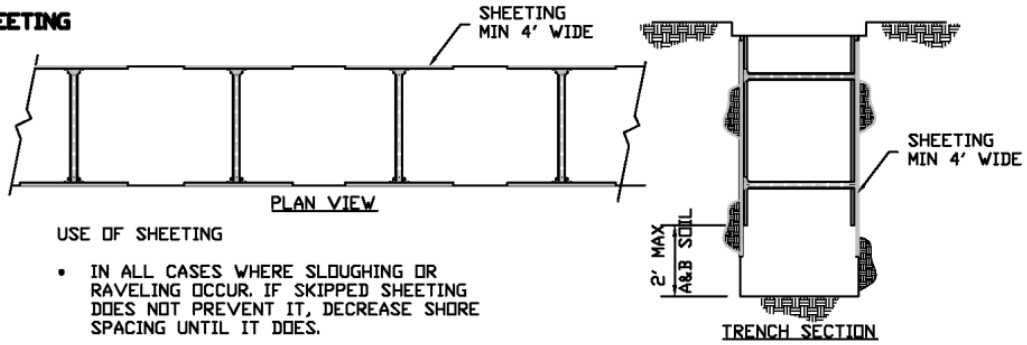
3) TRENCH WIDTH



TRENCH WIDTH OVERSLEEVE REQUIREMENTS:

- 0 TO 8 FT WIDE — NO OVERSLEEVE REQUIRED TYPE A & B SOIL
- 8 TO 12 FT WIDE — 3" ROUND ALUMINUM OVERSLEEVE
- 12 TO 15 FT WIDE — 3.5" X 3.5" X ¼" WALL SQUARE STEEL OVERSLEEVE

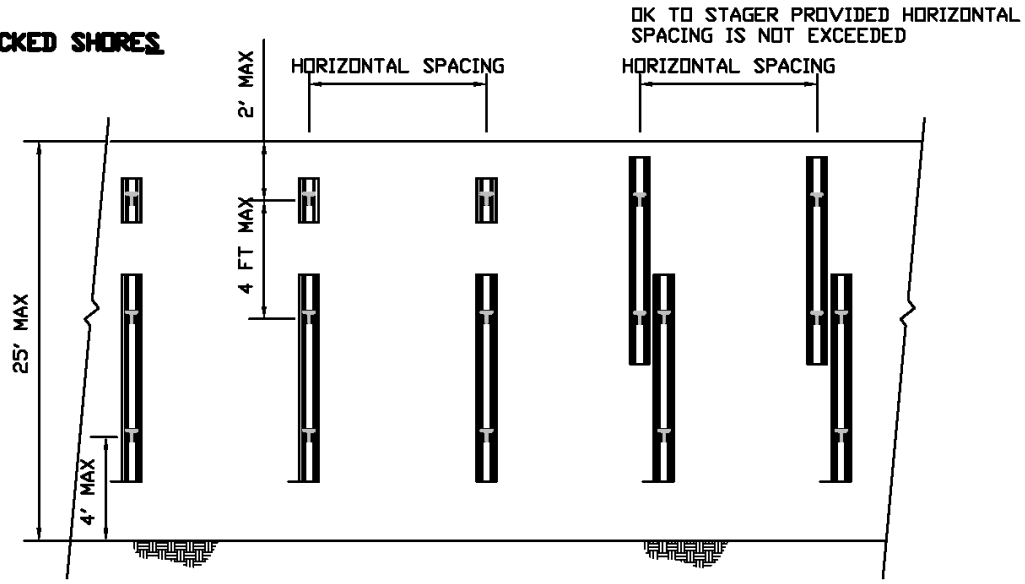
4) SHEETING



USE OF SHEETING

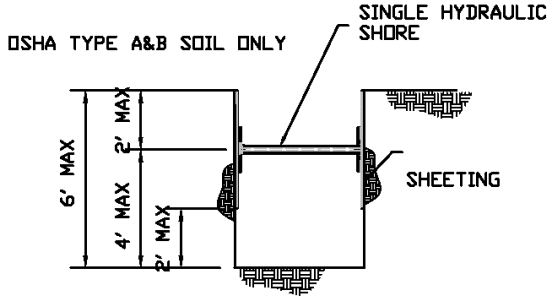
- IN ALL CASES WHERE SLOUGHING OR RAVELING OCCUR. IF SKIPPED SHEETING DOES NOT PREVENT IT, DECREASE SHORE SPACING UNTIL IT DOES.
- TYPE C-60 SOIL
- MAXIMUM 2 FT ABOVE BOTTOM IN TYPE A & B SOIL TO BOTTOM IN C-60 SOIL

5) STACKED SHORES



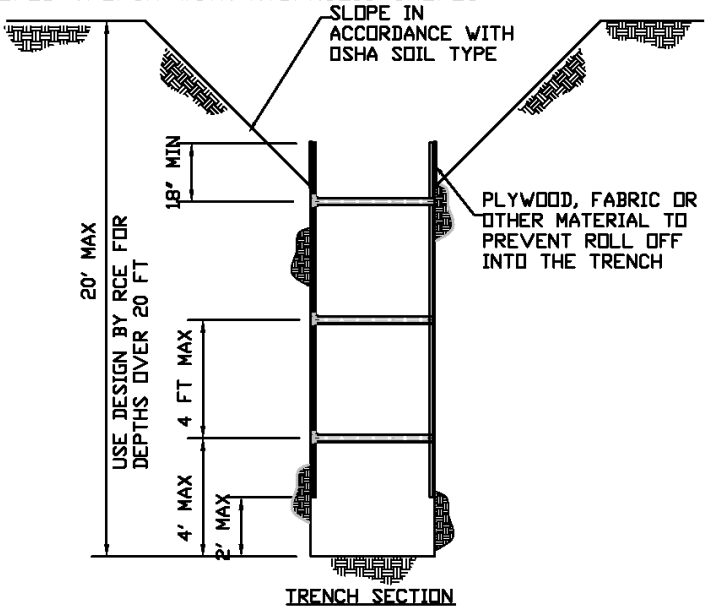
TRENCH ELEVATION

6) SINGLE SHORE IN 6 FT TRENCH



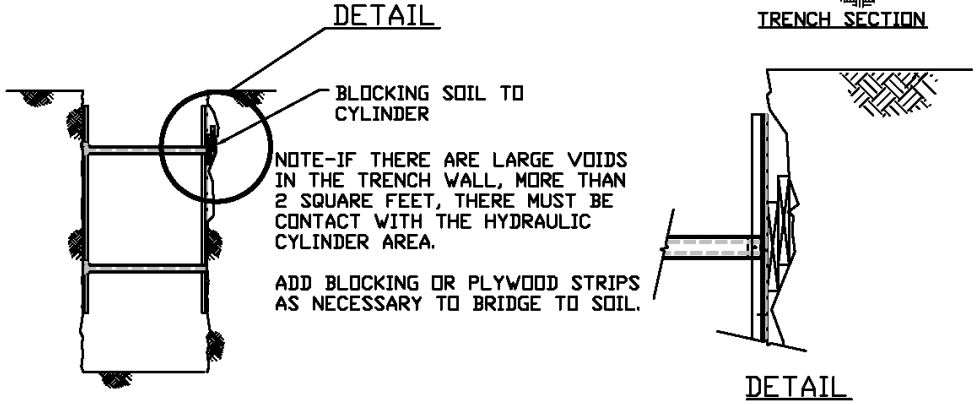
TRENCH SECTION

7) SLOPED TRENCH WITH HYDRAULIC SHORES



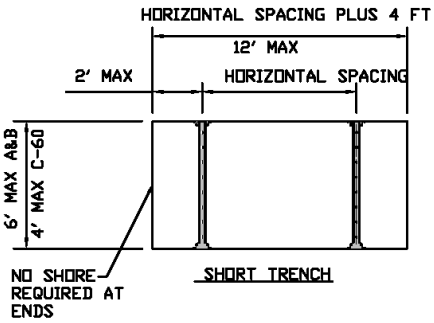
TRENCH SECTION

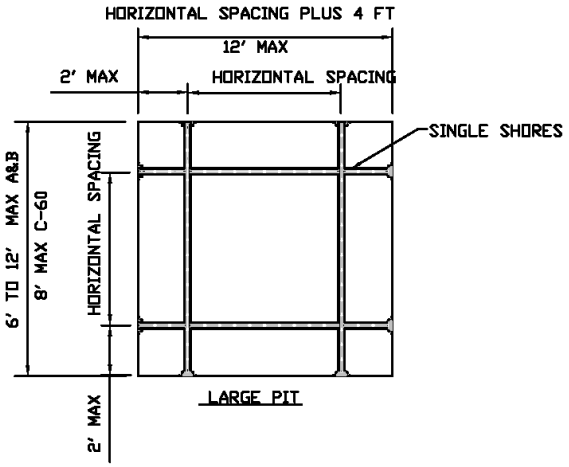
8) SOIL CONTACT WITH CYLINDERS



DETAIL

9) NON LINEAR TRENCH CONFIGURATIONS





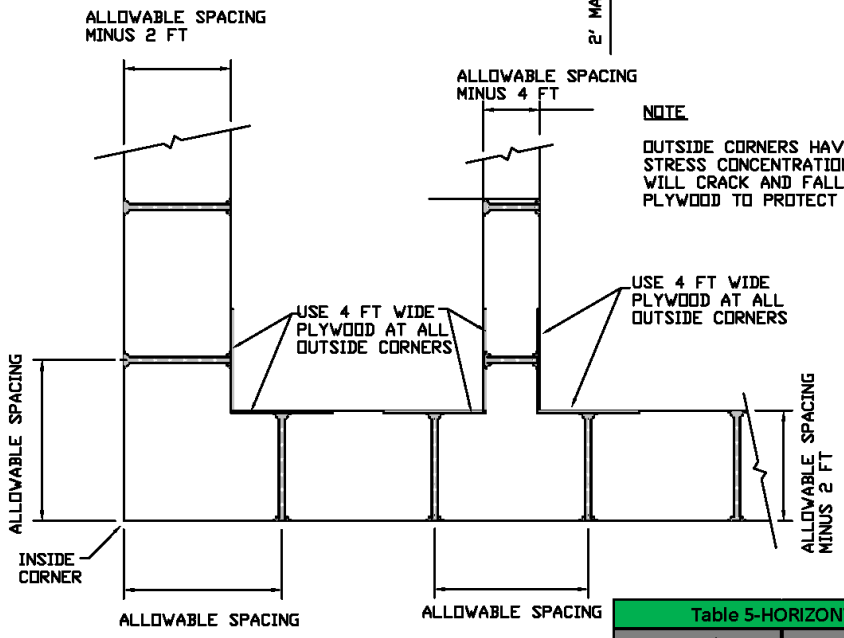
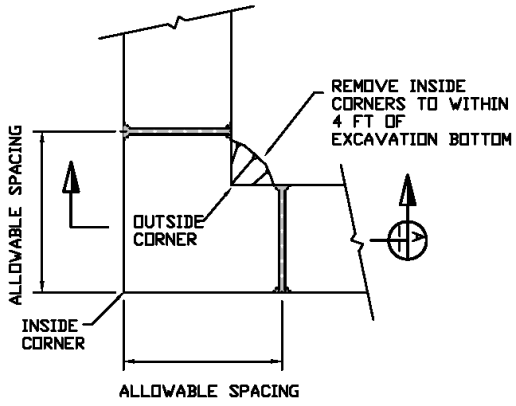
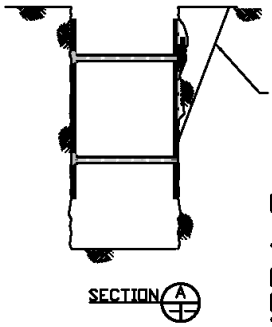


Table 5-HORIZONTAL SHORE SPACING			
Depth	OSHA Soil Type		
ft	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	6	4
over 15 to 20	8	6	4
over 20 to 25	6	4	3



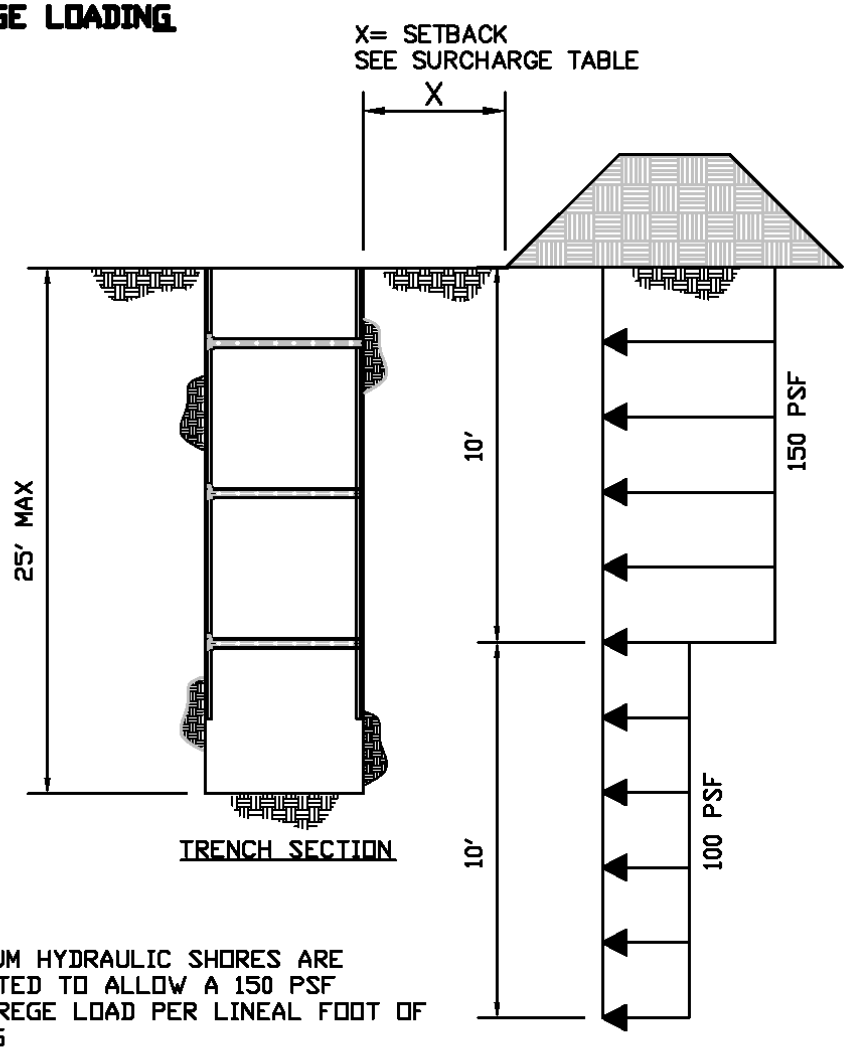


NOTE:

THESE CONFIGURATIONS REPRESENT THE LIMITS OF EXCAVATION SIZES THAT CAN BE SHORED WITH 2' VERTICAL HYDRAULIC SHORES

CORNER AND T TRENCH ALTERNATIVE TO USING PLYWOOD AT OUTSIDE CORNERS

10) SURCHARGE LOADING



NOTE

ALUMINUM HYDRAULIC SHORES ARE TABULATED TO ALLOW A 150 PSF SURCHAREGE LOAD PER LINEAL FOOT OF SPACING

SURCHARGE LOADING DIAGRAM
SURCHARGE AFTER 20 FT DEEP IS 50 PSF OR LESS

SURCHARGE SETBACK TABLE			
Surcharge	Setback Distance x	Surcharge	Setback Distance x
K-Rail	1 ft	3 Cy Loader	2 ft
HS20-44 Traffic	4 ft	5 Cy Loader	3 ft
Spoil Pile 4 ft high	2 ft	225 Excavator	2 ft
Backhoe	2 ft	325 Excavator	3 ft
Equipment < 20,000 lb	2 ft	Dump Truck and Haul Trucks	3 ft
Equipment >20,000 lb	3 ft	12 CY Concrete Truck	3 ft
		Boom Truck Pad	6 ft

Table Notes:

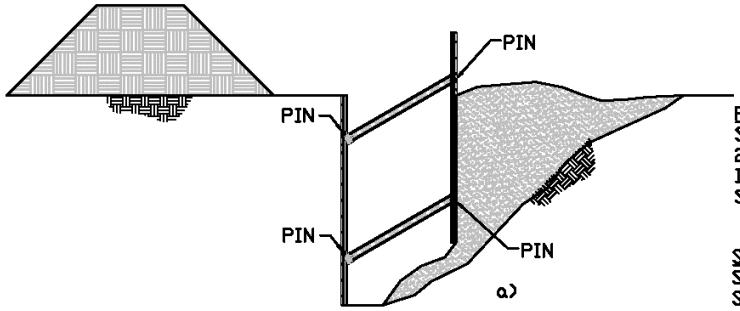
1 These setbacks limit horizontal shoring loads to 72 psf for 0 to 10 ft and 50 psf 10 to 20 ft

2 Provide separate surcharge analysis for all cranes and structures within 15 ft of the excavation

3 Table setbacks are for open trenches. When traffic covers are in place HS20-44 traffic can pass over the covered excavation

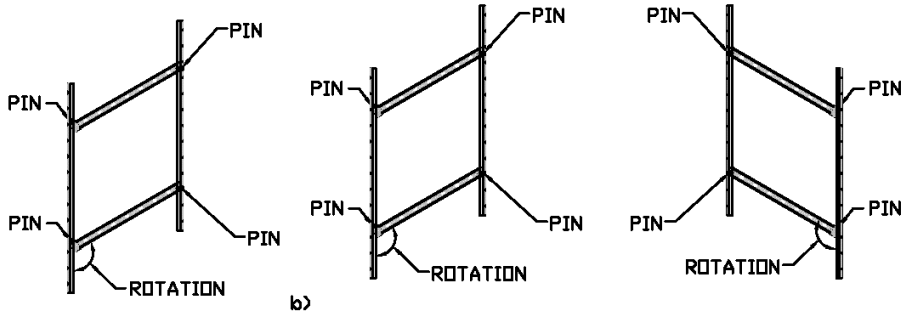
Hydraulic Shore Safety Issues

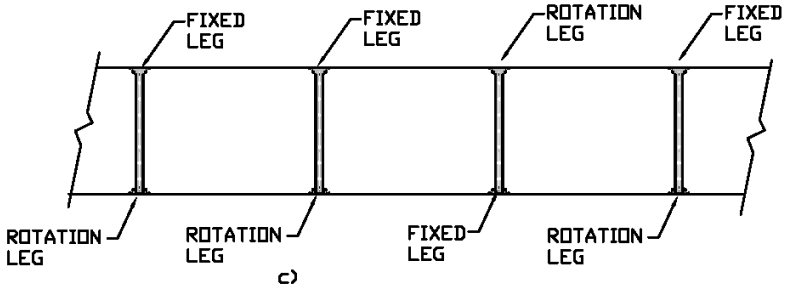
1) SHORE FOLD UP



PROBLEM
SHORES WITH 2 HYDRAULIC CYLINDERS OR 2 SINGLE CYLINDER SHORES CAN ROTATE DUE TO UNBALLANCED LOADING ON ONE SIDE

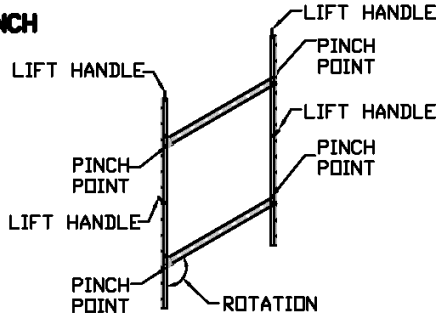
SOLUTION
SET EVERY THIRD SHORE SO THAT THE SHORE ROTATION IS OPPOSITE





PLAN VIEW

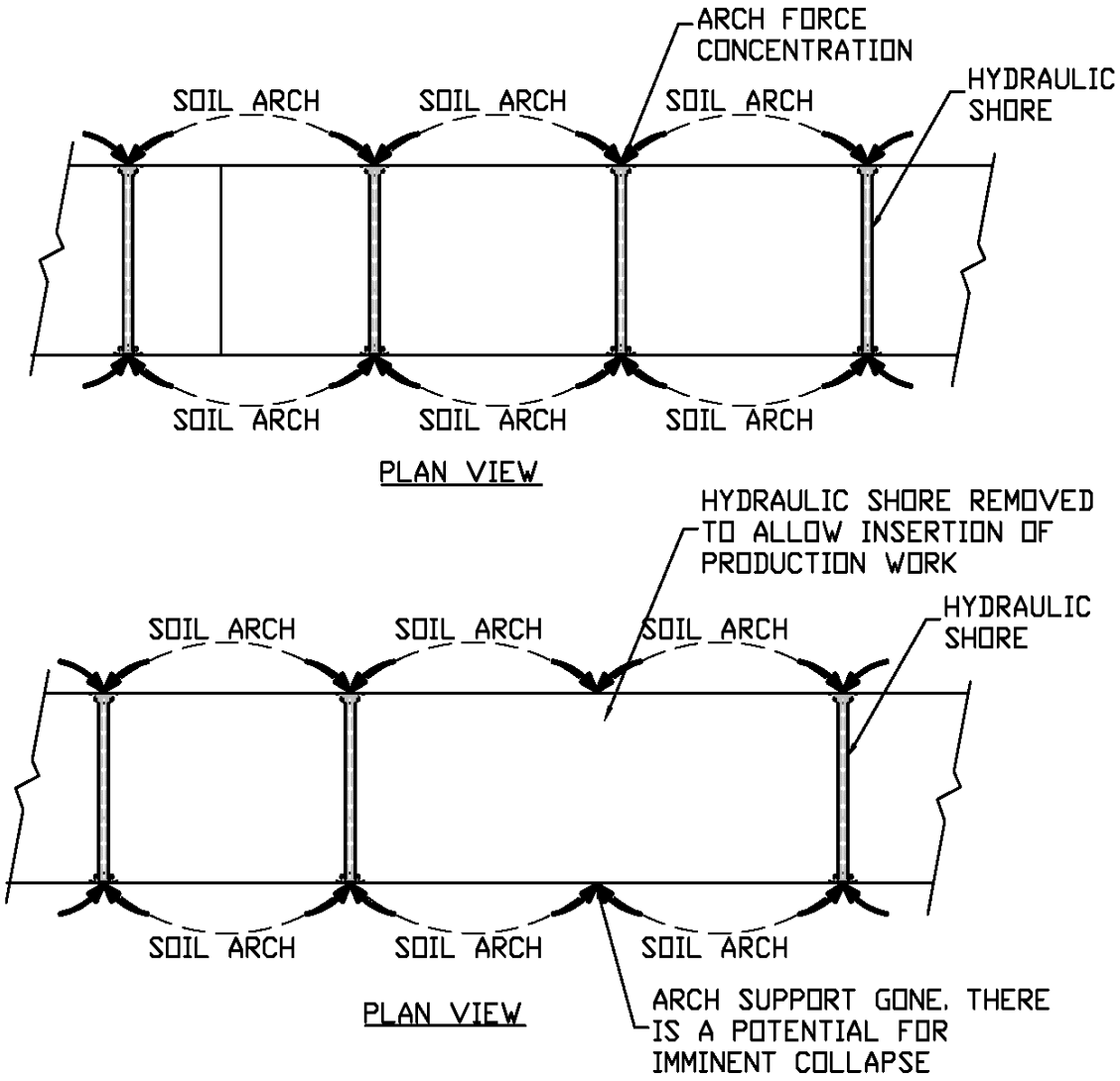
2) FINGER PINCH



PROBLEM
FINGERS CAN BE PINCHED OR SEVERED BETWEEN THE RAIL AND THE CYLINDER BLOCK WHEN MOVING OR SETTING SHORES

SOLUTION
USE LIFT HANDLES ONLY TO LIFT AND SET THE SHORE

3) REMOVAL OF SOIL ARCH



PROBLEM

SOIL ARCHING IS ESTABLISHED WHEN SHORES ARE INSTALLED. TEMPORARY OR PERMANENT REMOVAL OF THE SHORE IS A POTENTIAL FOR IMMINENT COLLAPSE

SOLUTION

1. WHEN REMOVING SHORES KEEP BACKFILL CLOSE TO SHORES BEING REMOVED

2. WHEN REMOVING AND RESETTING SHORES TO ALLOW PLACEMENT OF PRODUCTION WORK USE REMOTE EQUIPMENT SUCH AS BACKHOE OR BOOM TRUCK TO PICK AND RESET SHORES. OPERATE SHORE HYDRAULICS FROM SHORED AREA.

Vertical Aluminum Hydraulic Shores Description

Vertical Aluminum Hydraulic Shores are constructed from standard duty or heavy-duty vertical rails attached to 2" hydraulic cylinders. The rail lengths vary from 18" to 20 ft long. The cylinders can extend from 18" to 88". Cylinder extensions can be added to obtain lengths to 15'. The hydraulic cylinder consists of a 2" OD piston, a 2" ID x 3/16" barrel, and a 3" OD x 3/16" oversleeve. The cylinders provide a 23,000 lb safe working load for cylinder bulging at a 1.5 factor of safety. At lengths 8 ft to 12 ft an additional 3" round aluminum over sleeve is required and at 12 ft to 15 ft a 3.5" x 3.5"x 3/16"wall a square steel oversleeve is required to prevent buckling. Based on the principal of soil arching Vertical Aluminum Hydraulic Shores can be spaced horizontally as much as 8 ft apart without sheeting on the trench walls. Plywood sheeting is used either attached or separate behind the rails to prevent the trench walls from sloughing or raveling.

Vertical Aluminum Hydraulic Shores are installed from outside the excavation. The shores are hinged so that they can be folded when lowered into the trench and then opened up and pressurized with a hydraulic hand pump. The hydraulic fluid is water soluble, environmentally safe, and biodegradable. Rails 5 ft long and less can typically be moved, set, and removed by a two man crew. Larger shores are typically handled by backhoe, loader or boom truck.

Vertical Aluminum Hydraulic Shores are typically used in linear trench applications in OSHA Type A, Type B, and Type C-60 soils at depths to 23 ft and trench widths to 15 ft. Constraints such as the requirement that the bottom cylinder be set a maximum of 4 ft from the bottom of the excavation , bedding requirements, and pipe wall thicknesses limits the pipe diameter or duct height to approximately 36" maximum. The 8 ft maximum horizontal spacing limits large pipe lengths to approximately 8 ft, while smaller diameters with longer lengths to 20 ft such as PVC sewer and water lines can be maneuvered between the cylinders to fit into the trench.

General Information for Use of Vertical Aluminum Hydraulic Shores

1. The vertical aluminum hydraulic shoring system tabulated here is based on requirements of Federal OSHA 29CFR, Part 1926, Subpart P-Excavations and Trenches

   1926.652(c)(3)-Option (3) - Designs Using other Tabulated Data.

   1926.652(c)(3)(i) -Design of support systems, shield systems, or other protective systems shall be in accordance with tabulated data, such as tables and charts.

   All provisions of Subpart P apply when utilizing this tabulated data. The contractor's competent person shall use this data to select:

   - allowable trench depth
   - vertical and horizontal shore spacing
   - proper oversleeve requirement based on trench width
   - plywood use requirements

2. The competent person utilizing this tabulated data shall be experienced and knowledgeable of all requirements of Subpart P, and trained in the use and safety procedures for aluminum vertical hydraulic shores.

3. For specific Subpart P requirements regarding aluminum hydraulic shoring that is in addition to the tabulated data requirements, see OSHA Subpart P additional requirements related to aluminum hydraulic shoring. Some of these requirements are listed at the end of this document, See **Header PG. 29**

4. Use of this tabulated data is dependent on first classifying the soil in accordance with OSHA Appendix A, Soil Classification. Classification shall be just prior to installing Vertical Hydraulic Shoring. Soil conditions may change at a later date and require Vertical Hydraulic Shoring to be reset at a different spacing.

5. Hydraulic vertical shores are tabulated based on the effect of a 20,000 lb surcharge load set back 2 ft from the edge of the trench and the equivalent weight effect of the OSHA soil type, See classification of soil types, 2.

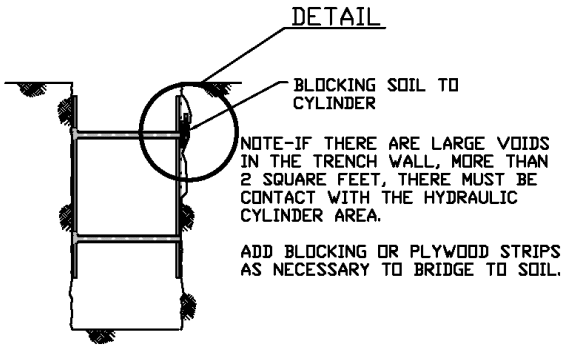


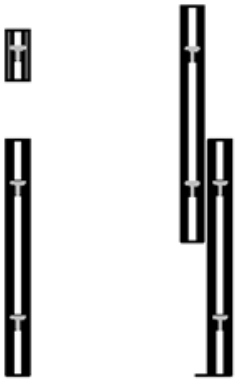
Figure 1. – See note 7

6. The depth and spacing given in **Table 1** governs the use of Vertical Hydraulic Shores and not tabulations given in OSHA Appendix C

7. Faces of excavations shall be vertical and there shall be in contact with the soil at each cylinder, **Figure 1**.

8. Shores shall be set near vertical; however, they may be set as much as 30 degrees from vertical provided that vertical and horizontal spacing is maintained.

9. Vertical Hydraulic Shores may be stacked or longitudinally lapped, **Figure 2**, provided shore spacing is maintained.



Stacked **Lapped**

Figure 2. – See note 9

10. Trenches maximum 12 ft long or horizontal spacing 4 ft or less shall have a minimum of 2 shores set in accordance with spacing requirements. Longer trenches shall have a minimum of 3 shores set at required spacing. See **Figure 3.**

11. Shores shall be installed and removed from outside the trench, see installation and removal procedure.

12. Single cylinder shores may be used in place of multiple cylinder shores provided that horizontal and vertical spacing is maintained.

13. The competent person shall continually monitor the shored excavation for changed conditions such as water seepage, soil movement cracks at the surface, sloughing or raveling, proper surcharge load weight less than 20,000 lbs and setback a minimum of 2 ft and damaged shores.

14. Workers shall always enter, exit, and work inside the shored area of the trench.

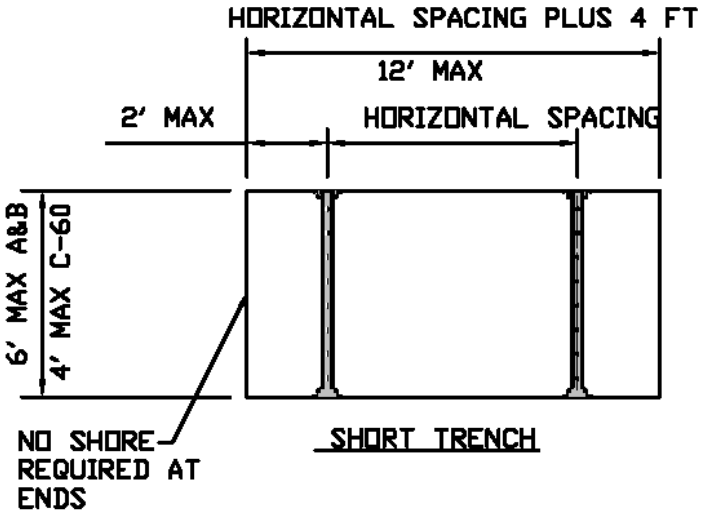


Figure 3. - Short trench, **See Note 10**

Classification of Soil Types

1. Soil classification shall be in accordance with OSHA Appendix A and classified just prior to installing hydraulic vertical shores. Soil conditions may change at a later date and require hydraulic vertical shores to be reset at a different spacing.

2. The equivalent weight of OSHA soil types* is assumed to be as follows:

• OSHA Type "A" Soil	25 PSF per ft of depth
• OSHA Type "B" Soil	45 PSF per ft of depth
• Type "C-60" Soil	60 PSF per ft of depth**
• OSHA Type "C" Soil	80 PSF per ft of depth

* These equivalent weights were adapted from OSHA 1926 Subpart P App C, Timber Shoring for Trenches, Tables C-1.1, C-1.2, and C-1.3

** Type C-60 soil is not identified or classified in OSHA Appendix A

3. Type C-60 soil is;
   - soil that does not qualify as OSHA Type A, or Type B, can be cut with vertical walls and will stand up long enough to safely insert and pressurize the hydraulic shore,
   - the water table must be at or below the bottom of the excavation with no visible water seeping from the sides of the excavation

4. Hydraulic shores shall not be used in OSHA Type C-80 Soil

Vertical Aluminum Hydraulic Shore Selection Guide

Table 1 Vertical Hydraulic Shore Selection Guide(1)

Depth of Trench (ft)	Hydraulic Cylinder Requirements					Sheeting
	Maximum Horizontal Spacing (ft)	Maximum Vertical Cylinder Spacing (ft)	Cylinder Size Width of Excavation (ft)			
			to 8	8 to 12	12 to 15	
TYPE "A" Soil						
to 10'	8'	4'	2"	2"	2"+OS2	NOTE 2
10' to 15'	↓	↓	↓	2"	2"+OS2	↓
15' to 20'				2"+OS1	2"+OS2	
20' to 25'	↓	↓	↓	2"+OS1	2"+OS2	↓
TYPE "B" Soil						
to 10'	8'	4'	2"	2"	2"+OS2	NOTE 2
10' to 15'	7'	↓		2"	2"+OS2	
15' to 20'	6'			2"+OS1	2"+OS2	
20' to 25'	5'	↓		2"+OS1	2"+OS2	NOTE 3, 4
TYPE "C-60" Soil						
to 10'	6'	4'	2"	2"	2"+OS2	NOTE 3
10' to 15'	5'	↓	↓	2"	2"+OS2	↓
15' to 20'	4'			2"+OS1	2"+OS2	
20' to 25'	3'	↓	↓	2"+OS1	2"+OS2	NOTE 3, 4
OS1 = 3"X3/16" Wall Aluminum Oversleeve						
OS2 = 3.5"x3.5"x3/16" Wall Steel Oversleeve						

Notes

1. Soil shall first be classified in accordance with OSHA Appendix A Soil Classification for use with this selection guide. Type C-60 soil is OSHA Appendix A Type C soil that will stand up long enough to install the hydraulic shores.

2. Sheeting is required at any depth whenever sloughing or raveling occur. If sloughing or raveling occurs between sheeting, decrease spacing until it is prevented. See **Table 2** for allowable sheeting. Sheeting may be attached to jack or set into trench separately.

Table 2-ALLOWABLE SHEETING

Plywood	Other Materials
3/4" Finn Form	1/2" thick steel plate 4 ft wide x depth
3/4" Omni Form	Steel sheet piling
3/4" plyform, Class 1 Exterior	Aluminum sheet piling
3/4" HDO, High Debsity Overlay	Buildable box panels
3/4" HDO, High Density Overlay	
3/4" 14 Ply Artic White Birch	
1-1/8" CDX	
2 sheets of 3/4" CDX	

Timber Lagging Set Horizontal			
Thickness	Soil Type/Span		
	A	B	C-60
2"	4 ft		
3"	5 ft	4 ft	
4"	8 ft	6 ft	4 ft
DF#2 or Oak			

3. Sheeting is required at this depth.

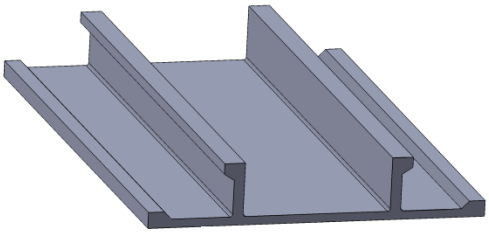
4. Sheeting must extend to the bottom of the excavation.

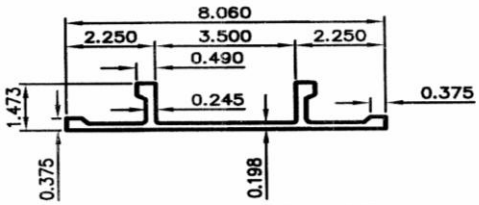
5. This tabulation includes lateral loading from equipment weighing 20,000 lbs or less and a maximum 2 ft high spoil pile set back a minimum of 2 ft. The competent person shall determine the effect of all other surcharge loads and reduce hydraulic shore spacing as required to resist those loads.

Vertical Aluminum Rail Specification

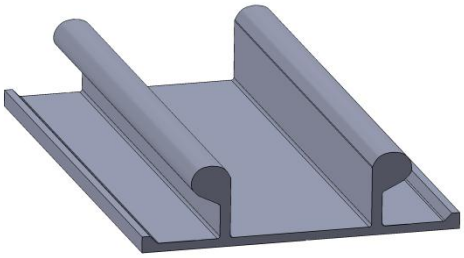
VERTICAL RAIL SPECIFICATION SHEET

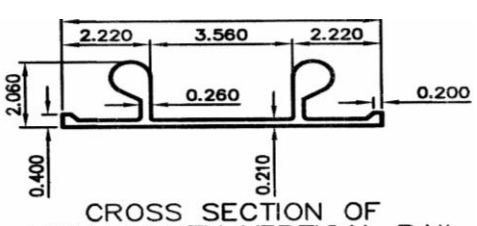
SECTION PROPERTIES	STANDARD RAIL	HEAVY DUTY RAIL
MATERIAL	ALUMINUM	ALUMINUM
ALLOY	6061–T6	6061–T6
AREA	2.45 in^2	3.47 in^2
WEIGHT	2.94 plf	4.17 plf
SECTION–MODULUS – TOP (LEG SIDE)	0.44 in^3	1.25 in^3
SECTION–MODULUS – BOTTOM (BLADE SIDE)	1.29 in^3	2.38 in^3
EQUIVALENT TIMBER SIZE * (#2 DOULAS FIR)	3x10 (FLAT)	4x10 (FLAT)



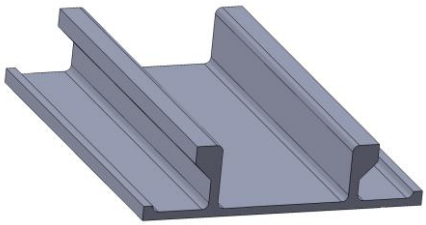


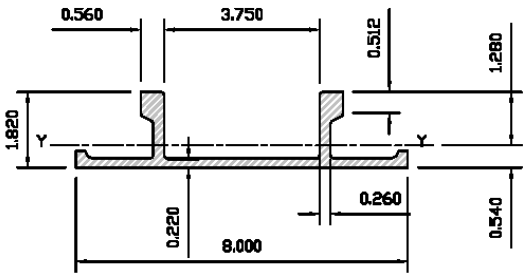
CROSS SECTION OF
STANDARD VERTICAL RAIL





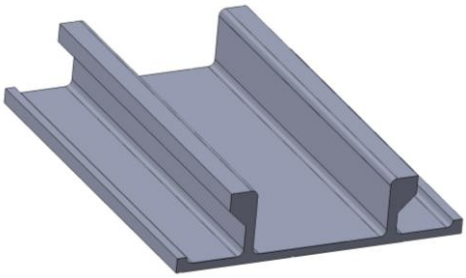
CROSS SECTION OF
HEAVY DUTY VERTICAL RAIL

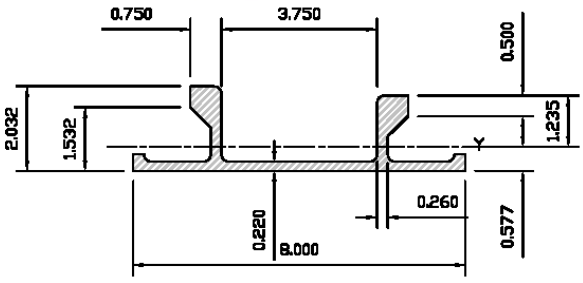




ALLIED HEAVY DUTY
TRENCH JACK RAIL

AREA	=3.08 IN^2
WEIGHT	=3.52 PLF
MOMENT OF INERTIA	=0.52 IN^4
SECTION MODULUS TENSION	=0.99 IN^3
SECTION MODULUS,COMPRESSION	=2.37 IN^3





ALLIED EXTRA HEAVY
DUTY TRENCH JACK RAIL

AREA	=3.49 IN^2
WEIGHT	=3.98 PLF
MOMENT OF INERTIA	=1.565 IN^4
SECTION MODULUS TENSION	=1.26 IN^3
SECTION MODULUS,COMPRESSION	=2.71 IN^3

Figure 4. Vertical Rail Specifications

Typical Vertical Aluminum Hydraulic Rail Dimensions

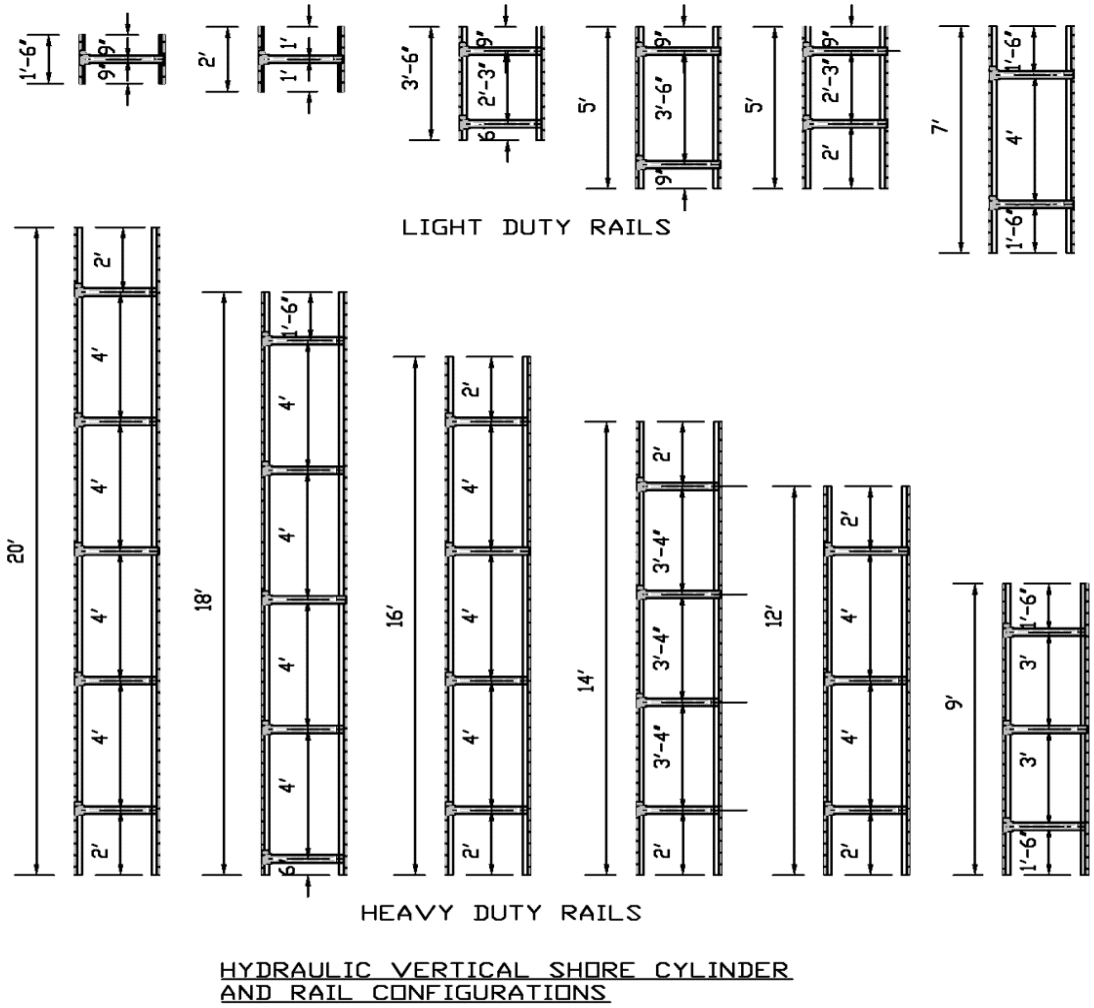


Figure 5 – Rail Dimensions

Note - Custom rail and cylinder spacing available upon request, however when using them with this tabulated data all spacing requirements of the data shall be met.

Hydraulic Cylinder Specifications

To configure for trench width, the proper cylinder range, extension if necessary, and oversleeve must be determined. **Table 3** lists some of the available cylinder ranges and some of the ranges with extensions.

Table 3- HYDRAULIC CYLINDER RANGE

Extension	Range		Extension	Range	
	Cylinder	w/ Extension		Cylinder	w/ Extension
(in)	(in)	(in)	(in)	(in)	(in)
11	17-27	28-38	21	40-64	61-85
22		39-49	42		82-106
33		50-60	56		96-120
11	22-36	33-47	24	52-88	76-112
22		44-58	42		94-130
33		55-69	56		108-144
15	28-46	43-61	74	52-88	126-162
30		58-76	82		132-168
45		73-91	92		144-180
18	34-55	52-73	128		180-216
36		70-91			
54		88-109			

Oversleeve requirements are given in **Table 4** and shown in **Figures 6, 7, 8.**

Table 4-OVERSLEEVE REQUIREMENTS

Trench Width	Oversleeve Required
to 8 ft	No oversleeve required
8 ft to 12 ft	3" x3/16" round aluminum oversleeve
12 ft to 15 ft	3-1/2" x 3-1/2" x 3/16" steel oversleeve

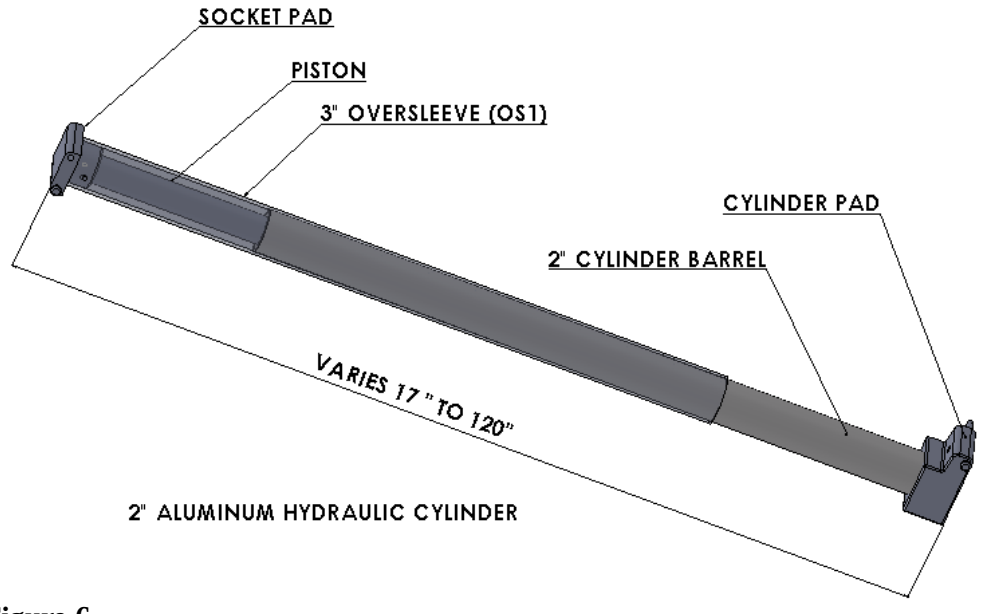


Figure 6

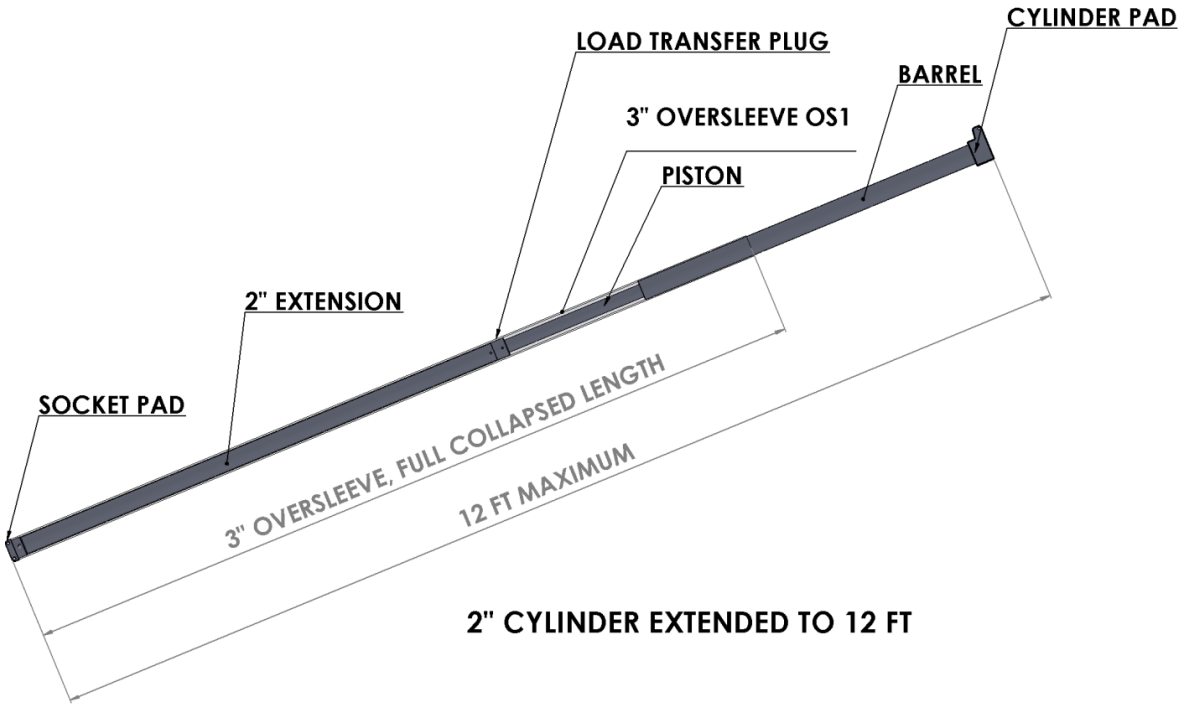


Figure 7

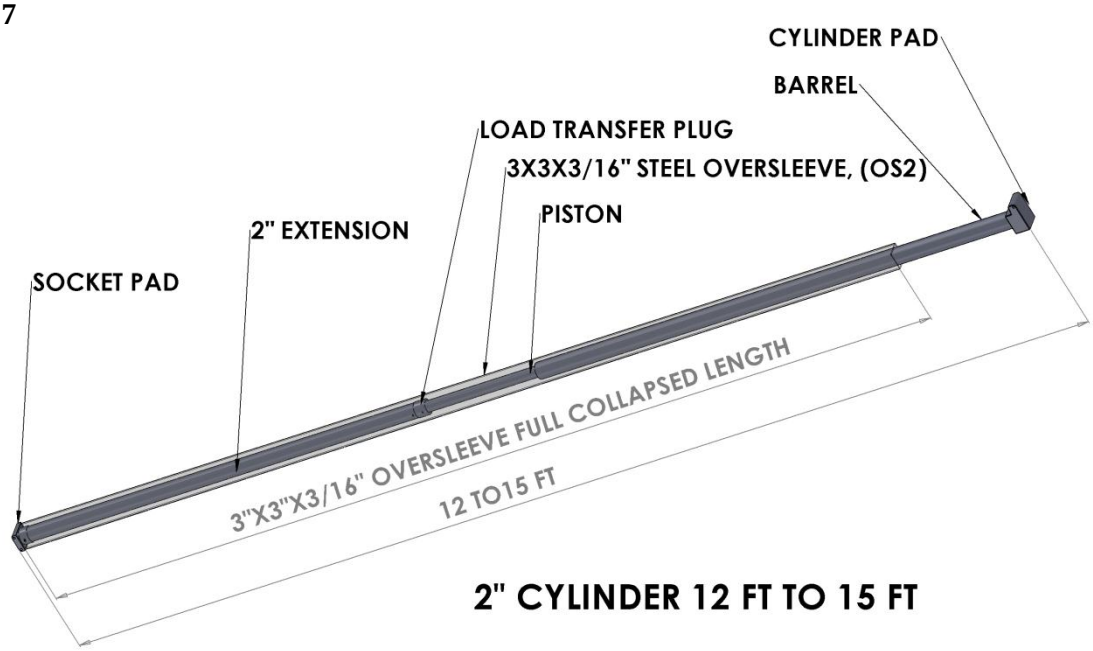


Figure 8

Vertical Aluminum Hydraulic Shore Installation and Removal Procedure

Required for installation

- Vertical Hydraulic Jack
- Pump with fluid and operating pressure gauge
- Release tool

Installation Procedure

Step 1 Attach hydraulic hose to hydraulic fitting on shore. Open the valve on the pump can so that the shore cannot be pressurized. Set plywood if required and not attached to the shore into trench.

Step 2 Lower shore into trench with folded up blade toward opposite trench wall and hydraulic fitting toward adjacent wall. After the shore is set to elevation, hold adjacent blade in place with release tool and let go of opposite blade allowing it to completely unfold and lock into position. In order for the shore to lock into position, the cylinder must be 90 degrees from the blade. Heavy or wide shores that cannot be safely lifted by one person should be set in with lifting equipment such as backhoe, boom truck or crane.

Step 3 Close the valve on the pump can and pressurize the hydraulic shore to between 750 and 1500 psi. Pressure gauge should hold at pressure and not indicate any loss of pressure.

Step 4 Remove the hydraulic hose by prying off with release tool. Clip hose to top of pump to prevent contamination by dragging it in the dirt. Move to next shore location and repeat process.

While trench shores are in place

- Check at least at start of shift for loose shores. This can be done by tapping the top of the shore with a metal rod; it will sound loose, sort of like kicking a tire to see if it is flat. Remove and replace loose shores.
- Check for sloughing or raveling. If it is occurring, sheeting must be used.
- Confirm that soil classification has not changed.

Required for Removal

- Vertical Hydraulic shore
- Release tool
- Removal tool or lifting equipment

Removal Procedure

Step 1 Place release tool over hydraulic fitting and removal hook in handle on opposite blade.

Step 2 Push release tool away to release fluid and pressure. Pull up on the removal hook to fold the shore up and then lift it out of trench.

Note - Depending on the length of the shore and width of the trench different installation procedures may be used. It is the responsibility of the contractor and his competent person to establish a safe installation and removal procedure for each application. All trench shore installers shall be instructed in the procedure prior to installing the shores.

Installation steps for use of Vertical Aluminum Hydraulic Trench Shores

Step 1 - Determine trench shoring requirements (Figure 9)

- Trench Depth
- Trench Width
- Trench Length

Note - Dewatering must be to the bottom of the excavation

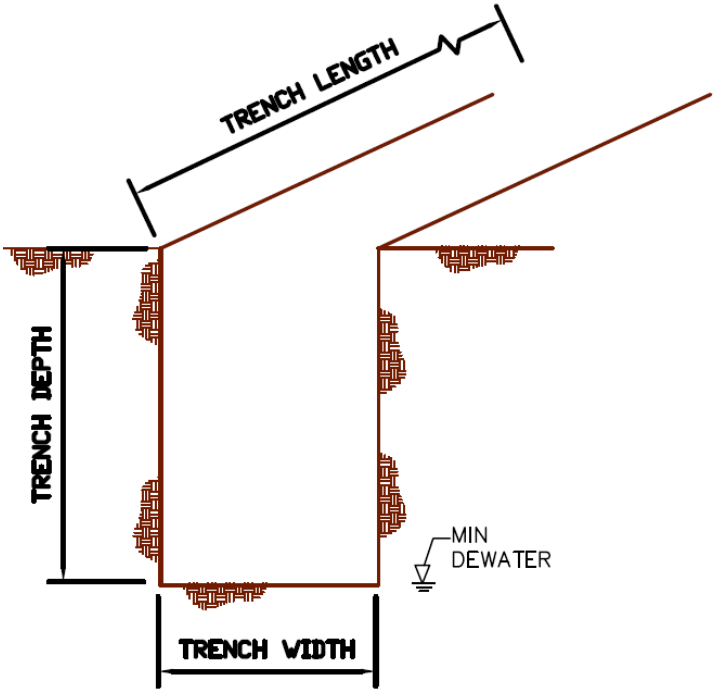


Figure 9 - Trench Parameters

Step 2 - Determine soil type in conformance with OSHA Appendix A

- **Type A-25 Sloping ¾ :1**
- **Type B-45 Sloping 1:1**
- **Type C-60 Sloping 1-1 ½ :1**

Hydraulic Shores cannot be used in Type C-80 soil

Step 3 - Determine horizontal shore spacing (Figure 10)

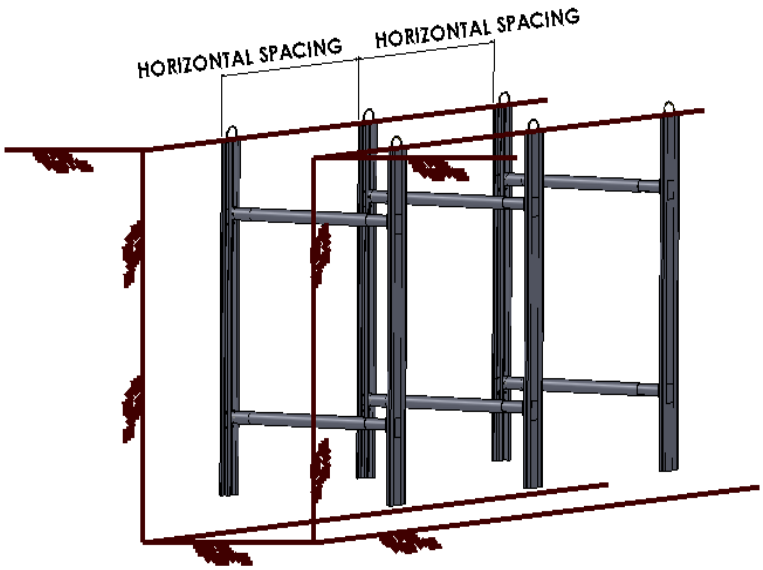


Figure 10 - Horizontal

Table 5 Notes

1. A competent person must decide whether trenches under 5 ft deep are stable or will require shoring.
2. Aluminum hydraulic shores are not allowed at any spacing in C-80 soil

Table 5-HORIZONTAL SHORE SPACING			
Depth	OSHA Soil Type		
ft	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	6	4
over 15 to 20	8	6	4
over 20 to 25	6	4	3

Step 4 - Determine vertical cylinder spacing (Figure 11)

Table 6-VERTICAL CYLINDER SPACING		
Between	Maximum (ft)	Minimum (ft)
Top cylinder and surface	2	1
Between cylinders (note 3)	4	—
Bottom to first cylinder	4	—
Bottom of trench and lowest element of shoring (note 1)	—	2

Table 6 Notes

1. See OSHA 1926.652 (e) (2) Additional requirements for trench excavations (i)
2. — Indicates no limitation
3. When stacking hydraulic shores do not set hydraulic cylinders more than 4 ft apart

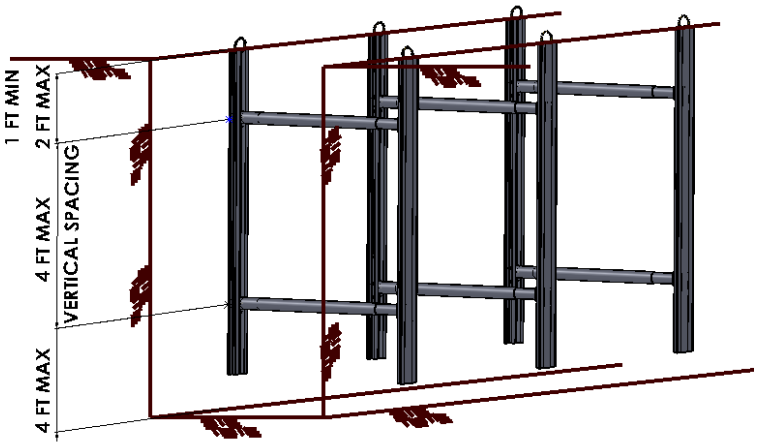


Figure 11 - Vertical

Step 5 - Determine Cylinder size and Oversleeve Requirement for trench width

Table 7-ALLOWABLE TRENCH WIDTH			
Depth	OSHA Type A, B, and C-60		
	Trench Width		
	To 8	8 to 12	12 to 15
(ft)	(ft)	(ft)	(ft)
to 5	2"	2" +OS 1	2" +OS2
over 5 to 10	2"	2" +OS 1	2" +OS2
over 10 to 15	2"	2" +OS 1	2" +OS2
over 15 to 20	2"	2" +OS2	2" +OS2
over 20 to 25	2"	2" +OS2	2" +OS2
Depth	OSHA Type B-45 Soil		
	Trench Width		
	To 8	8 to 12	12 to 15
(ft)	(ft)	(ft)	(ft)
to 5	2"	2" +OS 1	2" +OS2
over 5 to 10	2"	2" +OS 1	2" +OS2
over 10 to 15	2"	2" +OS2	2" +OS2
over 15 to 20	2"	2" +OS2	2" +OS2
over 20 to 25	2"	2" +OS2	2" +OS2
Depth	OSHA Type C-60 Soil		
	Trench Width		
	To 8	8 to 12	12 to 15
(ft)	(ft)	(ft)	(ft)
to 5	2"	2" +OS 1	2" +OS2
over 5 to 10	2"	2" +OS 1	2" +OS2
over 10 to 15	2"	2" +OS2	2" +OS2
over 15 to 20	2"	2" +OS2	2" +OS2
over 20 to 25	2"	2" +OS2	2" +OS2
OS 1 =	3" round x 3/16" wall aluminum ovesleeve		
OS2 =	3x3x3/16" wall square steel oversleeve		

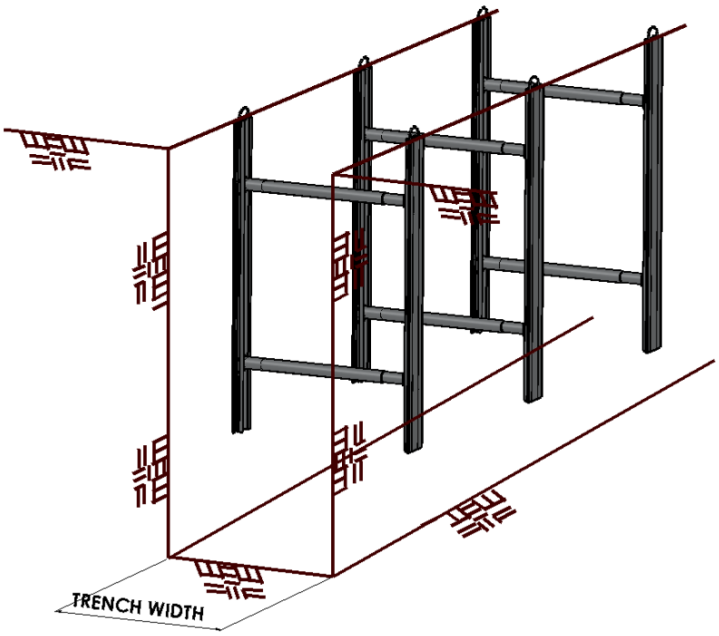


Figure 12 - Trench Width

Step 6 - Determine sheeting requirements (Figure 13)

Table 8-SHEETING REQUIREMENTS			
Depth	OSHA Soil Type		
ft	A	B	C-60
to 8	Not Required	Not Required	Not Required
over 8 to 10	↓	↓	Required
over 10 to 15	↓	↓	↓
over 15 to 20	↓	↓	↓
over 20 to 25	↓	↓	↓

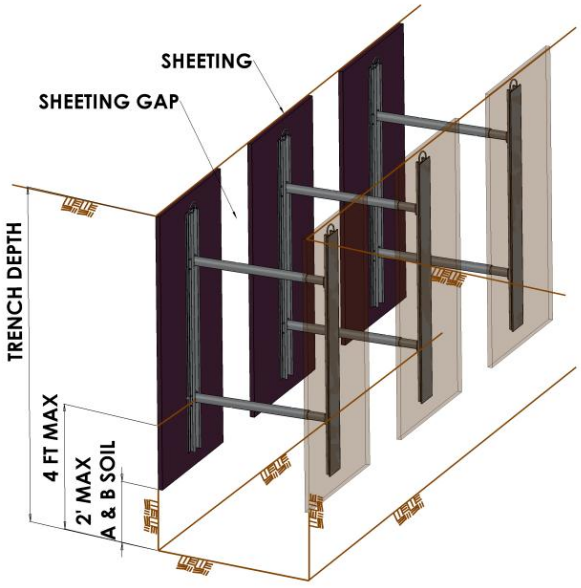


Figure 13 Sheeting Requirements

Table 8 Notes:

1. Sheeting is always required when sloughing or raveling occurs and in C-60 soil over 8' deep.
2. If there is a sheeting gap due to allowable shore spacing, the gap must be reduced until sloughing or raveling is prevented.
3. Sloughing is associated with soft cohesive soil that squeezes around the rail or sheeting. Raveling is associated with non-cohesive soil, sands and gravels that fall off the face of the trench wall. Trench wall face exposure over time can create raveling as moisture cohesion weakens due to drying.
4. Sheeting is not considered a structural part of the shore. Sheeting material requirements are strictly to meet minimum durability and handling requirements.
5. Sheeting may be set separately or connected to the shore.
6. In C-60 soil sheeting shall extend to the bottom of the excavation.
7. See **Table 2** for allowable sheeting material.

Table 2-ALLOWABLE SHEETING				
Plywood				Other Materials
3/4" Finn Form				1/2" thick steel plate 4 ft wide x depth
3/4" Omni Form				Steel sheet piling
3/4" plyform, Class 1 Exterior				Aluminum sheet piling
3/4" HDO, High Debsity Overlay				Buildable box panels
3/4" HDO, High Density Overlay				
3/4" 14 Ply Artic White Birch				
1-1/8" CDX				
2 sheets of 3/4" CDX				
Timber Lagging Set Horizontal				
Thickness	Soil Type/Span			
	A	B	C-60	
2"	4 ft			
3"	5 ft	4 ft		
4"	8 ft	6 ft	4 ft	
DF#2 or Oak				

Step 7 - Stacked Configurations (Figure 14)

- Shores may be stacked vertically as long as the hydraulic cylinders are no more than 4 ft apart
- Shores may be staggered as long as allowable shore spacing is not exceeded

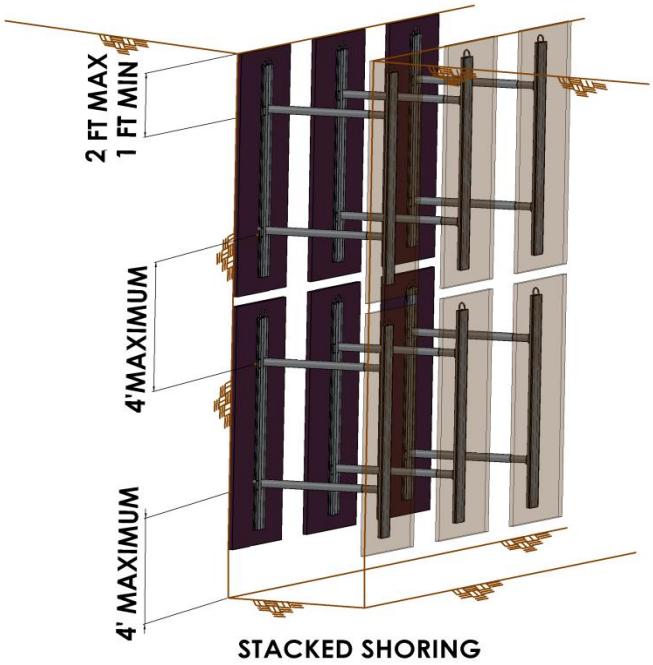
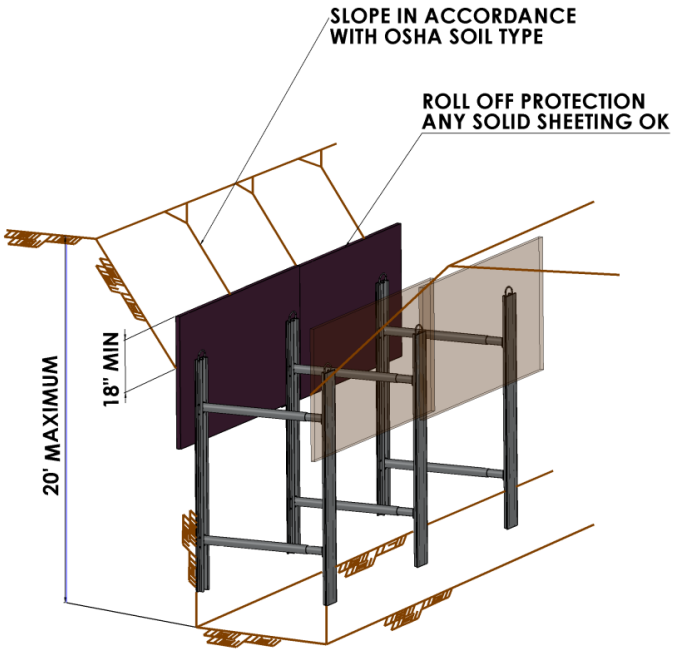
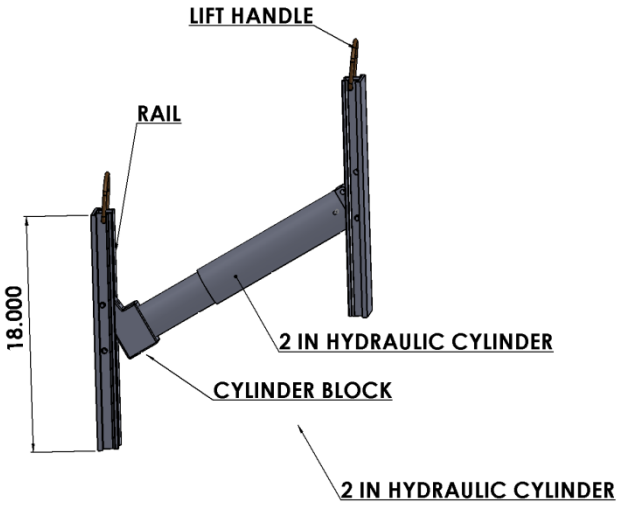


Figure 14

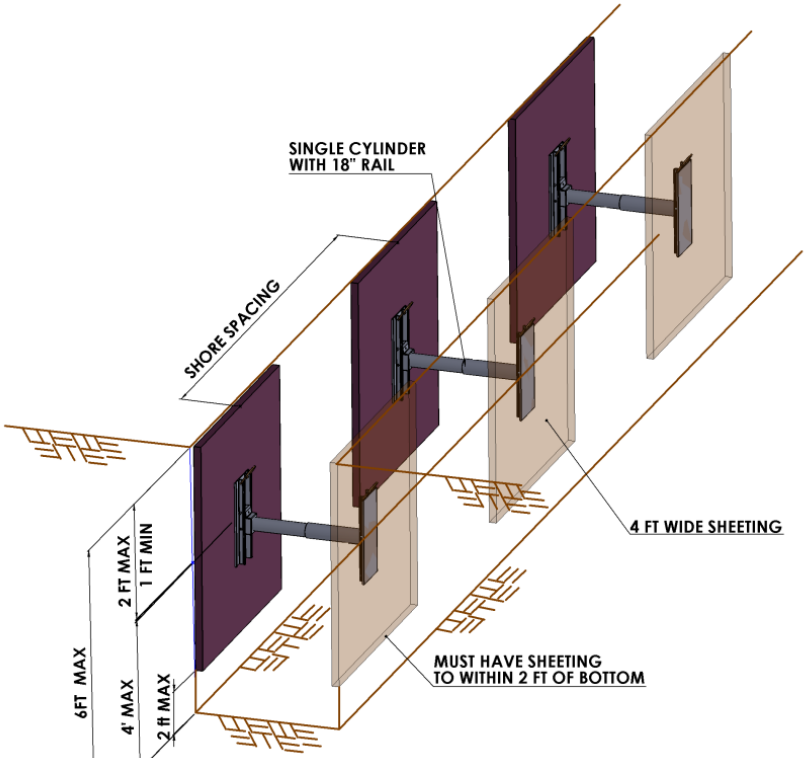
Step 8 - Combined sloping and shoring configurations



Step 9 - Single Hydraulic Shore

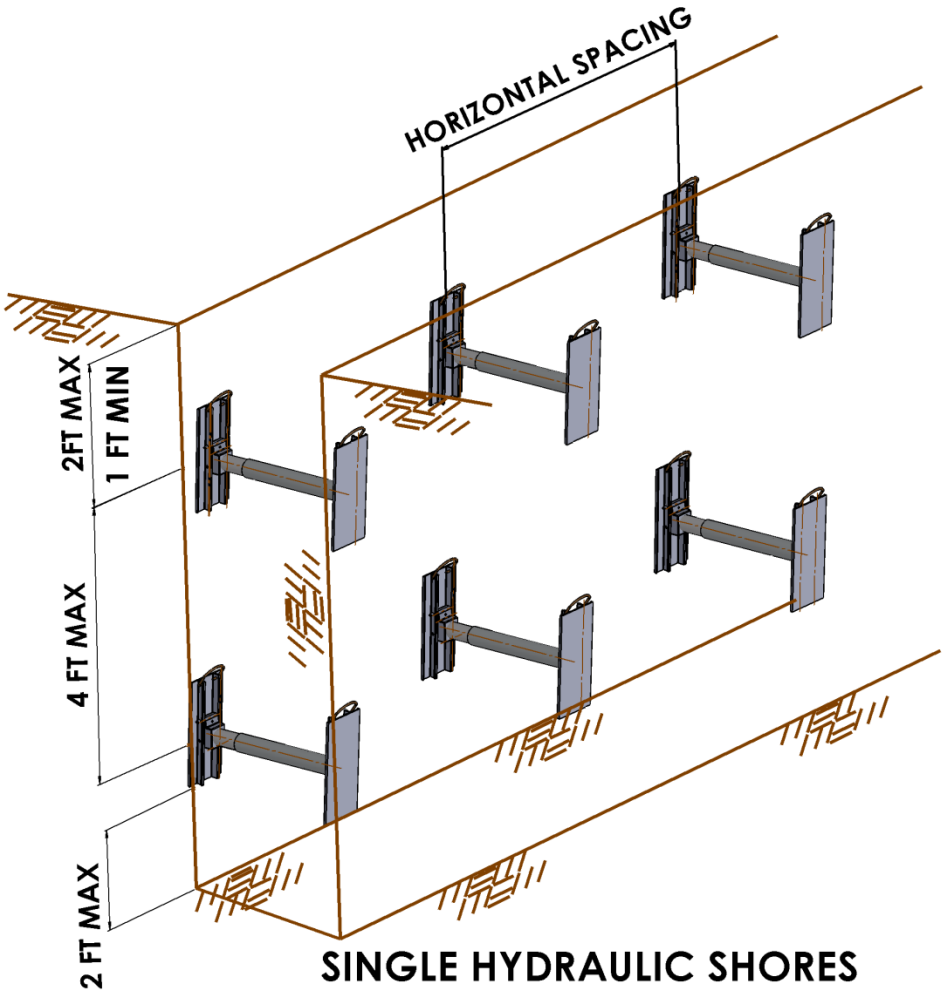


SINGLE HYDRAULIC SHORE



SINGLE HYDRAULIC IN 6 FT MAX TRENCH

TYPE A AND B SOIL ONLY



SINGLE HYDRAULIC SHORES

Safe Handling and Use of Trench Shores

By removing the shoring installer from the unshored trench and making shoring equipment more available and easy to install, trench jacks have no doubt had a huge impact on excavation safety. Utilizing trench jacks for shoring still has safety hazards that users should understand and protect workers from these hazards. These things happen rarely however it is still important that workers be informed of the risks they are taking before placing them at risk. The following are hazards and safety procedures associated with the use of trench jacks

- Injury to back and muscles from lifting heavy objects - An 8 ft long 52x88 extension trench jack weighs approximately 120 lbs. A two-man crew can safely lift, set and remove it from the trench. Anything longer or heavier should be lifted and set with equipment such as a backhoe or boom truck.

- Overhead lifting hazard - When jacks are being hoisted by sling from a tractor bucket or boom truck, the swinging jack presents a hazard to workers guiding it. Loose plywood and rocks can also fall off onto workers. Workers should stand clear and guide with a lead rope.

- Finger and hand protection - Trench jacks have moving parts at the connection between the cylinder and the rail. When the jack swings open fingers can be crushed under the cylinder block and when it is swung closed fingers can easily be sheared off if they are between the block and the rail leg. When the hydraulic hose is being connected to the block, fitting and when the jack is being lifted by hand shearing and crushing is most likely to happen.
  Awareness through safety instruction and hand placement a safe distance, 12", from the blocks is safe practice. Trench jacks may have optional finger guards however, it is still possible to get fingers under the block and wrists cut and banged when the jack folds or unfolds. See **Figure 15.**

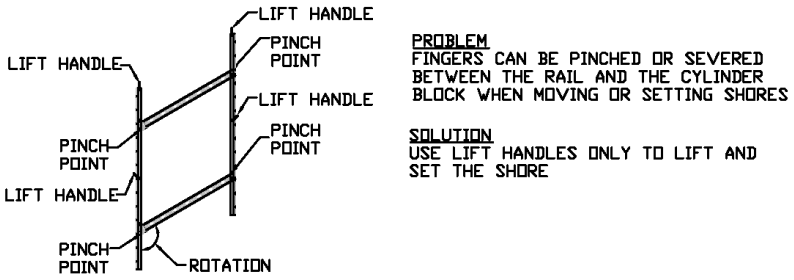


Figure 15. Trench Safety issues

- Bank collapse with worker standing on it - When the jack is being set it is still possible for the trench wall to collapse from the additional weight and activity going on around it. Trench jack installation should closely follow the excavation activity.

  During jack removal, the arch column is being literally removed with the load still on it. Pipe bedding and initial backfill cut the trench depth adding some stability prior to removing the jack. If backfill operations are closely following jack removal, the length of unshored collapsible trench wall becomes short. Soil arching back to the backfilled area is likely and trench wall failure becomes less likely. Remote backfill operation such as

excavator wheel or vibraplate, or remote operated compactors must always be used for compaction outside the shored area. When trench jacks are being removed to allow pipe installation and then reset there is a greater likelihood of trench wall collapse. Equipment and personnel in close proximity are at risk of loosing the ground under their feet. Keep equipment and personnel except those needed to remove the jack a safe distance away. This type of operation is not uncommon and most often works safely, however if there is any evidence of trench wall collapse the operation should be discontinued and a different method of getting production materials into the trench or a different shoring system should be used. Several bad accidents have occurred in conjunction with this type of operation.

- Get the surcharge loads right - Equipment over 20,000 lbs and large spoil piles over 2 ft high quickly add additional surcharges, especially in the top 10 ft, that can easily overload the trench jack. If one cylinder fails, a progressive failure to the bottom of the trench and then down the length of the trench is possible. A boom truck or backhoe outrigger placed next to a trench jack can trigger this. The way to adjust for additional surcharge load is to move the load away from the trench, spread the load with timber pad or steel plate, or decrease the trench jack spacing. Centering the load on the jack, places most of the load on that jack. The alternative, centering the load between the jacks distributes the load evenly between the jacks, however it increases the possibility of the arch void to fall out or arch shear failure at the jack. One alternative may not be any better than the other.

- Trench Jack fold-up failure - If all of the jacks were unfolded into the trench from one side of the trench, it is possible to get a bank failure that can lift the rotating jack leg. This type of failure is not common; however, the author has spoken with more than one worker that has, fortunately from outside the trench, witnessed this type of failure.

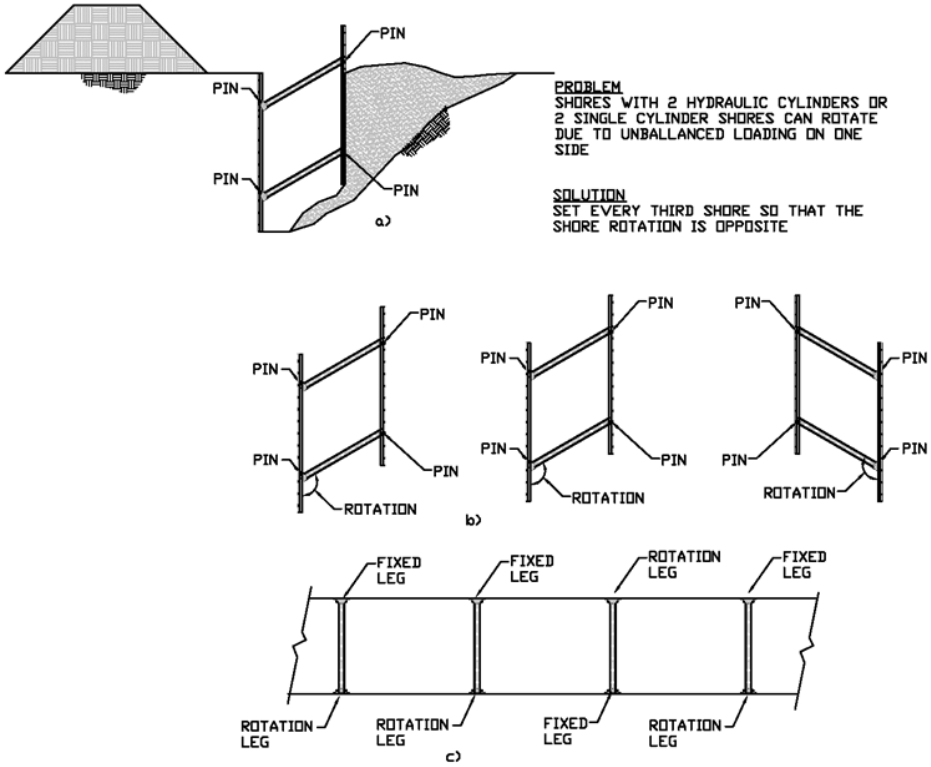


Figure 16. a) Trench jack fold up failure, **b)** leg rotation, **c)** jack rotation to prevent fold up failure

No workers were inside the trench. The story goes that 40 ft of trench folded up the jacks and collapsed. The solution is to rotate the jack so that the rotation leg is on the other side of the trench. The problem is that the installers have to move to the other side of the trench to set and pressurize the jack. Two soil conditions that this would be most likely to happen are in medium dense to loose non-cohesive soils and soft clays with high surcharge loads. See **Figure 16**

- Loose trench jacks in the trench - Jacks that are not pressurized in the trench are not setting up arching and preventing trench collapse. In this condition the jacks can also fall down on workers below them. Jacks should not leak at all. Pressure can change slightly up or down due to temperature changes or increase due to loading however it should never loosen up in the ditch. If jacks are left overnight they should be checked before entering the trench in the morning. Simply tap them with a hammer or bar of metal, they will sound loose if they are. Remove and replace jacks that bleed off.
  If the trench wall has voids where the cylinder hits the wall, use wood blocking to extend the connection to the soil.

- Non-vertical trench walls - Trench walls that are not vertical, an inverted A shape, the trench jack is not stable. Assuming a coefficient of friction of 0.1 between the soil and the aluminum rail and applying a factor of safety of 1.5 calculations indicate that the slope of the trench wall should not exceed 3 degrees or the jack will lift up and fail to provide an arching point.

- In trenches that are sloped above, extending the jack 18" above the hinge point does not provide roll off protection for workers below due to the fact that the jack is spaced. Place fabric or boards behind the jack rail to stop objects at the surface and bank ravel from falling on workers, See **Figure 17**.

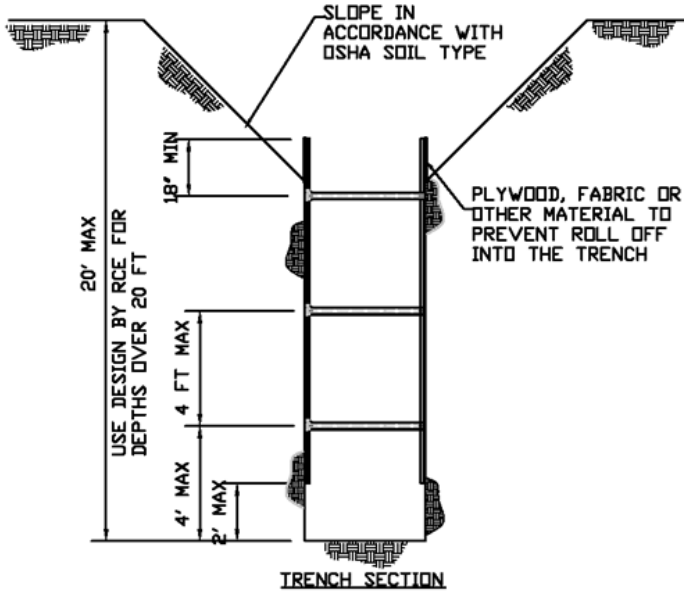


Figure 17. Trench Safety issues

Subpart P Additional Requirements Related to Hydraulic Shoring with Commentary

The following are excerpts from Subpart P that are relative to hydraulic shoring use.

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)(2)(ii)
Installation of a support system shall be closely coordinated with the excavation of trenches.

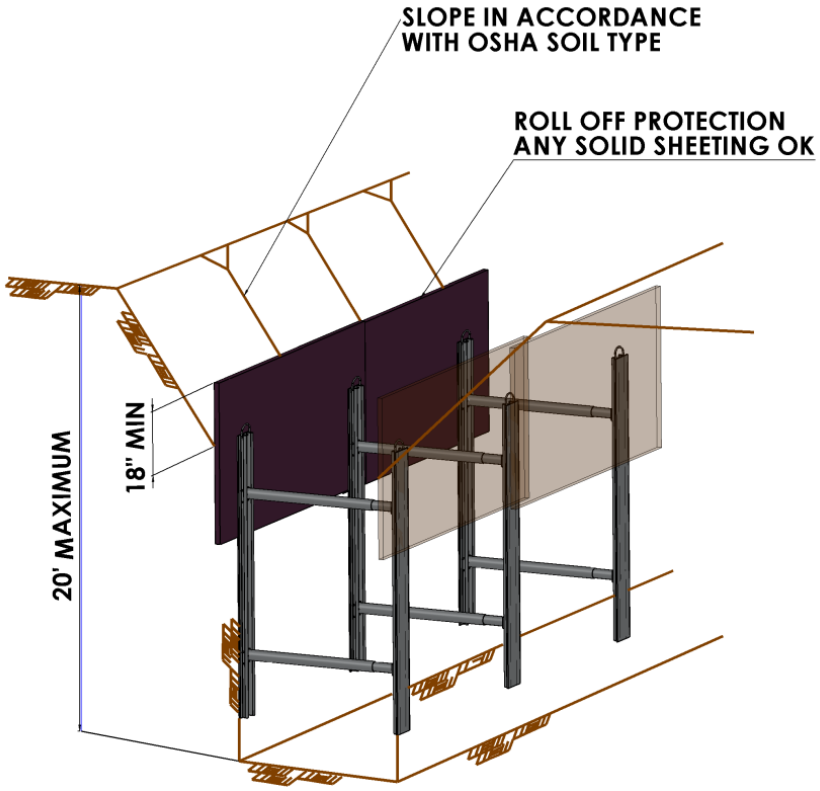
Commentary - Hydraulic shores were developed so that they could be installed and removed from outside the excavation. Cave-in from the surface is still a hazard while installing and removing the shore. Hydraulic shores should be installed as soon as possible after the trench is excavated. This means that if the shores are being installed horizontally at 6 ft on center there should be no more than 6 to 10 ft of trench unshored at any time. It is not acceptable to open a length of trench and then go back and install the shores later.

When hydraulic shores are being removed use caution, stand away from the trench edge and backfill as close to the shore removal location as possible.

It is not allowed to remove and replace a hydraulic shore in order to install production work that will not fit within the shore spacing. If a hydraulic shore is being removed and replaced in order to set pipe into the excavation the soil arching support that was originally set up is being removed similar to removing a column from under an arch. Collapse is imminent and can occur immediately or at the time of resetting the shore.

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.

Commentary - When hydraulic shores are used in sloped excavations without sheeting some form of roll off protection must be provided.



SLOPED 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.

Commentary - Either the rail or the plywood must be within 2 ft of the bottom of the excavation.

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.

Commentary - Daily inspections are required to check for equipment malfunctions.