

This Field Operations Guide contains specific information on technical rescue procedures.

THIS GUIDE IS NOT ALL INCLUSIVE!

It is intended to be used as a tool for training and for quick field reference. Refer to current training manuals and your department policies for detailed explanations. There is no substitute for regular, quality, hands-on training by a qualified instructor.



The techniques and procedures illustrated in this guide follow NFPA standards and OSHA regulations as much as possible. This guide can be used by rescuers at all skill levels but was specifically developed for fully qualified technical rescue technicians. Special operations are inherently dangerous and serious injury or fatality may result from improper performance of these techniques. The author accepts no responsibility for damage, loss, injury or death resulting from information contained in or omitted from this guide.

Thanks to the Phoenix Fire Department and everyone who helped make this guide possible. Special thanks to my friend Ron Jamison for helping to write this guide, Kathy Darrow for editing and to George Drees, Ken Phillips and Jim Frank for great ideas and input.

This guide is dedicated to all those people who go the extra inch every day to make themselves better rescuers.

This handbook is based on the Phoenix Fire Department and Arizona State Fire Marshall's Office technical rescue programs.

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Trench Rescue Command Checklist

Phase I: Size-up

- Primary assessment
 - Secure witness or competent person
 - Identify immediate hazards
 - Location, number, condition of victims
 - Rescue or recovery
- Secondary assessment
 - Trench collapse yes no
 - Proper equipment and personnel on scene
 - Additional resources necessary: ventilation, shoring, retrieval system

Phase II: Pre-Entry Operations

- Make general area safe
 - Traffic control
 - Crowd control
 - Heavy equipment shut down
 - Establish zones: hot, warm, cold
- Make rescue area safe
 - Establish lobby control accountability
 - Secure hazards: gas, electric, utilities
 - De-water trench
 - Monitor atmosphere
 - Ventilate

Phase III: Rescue Operations

- Make trench lip safe
 - Assess spoil pile
 - Approach from ends
 - Place ground pads
- Make trench safe
 - Access/egress ladders less than 50 ft. (15m) apart
 - Protective system; sloping, hydraulic, timber, other
 - Create safety zones
 - Remove dirt: extend safety zones.

- Victim assessment.
 - Treatment in trench, see crush syndrome (p.151)
 - Patient packaging
 - Retrieval system/extrication
 - Transfer to treatment sector

Phase IV: Termination

- Personnel Accountability Report (PAR)
- Remove tools and equipment
- Remove protective system
 - Last in - first out
- Secure scene
- Consider debriefing
- Call OSHA

Soil Types

Type A: cohesive soils with an unconfined, compressive strength of 1.5 ton/sq. ft. (tsf) (144 kPa) or greater (most stable)

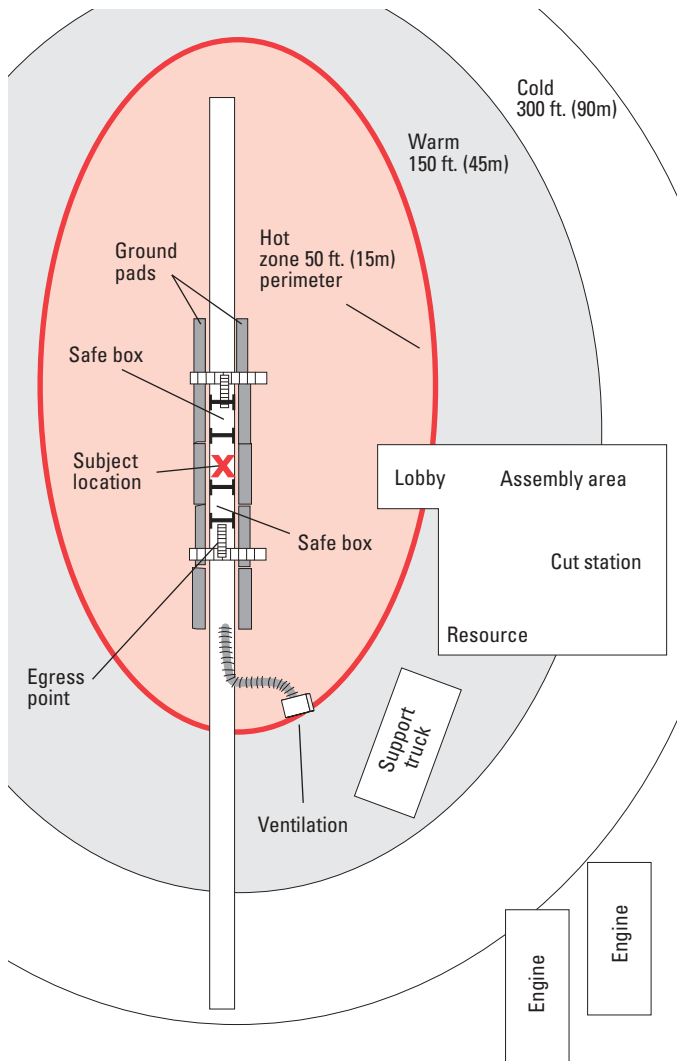
Type B: cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)

Type C: cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less (least stable)

Unconfined compressive strength: the load per unit area at which a soil will fail in compression.

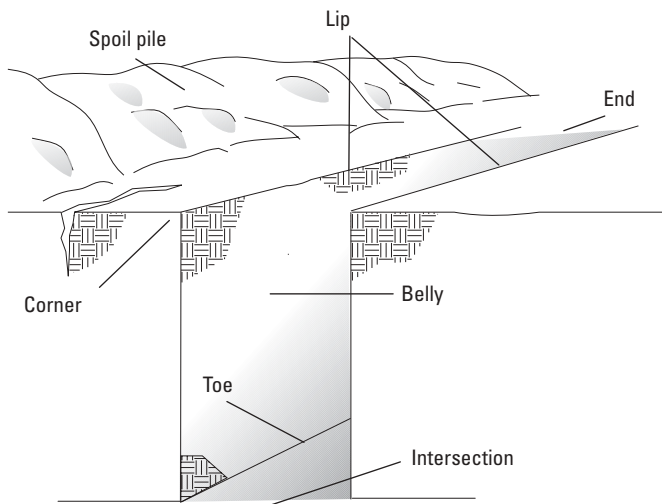
In a rescue situation, soil types are considered to be worst case scenario (type C) and shoring should be constructed accordingly.

Trench Incident Site Setup

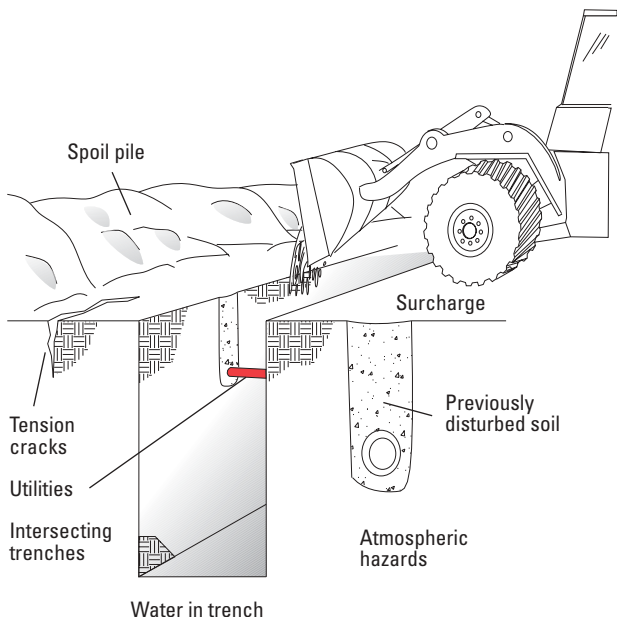


Trench Definitions and OSHA Regulations **A**

- Any trench 4 ft. (1.2m) deep or greater must have a means of egress within 25 ft. (7.5m) of any worker
- Any trench with a hazardous atmosphere or a potential hazardous atmosphere that is 4 ft. (1.2m) deep or greater must be monitored prior to employee entry
- An occupied trench 5 ft. (1.5m) deep or greater must have an approved protective system to protect employees from cave-ins
- Protective systems shall be placed from the top working down and removed from the bottom working up so as to protect the employee during construction or removal
- During rescue operations all soil should be considered type C and protective systems and practices shall be used accordingly
- *The timber shoring system illustrated in this guide is designed by a registered professional engineer for the Phoenix Fire Department, and any agency wishing to use this system or a similar system must establish an agreement with a registered professional engineer*



Trench Hazards and Causes of Collapse



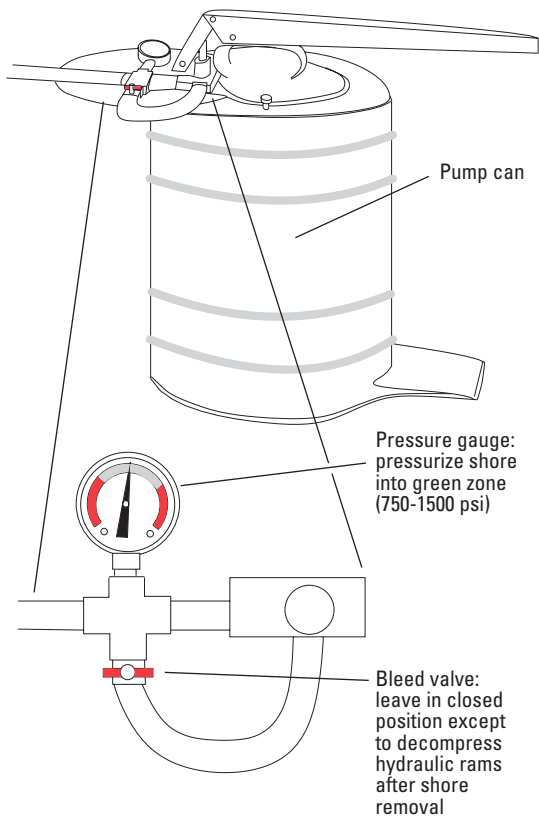
Remember:

- Soil weighs approximately 100 lbs./ft³ (50kg/.5m³) per cubic ft. and 3000 lbs./yd³ (1400kg/m³)
- If an initial collapse occurred, secondary collapse is highly likely
- Consider the possibility of a hazardous atmosphere in a trench
- Exposed utilities should be supported in place

✓ Do not enter an unprotected trench for any reason!



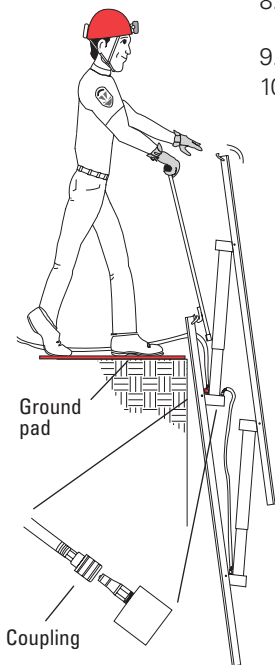
Hydraulic Speed Shore® System



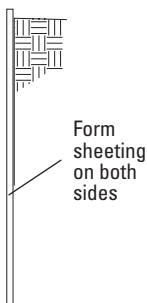
- ✓ Pressurize all shores to a consistent pressure within the green zone.

Speed Shore Installation

1. Measure trench width and depth and then select suitable shore.
2. Lower two sheets of form sheeting into trench at designated location and hold.
3. Connect pump can pressure hose to inlet port on upper cylinder assembly.
4. Place pump can bleed valve in closed position.
5. Attach T handle to handle on lower vertical rail.
6. Grasp handle of other vertical rail and lower shore into trench.
7. Release upper vertical rail and let it drop into position.
8. Hold shore in position and pump up to operation pressure (green).
9. Do not open bleed valve.
10. Remove hose from coupling with end of T handle.



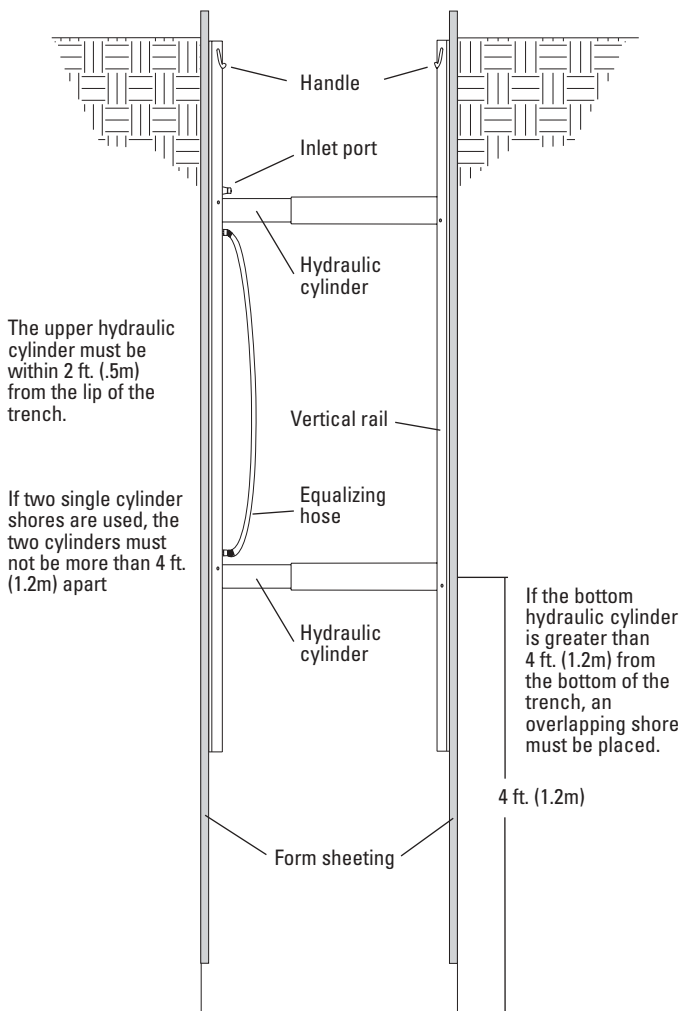
For irregular or sloping walls a single cylinder rescue shore can be used



- ✓ Avoid the use of hydraulic shores near trench intersection corners.



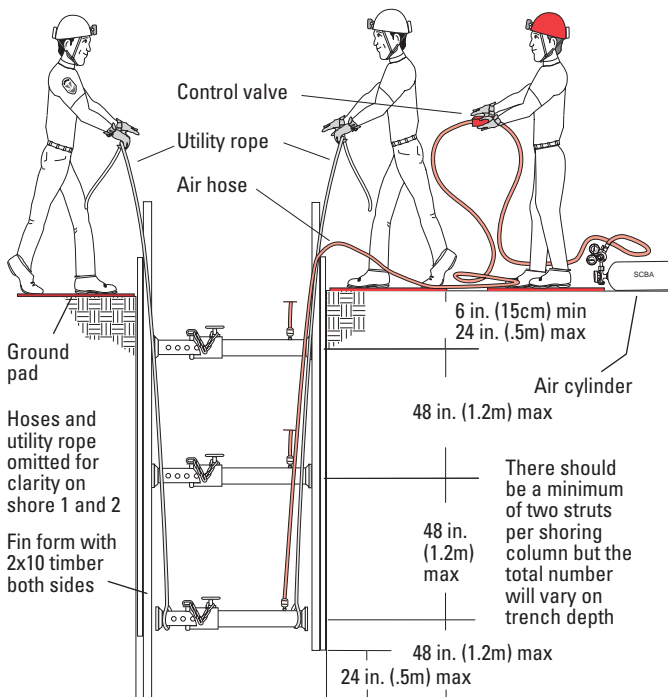
Aluminum Hydraulic Speed Shore



Pneumatic Shore Placement

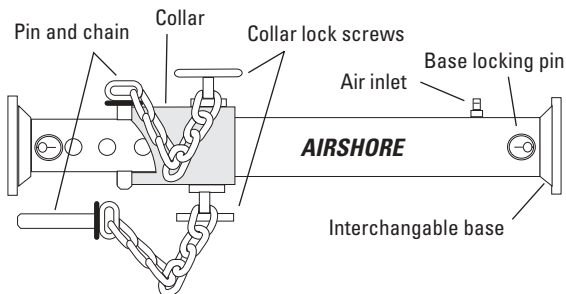
Pneumatic shores can be properly installed from outside the trench initially. Try to protect as much of the trench as possible using this technique before entering.

1. Clean lip of trench and place ground pads around work area.
2. Measure trench depth and width.
3. Select suitable size shores and lay out air control system.
4. Assemble 3 sets of timber panels.
5. Install first set of panels as close to subject location as possible.
6. Attach utility rope and air hose to first shore (set up additional shores with rope and air hoses). (continued)



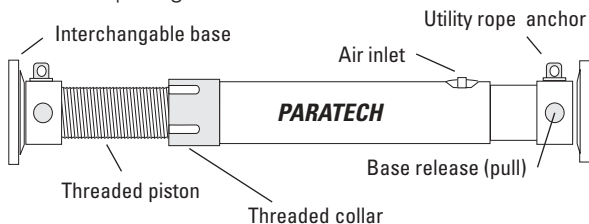
Pneumatic Shore Placement

7. Lower first shore into trench and position between 6 in. (15cm) and 24 in. (61cm) of the lip.
8. Ensure shore is level, then pressurize appropriately.
9. Tie off utility rope to top of panel and place second shore within 48 in. (122cm) of first shore.
10. Place third shore and pressurize.
11. Install second set of panels within 4 ft. (1.2m) on center of first set and repeat shore process.
12. Install third set of panels within 4 ft. (1.2m) on center on the other side of the first set of shores.
13. Set pins on shores and tighten all collars.
14. Nail or screw each shore base plate to timber.

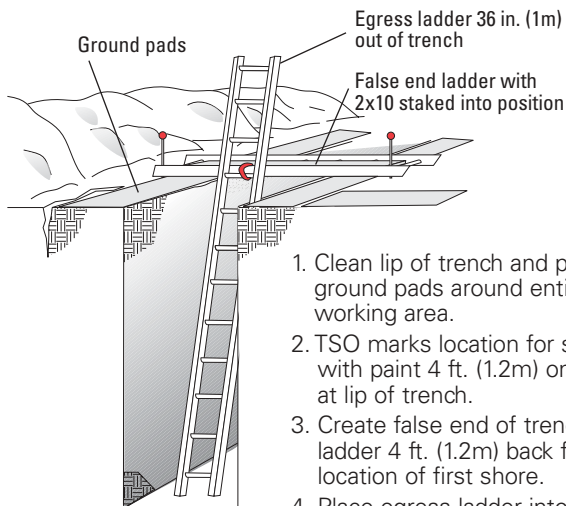


Pneumatic shore key points are

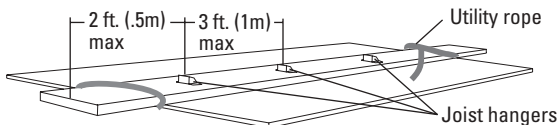
- Install shores from top down or according to manufacturer
- Pressurize to manufacturers specifications per soil conditions
- Tighten collars and screw or nail base to timber
- Always refer to tabulated data provided by the manufacturer for correct spacing



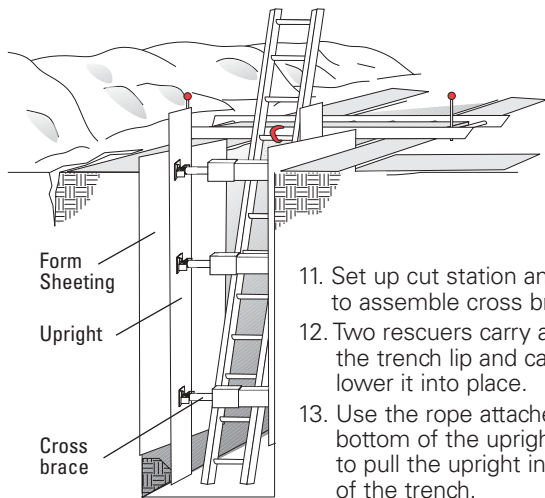
Timber Shore Step-by-Step



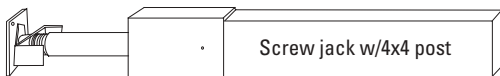
1. Clean lip of trench and place ground pads around entire working area.
2. TSO marks location for shores with paint 4 ft. (1.2m) on center at lip of trench.
3. Create false end of trench with ladder 4 ft. (1.2m) back from location of first shore.
4. Place egress ladder into trench and secure to end ladder.
5. Assemble vertical uprights by placing one piece of form sheeting on top of 2x10 (may be pre-assembled).
6. Position with 1 ft. (.3m) of 2x10 exposed on each end and nail into place.
7. Flip over and nail bottom joist hanger no greater than 2 ft. (.5m) from end.
8. Measure trench and determine best location for last joist hanger so that it will be inside trench.
9. Joist hangers must not be greater than 3 ft. (1m) apart for a trench less than 8 ft. (2.5m) deep.
10. Assemble opposite vertical upright in the same manner but do not put on joist hangers. (continued)



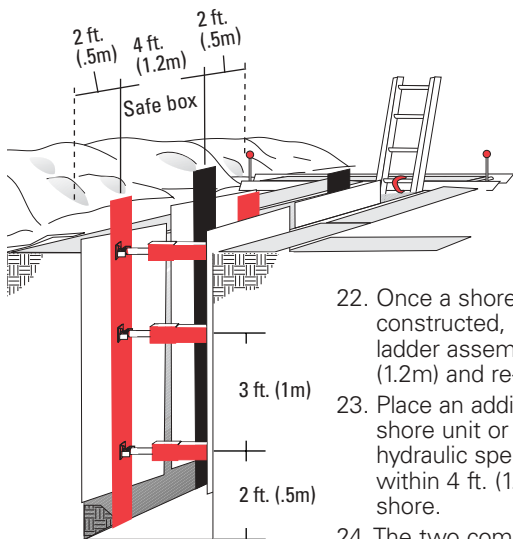
Timber Shore Step-by-Step



11. Set up cut station and prepare to assemble cross braces.
12. Two rescuers carry an upright to the trench lip and carefully lower it into place.
13. Use the rope attached to the bottom of the upright assembly to pull the upright into the toe of the trench.
14. When both uprights are in position, the builder climbs down the ladder no more than waist deep and measures the distance from upright to upright.
15. The builder calls out the distance in inches and the cut station subtracts 10 in. (25cm) and make the cut.
16. The assembly crew adds the 4x4 to a screw jack and secures it with one nail.
17. A utility rope is clipped to the assembled cross brace and it is handed to the builder.
18. The builder places the 4x4 in the top joist hanger and begins to expand the screw jack.
19. Place a nail in the base of the screw jack to secure it to the upright.
20. Repeat the process from the top down, until all cross braces are in position.
21. A final tightening is done on each cross brace.



Timber Shore Step-by-Step



22. Once a shore unit is constructed, move the ladder assembly back 4 ft. (1.2m) and re-secure.
23. Place an additional timber shore unit or an aluminum hydraulic speed shore within 4 ft. (1.2m) of the first shore.
24. The two complete shore units create a safe box that extends 2 ft. (.5m) on either side of the cross brace center.
25. An additional shore unit would extend the safe zone provided it is placed within 4 ft. (1.2m) on center.
26. Once a safe box is constructed, dirt removal and patient stabilization can occur.
27. Move as much dirt laterally as is possible then move dirt vertically with buckets, if required.
28. Use several buckets and only fill half full.
29. Be prepared for crush syndrome (p.151).
30. Focus on patient removal as first priority and ALS treatment as second priority.

✓ You must be prepared to modify timber shore to fit the irregular shape and depth of a collapse area.



Wale System



A wale system is used for protecting intersecting trenches and other difficult to shore locations.

1. Follow all steps required to make the trench safe and to construct protected safe zones for workers to enter the trench.
2. Construct a safe box on all sides of the intersection or area to be protected.
3. Measure distance on center between safe boxes (must not exceed 6 ft. (2m) per engineer specifications).
4. Nail joist hangers on 6x6 wales at specified distance apart.
5. Attach utility rope to each end of wale and lower into trench, feeding between protective system components.
6. Place top wale within 18 in. (.4m) of trench lip (plan ahead).
7. Place second wale within 3 ft. (1m) on center of first wale.
8. Measure distance between wale and opposite vertical upright.
9. Place cross braces as noted in earlier procedure.
10. Slide sheeting between wale and unprotected trench area.
11. This system is for trenches between 5 ft. and 8 ft. (1.5 to 2.5m) deep. Deeper trenches require larger walers 3 ft. (1m) on center up to 11 ft. (3.3m) deep and 2 ft. (.5m) on center between 11 ft. and 15 ft. (3.3 to 4.5m).
12. If trench is too narrow to use screw jacks, use wedges.

✓ **Standing water in trench is inherently unsafe and must be removed prior to shoring.**

Wale Setup

