

UPRIGHT with STRUT and PLYWOOD SYSTEM

TABULATED DATA FOR TRENCH RESCUE SHORING^(Note 1)

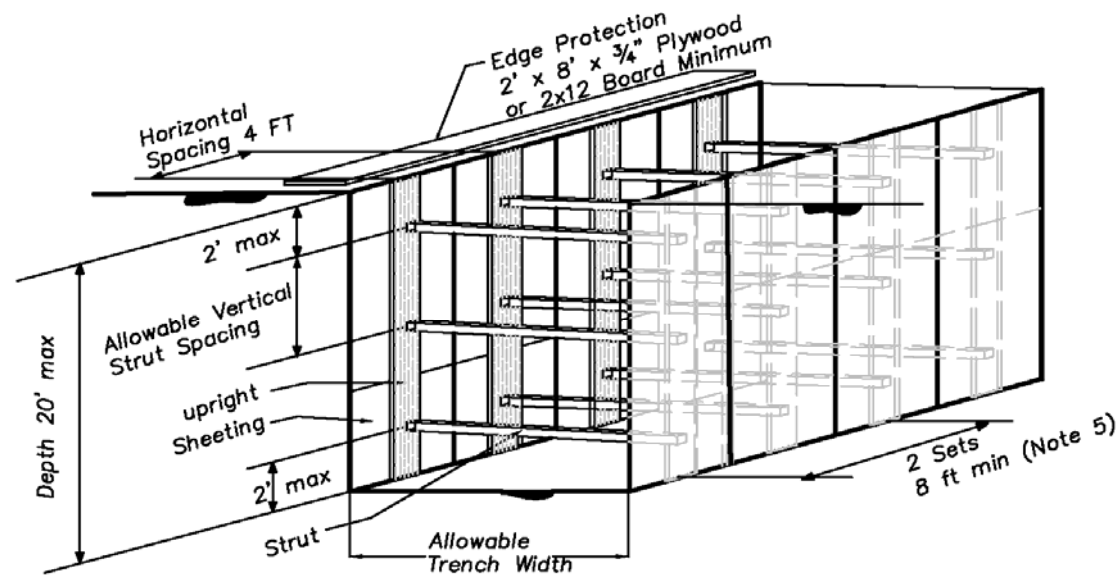
OSHA TYPE C-60 ^(Note 3)

Max Depth (ft)	Upright	Maximum Vertical Strut Spacing (ft)	Maximum horizontal Strut Spacing (ft)	Allowable Trench Width (ft) ^(Note 2)			Sheeting
				Strut			
				4x4	2x4+4x4	2-4x4	
6	2x12	4	4	9	11	13	3/4" CDX plywood
8	2x12	4	4	8	10	11	
10	2x12	4	4	7	9	10	
12	2x12	4	4	7	8	9	
14	2x12	4	4	6	7	9	
16	2x12	4	4	6	7	8	
18	2x12	3	4	6	7	9	
20	2x12	3	4	6	7	8	

OSHA TYPE C-80 ^(Note 4)

Max Depth (ft)	Upright	Maximum Vertical Strut Spacing (ft)	Maximum horizontal Strut Spacing (ft)	Allowable Trench Width (ft) ^(Note 2)			Sheeting
				Strut			
				4x4	2x4+4x4	2-4x4	
6	2x12	4	4	8	10	11	3/4" CDX plywood
8	2x12	4	4	7	8	10	
10	2x12	4	4	6	7	9	
12	2x12	4	4	6	7	8	
14	2x12	3	3	6	7	9	
16	2x12	3	3	6	7	8	
18	2x12	2	2	7	8	9	
20	2x12	2	2	6	7	9	

highlighted green = standard "2-4-2 system"



UPRIGHT with STRUT and SHEETING



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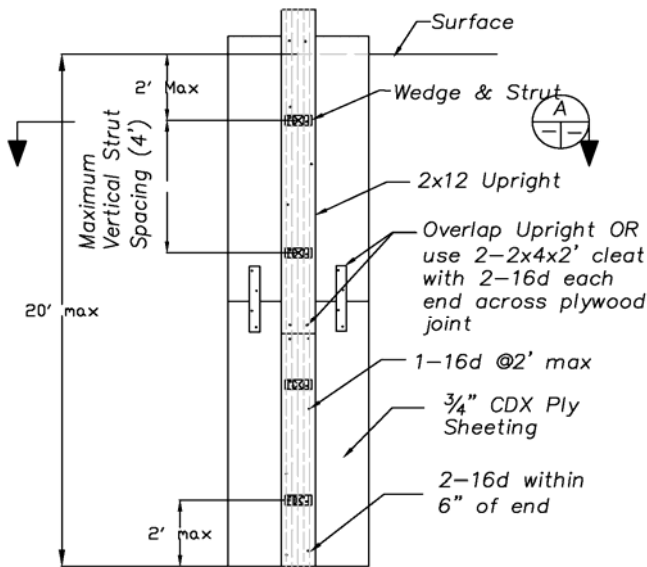
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Construction Engineering Resource, Inc.
1837 Wright Street
Santa Rosa, CA 95404

Job #1373-1	10/1/2013
Drawn by: JT	Sheet 1 of 3

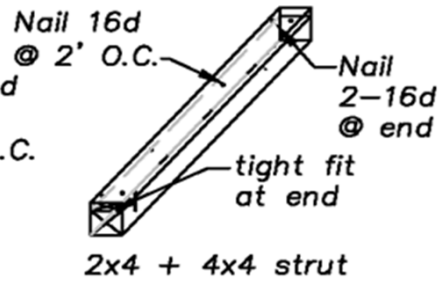
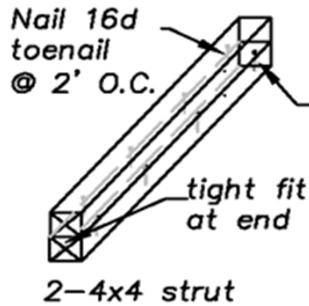
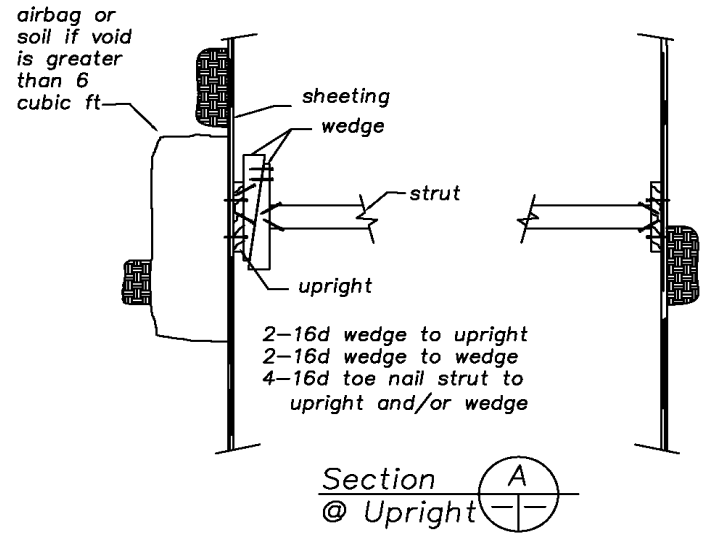
UPRIGHT with STRUT and PLYWOOD SYSTEM

TABULATED DATA FOR TRENCH RESCUE SHORING

Details



Wall Elevation



Framing Notes-

- 1) Use only 1 wedge set, do not stack them.
- 2) General rule for nailing strut connections-use two toe-nails (total 4 nails) on both sides of strut.
- 3) Struts may also be cut-to-fit and driven in without wedges.
- 4) Struts may also be manufactured, see Note 11.



Installation Notes

- 1) Uprights may be nailed to plywood before or after setting plywood into excavation.
- 2) Move spoil pile and obstructions a minimum of 2 ft from trench edge and place edge protection before installing shoring.
- 3) Place ladder within 25 ft of work. Ladder must be secure and accessible.
- 4) While working off a ladder and until top strut is secured, workers may only work within waist level to lip of trench and must be tied off.
- 5) Remove struts from bottom to top. If there is sheeting movement when bottom strut is removed, leave shoring in place and bury or remove with power equipment from outside the trench.

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UPRIGHT with STRUT and PLYWOOD SYSTEM

TABULATED DATA FOR TRENCH RESCUE SHORING

Notes

- 1) This shoring system is in accordance with Cal OSHA Article 6, Section 1541.1(c)(3) Option 3-Designs Using Other Tabulated Data. This tabulation is for the purpose of protecting rescue personnel from cave-ins while rescuing victims of collapsed excavations and trenches, and training and for no other purpose.
- 2) In order to use these tabulations the soil must first be classified as Type C-60 or C-80. The soil loading configuration is rectangular. This means that the soil pressure at the top of the excavation is the same as at the ultimate depth of the excavation. **Read all element size and spacing requirements from the line at the depth the final excavation is expected to be ("original trench depth").**
- 3) C-60 Soil includes all soil types that will stand long enough to install shoring and have a water level at or below the bottom of the excavation.
- 4) Type C-80 soil is soil that will not stand up long enough to install shoring. Generally shoring in C-80 soil has to be installed in short increments or driven into the soil as excavation is taking place. Prior to reaching 12 ft deep in marine clays such as San Francisco "Bay Mud", Gulf States Swamp Mud, etc" an engineer should be consulted. If there is any additional deflection or movement after elements are installed additional upright and strutting may be required.
- 5) Minimum shoring system length is 2 sets. **The general rule for shoring system length is that it should be at least as long as the shoring system is deep.**
- 6) This tabulation includes loading from a spoil pile set back 2 feet from edge of trench and no higher than 4 ft and foot traffic. All heavy equipment and vehicles to be set back at least the depth of the trench.
- 7) Wood members shall be minimum Douglas fir #2 and better, S4S.
- 8) **Plywood shall be minimum 3/4" CD X. Decrease horizontal spacing, double up plywood or decrease upright spacing if deflection is occurring due to soil movement.**
- 9) Install strutting from top to bottom. Nailing can be done in stages by first using enough nails to stabilize shoring and then following through to make sure that required nail quantity is achieved.
- 10) This shoring system may be used in conjunction with Wale with Strut and Plywood System, and Trench End Shore System.
- 11) Alternative manufactured strut systems such as screw jacks, pneumatic struts, and single/double cylinder hydraulic jacks may be substituted for timber struts installed in accordance with their tabulated data.
- 12) If plywood is 3/4" Finform it is OK to eliminate the 2x12 upright and use struts at the tabulated spacing nailed directly to the Finform.
- 13) Two 3/4" CDX plywood sheets may be used in lieu of one sheet of 3/4" CDX with a 2x12 upright.
- 14) Aluminum fire service ladders with 4x4 cribbing may be used as an upright or waler. (see CMC Trench Rescue Manual)



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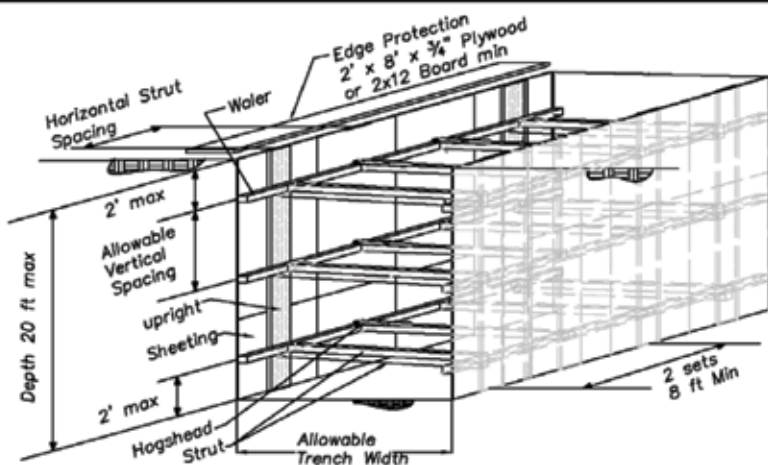
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Tabulated Data for Trench Rescue Shoring

WALE with STRUT and PLYWOOD SYSTEM													
TABULATED DATA FOR TRENCH RESCUE SHORING (Note 1)													
OSHA TYPE C-60 (Note 3)													
Max Depth (ft)	Upright	Maximum Vertical Strut Spacing (ft)	Maximum Horizontal Strut Spacing and Trench Width (ft) ^(Note 2)										Sheeting
			Strut Spacing (ft)		Allowable Trench Width (ft)			Strut Spacing (ft)		Allowable Trench Width (ft)			
			Wale Size		Strut			Wale Size		Strut			
			2 x 12	4x4	4x4	2x4+4x4	2-4x4	6x6	4x4	2x4+4x4	2-4x4		
6	2x12	4	5	6	8	9	11	10	5	6	8	3/4" CDX plywood	
8	2x12	4	4	5	7	9	10	10	5	6	7		
10	2x12	4	3	4	7	9	10	9	5	6	7		
12	2x12	4	3	4	7	8	9	8	5	6	7		
14	2x12	4	3	4	6	7	9	7	0	5	6		
16	2x12	4	3	4	6	7	8	7	0	5	6		
18	2x12	3	3	4	6	7	9	7	0	5	6		
20	2x12	3	3	4	6	7	8	7	0	5	6		
OSHA TYPE C-80 (Note 4)													
Max Depth (ft)	Upright	Maximum Vertical Strut Spacing (ft)	Maximum Horizontal Strut Spacing and Trench Width (ft) ^(Note 2)										Sheeting
			Strut Spacing (ft)		Allowable Trench Width (ft)			Strut Spacing (ft)		Allowable Trench Width (ft)			
			Wale Size		Strut			Wale Size		Strut			
			2 x 12	4x4	4x4	2x4+4x4	2-4x4	6x6	4x4	2x4+4x4	2-4x4		
6	2x12	4	3	4	8	9	11	7	5	6	7	3/4" CDX plywood	
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20	2x12	3	2	2.5	6	7	8	5	0	5	5		

highlighted green = standard "2-4-2 system"

WALE with STRUT and PLYWOOD

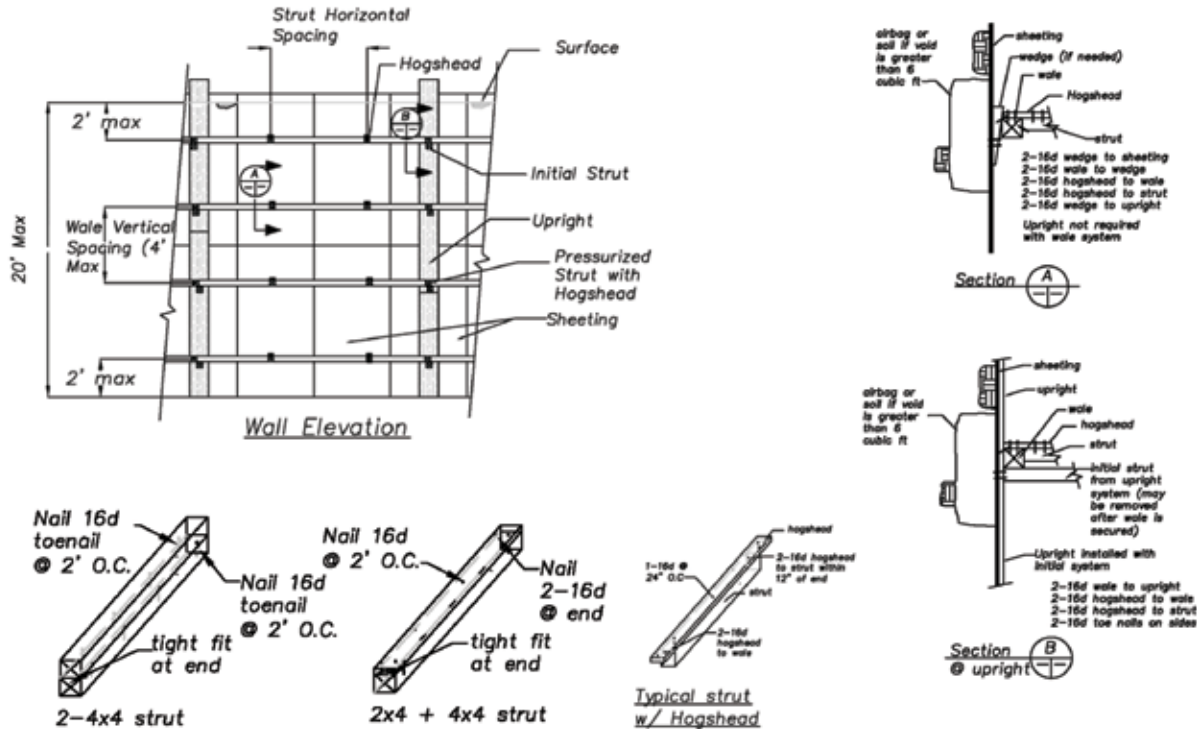
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Job #1373-2	10/1/2013					
Drawn by: JT	Sheet 1 of 3					



Tabulated Data for Trench Rescue Shoring

WALE with STRUT and PLYWOOD SYSTEM

TABULATED DATA FOR TRENCH RESCUE SHORING



Framing Notes-

- 1) Use only 1 wedge set, do not stack them.
- 2) General rule for nailing strut connections-use two toe-nails (total 4 nails) on both sides of strut.
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Installation Notes

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Drawn by: JT	Sheet 2 of 3



Tabulated Data for Trench Rescue Shoring


WALE with STRUT and PLYWOOD SYSTEM						
TABULATED DATA FOR TRENCH RESCUE SHORING						
<p>Notes</p> <ol style="list-style-type: none"> 1) This shoring system is in accordance with Cal OSHA Article 6, Section 1541.1(c)(3) Option 3-Designs Using Other Tabulated Data. This tabulation is for the purpose of protecting rescue personnel from cave-ins while rescuing victims of collapsed excavations and trenches, and training and for no other purpose. 2) In order to use these tabulations the soil must first be classified as Type C-60 or C-80. The soil loading configuration is rectangular. This means that the soil pressure at the top of the excavation is the same as at the ultimate depth of the excavation. Read all element size and spacing requirements from the line at the depth the final excavation is expected to be ("original trench depth"). 3) C-60 Soil includes all soil types that will stand long enough to install shoring and have a water level at or below the bottom of the excavation. 4) Type C-80 soil is soil that will not stand up long enough to install shoring. Generally shoring in C-80 soil has to be installed in short increments or driven into the soil as excavation is taking place. Prior to reaching 12 ft deep in marine clays such as San Francisco "Bay Mud", Gulf States Swamp Mud, etc" an engineer should be consulted. If there is any additional deflection or movement after elements are installed additional upright and strutting may be required. 5) Minimum shoring system length is 2 sets. The general rule for shoring system length is that it should be at least as long as the shoring system is deep. 6) This tabulation includes loading from a spoil pile set back 2 feet from edge of trench and no higher than 4 ft and foot traffic. All heavy equipment and vehicles to be set back at least the depth of the trench. 7) Wood members shall be minimum Douglas fir #2 and better, S4S. 8) Plywood shall be minimum 3/4" CD X. Decrease horizontal spacing, double up plywood or decrease upright spacing if deflection is occurring due to soil movement. 9) Install strutting from top to bottom. Nailing can be done in stages by first using enough nails to stabilize shoring and then following through to make sure that required nail quantity is achieved. 10) This shoring system may be used in conjunction with Upright with Strut and Plywood System, and Trench End Shore System. 11) Alternative manufactured strut systems such as screw jacks, pneumatic struts, and single/double cylinder hydraulic jacks may be substituted for timber struts installed in accordance with their tabulated data. 12) If plywood is 3/4" Finform it is OK to eliminate the 2x12 upright and use struts at the tabulated spacing nailed directly to the Finform. 13) Two 3/4" CDX plywood sheets may be used in lieu of one sheet of 3/4" CDX with a 2x12 upright. 14) Aluminum fire service ladders with 4x4 cribbing may be used as an upright or waler. (see CMC Trench Rescue Manual) 						
<p style="text-align: center;">California State Fire Training 1131 S. Street Sacramento, Ca. 95811</p>		<div style="text-align: center;"> <p>CER. Inc. Construction Engineering Resource, Inc. 1837 Wright Street Santa Rosa, Ca. 95404</p> </div> <table border="1" style="width: 100%; margin-top: 5px;"> <tr> <td style="padding: 2px;">Job #1373-2</td> <td style="padding: 2px;">10/1/2013</td> </tr> <tr> <td style="padding: 2px;">Drawn by: JT</td> <td style="padding: 2px;">Sheet 3 of 3</td> </tr> </table>	Job #1373-2	10/1/2013	Drawn by: JT	Sheet 3 of 3
Job #1373-2	10/1/2013					
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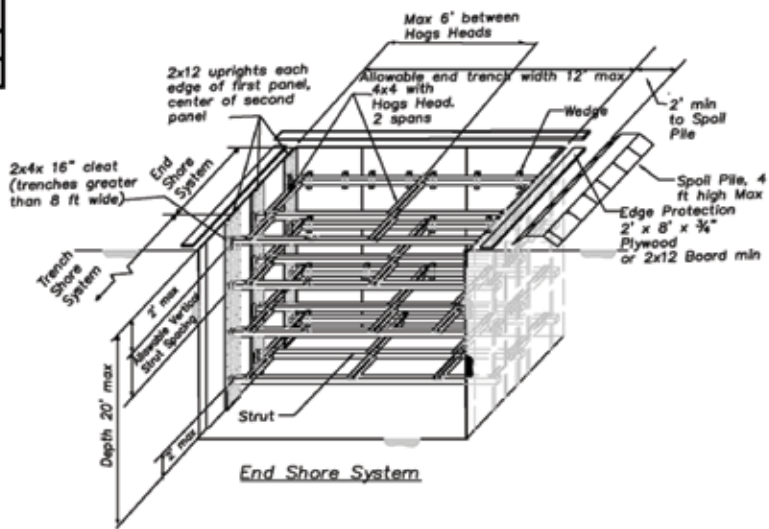



Tabulated Data for Trench Rescue Shoring

TRENCH END SHORE SYSTEM																
TABULATED DATA FOR TRENCH RESCUE SHORING (Note 1)																
OSHA TYPE C-60 (Note 3)																
Max Depth (ft)	Wale / Strut Vertical Spacing (ft)															
	Trench Width															
	5 ft			6 ft			8 ft			10 ft			12 ft			
	Strut			Strut			Strut			Strut			Strut			
	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	
6	4	4	4	4	4	4	2	3	4	1	2	4	0	1	4	
8	4	4	4	4	4	4	2	3	4	1	1	4	0	1	3	
10	4	4	4	4	4	4	2	2	4	1	1	4	0	0	3	
12	4	4	4	3	4	4	1	2	4	1	1	4	0	0	2	
14	3	4	4	2	3	4	1	1	4	1	0	3	0	0	2	
16	3	4	4	2	3	4	1	1	4	0	0	3	0	0	1	
18	2	3	4	1	2	4	1	1	4	0	0	2	0	0	1	
20	2	3	4	1	2	4	1	1	3	0	0	2	0	0	1	
OSHA TYPE C-80 (Note 4)																
Max Depth (ft)	Wale / Strut Vertical Spacing (ft)															
	Trench Width															
	5 ft			6 ft			8 ft			10 ft			12 ft			
	Strut			Strut			Strut			Strut			Strut			
	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	4x4	2x4+4x4	2-4x4	
6	4	4	4	3	4	4	2	4	4	0	2	4	0	1	2	
8	4	4	4	2	4	4	2	4	4	0	1	3	0	1	2	
10	3	4	4	2	4	4	1	3	4	0	1	2	0	0	2	
12	2	4	4	1	4	4	1	2	4	0	0	2	0	0	2	
14	2	4	4	1	4	4	1	2	3	0	0	2	0	0	1	
16	1	4	4	1	3	4	1	1	3	0	0	1	0	0	1	
18	1	3	4	1	3	3	0	1	2	0	0	1	0	0	1	
20	1	2	4	1	2	3	0	1	2	0	0	1	0	0	1	

Sheeting (Note 8) C-60 and C-80	
end wall	3/4" CDX with shims at each wale/strut
side wall	3/4" CDX with 2x12 upright

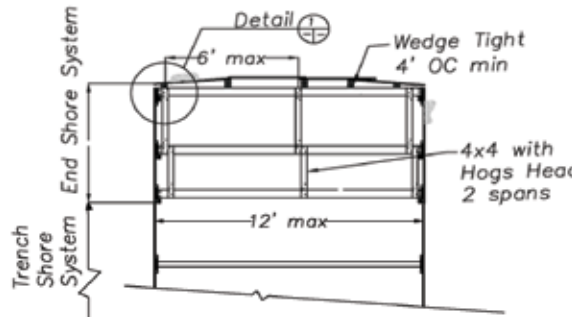
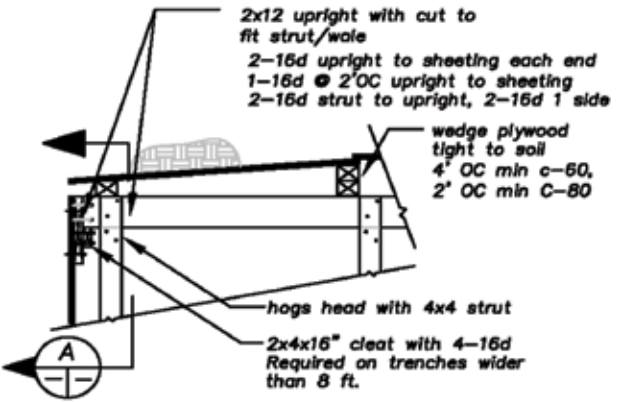
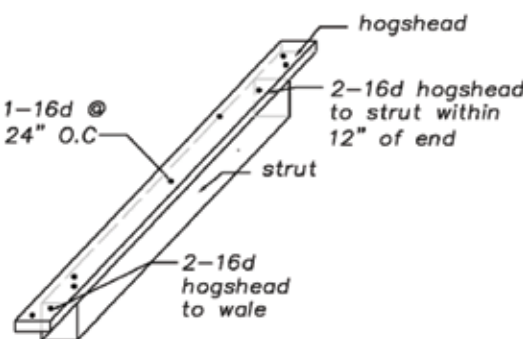
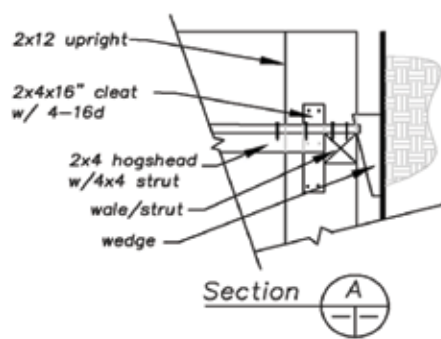
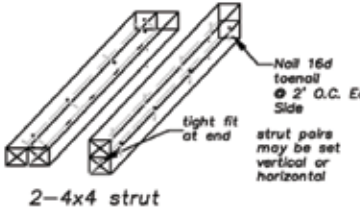
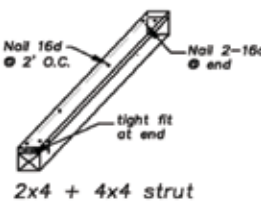





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		10/1/2013 Sheet 1 of 3




Tabulated Data for Trench Rescue Shoring

TRENCH END SHORE SYSTEM		
TABULATED DATA FOR TRENCH RESCUE SHORING		
<p>Details</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">  <p style="text-align: center;"><i>Plan View End Shore System</i></p> </div> <div style="width: 45%;">  <p style="text-align: center;"><i>Detail 1</i></p> </div> </div> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;">  <p style="text-align: center;"><i>Typical Hoghead Strut</i></p> </div> <div style="width: 45%;">  <p style="text-align: center;"><i>Section A</i></p> </div> </div> <div style="display: flex; justify-content: space-around;"> <div style="width: 45%;">  <p style="text-align: center;"><i>2-4x4 strut</i></p> </div> <div style="width: 45%;">  <p style="text-align: center;"><i>2x4 + 4x4 strut</i></p> </div> </div>		
<p>California State Fire Training 1131 S. Street Sacramento, Ca. 95811</p>		<p style="text-align: center;">CER, Inc. Construction Engineering Resource 1837 Wright St. Santa Rosa, Ca. 95404</p>
Job #1373-3	10/1/2013	Sheet 2 of 3
Drawn by: JT		



Tabulated Data for Trench Rescue Shoring

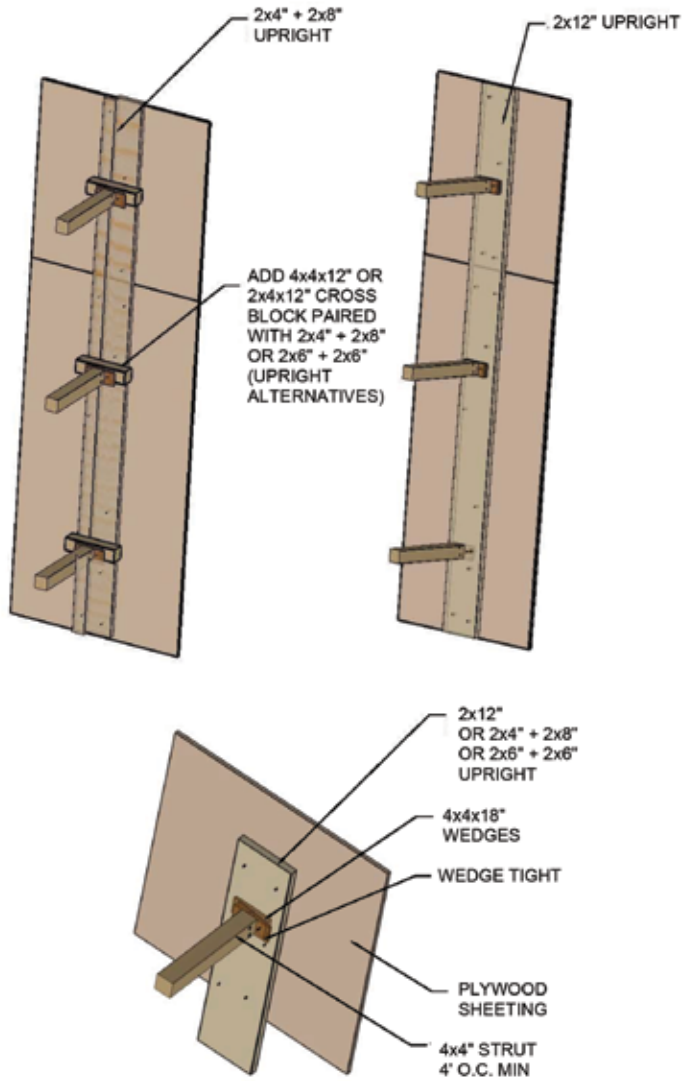
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TABULATED DATA FOR TRENCH RESCUE SHORING						
<p>Notes</p> <ol style="list-style-type: none"> 1) This shoring system is in accordance with Cal OSHA Article 6, Section 1541.1(c)(3) Option 3-Designs Using Other Tabulated Data. This tabulation is for the purpose of protecting rescue personnel from cave-ins while rescuing victims of collapsed excavations and trenches, training and for no other purpose. 2) In order to use these tabulations the soil must first be classified as Type C-60 or C-80. The soil loading configuration is rectangular. This means that the soil pressure at the top of the excavation is the same as at the ultimate depth of the excavation. Read all element size and spacing requirements from the line at the depth the final excavation is expected to be ("original trench depth"). 3) C-60 Soil includes all soil types that will stand long enough to install shoring and have a water level at or below the bottom of the excavation. 4) Type C-80 soil is soil that will not stand up long enough to install shoring. Generally shoring in C-80 soil has to be installed in short increments or driven into the soil as excavation is taking place. Prior to reaching 12 ft deep in marine clays such as San Francisco "Bay Mud", Gulf States Swamp Mud, etc" an engineer should be consulted. If there is any additional deflection or movement after elements are installed additional upright and strutting may be required. 5) Minimum shoring system length is 2 sets. The general rule for shoring system length is that it should be at least as long as the shoring system is deep. 6) This tabulation includes loading from a spoil pile set back 2 feet from edge of trench and no higher than 4 ft and foot traffic. All heavy equipment and vehicles to be set back at least the depth of the trench. 7) Wood members shall be minimum Douglas fir #2 and better, S4S. 8) Plywood shall be minimum 3/4" CD X. Decrease horizontal spacing, double up plywood or decrease upright spacing if deflection is occurring due to soil movement. 9) Install strutting from top to bottom. Nailing can be done in stages by first using enough nails to stabilize shoring and then following through to make sure that required nail quantity is achieved. 10) This shoring system may be used in conjunction with Upright with Strut and Plywood, and Wale with Strut and Plywood System. 11) Alternative manufactured strut systems such as screw jacks, pneumatic struts, and single/double cylinder hydraulic jacks may be substituted for timber struts installed in accordance with their tabulated data. 12) If plywood is 3/4" Finform it is OK to eliminate the 2x12 upright and use struts at the tabulated spacing nailed directly to the Finform. 13) Two 3/4" CDX plywood sheets may be used in lieu of one sheet of 3/4" CDX with a 2x12 upright. 14) Aluminum fire service ladders with 4x4 cribbing may be used as an upright or waler. (see CMC Trench Rescue Manual) <p>Framing Notes-</p> <ol style="list-style-type: none"> 1) Use only 1 wedge set, do not stack them. 2) General rule for nailing strut connections-use two toe-nails (total 4 nails) on both sides of strut. 3) Struts may also be cut-to-fit and driven in without wedges, or Ellis post screw jacks may be used. 4) Struts may also be manufactured, see Note 11. <p>Installation Notes</p> <ol style="list-style-type: none"> 1) Uprights may be nailed to plywood before or after setting plywood into excavation. 2) Move spoil pile and obstructions a minimum of 2 ft from trench edge and place edge protection before installing shoring. 3) Place ladder within 25 ft of work. Ladder must be secure and accessible. 4) While working off a ladder and until top strut is secured, workers may only work within waist level to lip of trench and must be tied off. 5) Remove struts from bottom to top. If there is sheeting movement when bottom strut is removed, leave shoring in place and bury or remove with power equipment from outside the trench. 						
<p style="text-align: center;">California State Fire Training 1131 S. Street Sacramento, Ca. 95811</p>		<p style="text-align: center;">CER, Inc. Construction Engineering Resource 1837 Wright St. Santa Rosa, Ca. 95404</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="padding: 2px;">Job #1373-3</td> <td style="padding: 2px;">10/1/2013</td> </tr> <tr> <td style="padding: 2px;">Drawn by: JT</td> <td style="padding: 2px;">Sheet 3 of 3</td> </tr> </table>	Job #1373-3	10/1/2013	Drawn by: JT	Sheet 3 of 3
Job #1373-3	10/1/2013					
Drawn by: JT	Sheet 3 of 3					



Tabulated Data for Trench Rescue Shoring

ALTERNATIVE for UPRIGHT

TABULATED DATA FOR TRENCH RESCUE SHORING^(Note 1)



Sketch 1

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Tabulated Data for Trench Rescue Shoring

CER, INC

Engineering Consulting

CONSTRUCTION ENGINEERING RESOURCE, INC

Construction Management

Claims Analysis

July 3, 2012

To: Firescope US&R Specialist Working Group

Attn: Battalion Chief Mark Brown, Chair

Re: 2x12 uprights and OSHA Subpart P Options 3 and Option 4

Question-Why is the use of the rescue shoring application tabulated data used under OSHA Option 3-other tabulated data instead of Option 4 design by a registered civil engineer.

The short answer is:

Under option 3 designs utilizing tabulated data are configured by a competent person at the site utilizing tabulated information. The tabulated information can be utilized to develop a shoring system at any location. The tabulated data is developed and stamped by a registered engineer but the engineer is not necessarily involved in deciding the configuration of the shoring system.

Under option 4 design by a civil engineer the plan and shoring configuration is developed by a registered engineer and is specific to the site. The person constructing the shoring system follows the plan. Under this option there would have to be a civil engineer called in for every trench rescue situation. Also it is important to note that if the trench rescue shoring configuration needs to be altered or different than shown on the tabulated data an engineer must approve the changes.

From the OSHA oversight perspective with option 3 they look to see that the person that configured the shoring system adhered to the tabulated data and under option 4 they look to see if the engineered plan was adhered to.

I am attaching a document, **CALIFORNIA TRENCH RESCUE SHORING, DRAFT DEVELOPMENT OF TABULATED DATA**. I have been developing this document as this project has proceeded and is intended to be the basis for the shoring system we are developing.

Question-Can we use 2x8 uprights instead of 2x12 uprights.

Timber strutted trench shoring systems are based on soil arching between rigid elements of the shoring. The plywood sheeting is the least rigid and the timber or metal strut is the most rigid. The rigidity of the upright affects the rigidity of the sheeting and the effectiveness of the soil arching to transmit the loads ultimately to the struts. The following are the factors that determine that a 2x12 is required and a 2x8 is insufficient.

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Tabulated Data for Trench Rescue Shoring

CER, INC

Engineering Consulting

CONSTRUCTION ENGINEERING RESOURCE, INC

Construction Management

Claims Analysis

April 30, 2014

To: Stan Klopfenstein
Executive Director
Regional Training Group
Los Angeles Area Fire Chief's Assn.

Attn: Stan Klopfenstein

Re: Letter of 6/3/12-Firescope US&R Specialist Working Group
2x12 uprights and OSHA Subpart P Options 3 and Option 4

Stan;

This is in further response to the referenced letter and questions.

As stated in the letter the upright should be minimum 2x12. As shown in attached sketch it is also ok to use a 2x8 and 2x4 or 2-2x6 with a 4x4 or 2x4 cross block. This configuration provides equivalent shear and bending strength as the 2x12.

The tabulated data for this project was developed utilizing allowable stress design with timber values from the National Design Specifications for Wood Construction, 2005 edition, NDS developed by the The American Forest and Paper Association. These are the same standards adopted by all US building codes.

The soil loading values are developed utilizing apparent earth pressure theories developed by Terzaghi, Peck and Hanson. Engineering judgement is applied and drawn from over 25 years of experience in excavation shoring system design.

Best Regards

Joe Turner



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Tabulated Data for Trench Rescue Shoring

CER, INC - CONSTRUCTION ENGINEERING RESOURCE, INC

- The 2x12 cuts the plywood free span to 18.25" and the 2x8 provides a free span of 20.25". The rigidity of the plywood is increased by 25% with the 2x12 upright.
- The upright must have sufficient shear and bending strength to with stand soil loading. Utilizing allowable bending and shear strength for Douglas Fir boards a 2x12 has sufficient section strength to support a C-80 soil load between the struts and a 2x8 does not.

Also as a durability issue the 2x12 will not fail during lifting and shore installation while it is possible for a 2x8 to break in two during lifting of a long shoring set.

You are welcome to contact me at this e-mail or my phone (707) 484-4704 if you have further questions regarding this.

Best Regards

Joe Turner

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