US&R SHORING OPERATIONS GUIDE
TABLE OF CONTENTS

The following Sections are contained in this SOG. Each Section has an Outline that gives the order in which subjects are presented.

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1 Hazard I.D. and Failure Modes by Building Type
   US&R Field Communication Procedures
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4 Repair & Strengthening Techniques
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R Disaster Site Information for Rescue Specialist
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Edition 4.1 July 2016

Changes to SOG:
1. Reduce Design Strength of Southern Pine
2. Add 4-4x4 Shore (see Sect 2),
3. Increase Raker Design Strength (see Sect 3)
DEFINITIONS OF ENGINEERING TERMS

USER SHOPPING OPERATIONS GUIDE (80G)

3.57” is preferred.

The wood species are specified as follows:

- For Eastern White Cedar, Western Red Cedar, Greater Green Bay
- For Southern Yellow Pine, Hem-Fir, & Spruce-Fir,-

The number should be No. J. Douglas Fir.

These are the standard grades selected for use in applications to the

Design Load for Wood Structures – due to the variation in the

Design Load for Wood Structures

Number of Structural Components (ends, etc) to support a load at
- Design Load (also Design Strength x Design Capacity) - Some
- Ultimate Strength (also Ultimate Load & Ultimate Capacity)
- Beam Span

- Force required to cause complete failure of a structure, given in
- Kips or k - 1000 pounds
- Tons or t - 2000 pounds

DEFINITIONS OF ENGINEERING TERMS

USER SHOPPING OPERATIONS GUIDE (80G)
INTRODUCTION to SECTION 1

This section contains Documents that are Useful References for the US&R Disaster Site, listed as follows:

- Hazard I.D. & Failure Modes by Bldg Type Page 1-2
- US&R Field Communication Procedures 1-16
- On-Site Emergency Signaling Procedures 1-18
- US&R Building Marking System 1-19
- FEMA US&R Shoring Symbols 1-31
- Design Loads & Quick Weight Estimating 1-32

HAZARD I.D. and FAILURE MODE SUMMARY

The following pages contain brief descriptions and graphics of the most common building classifications used for US&R Evaluations:

Building Types are:

Wall Systems Frame Systems

- Light Frame, multi-story Heavy Floor, C.I.P.
- Heavy Wall, URM & Tilt-Up Heavy Steel Bldgs
- Precast Buildings Light Metal Bldgs

Pages for each bldg type present the characteristics, typical failure modes, hazards, check points, plus hazard reduction and victim access suggestions.

CRITICAL ISSUES:

- Buildings may be varied, of combined types, and complicated.
- Focus on determining the amount of Potential Energy that remains (heavy structure/objects that can collapse or fall).
  - Important to separate Brittle from Ductile Behavior.
  - Judgments may not be able to be precise.
  - Partial collapse is most difficult to assess.
- Make judgments based on what type of forces are expected after initial event (aftershock, high winds, etc).
- Victim Survivability is highly dependent on void formations, void stability, and void accessibility.
- One should always consider Risk/Reward Ratio.
- The viability of the various Mitigation Choices is dependent on the potential for Ductile Behavior of the damaged structure.
US&R SHORING OPERATIONS GUIDE
DISASTER SITE REFERENCE DATA

MULTI-STORY LIGHT FRAME BUILDING (continued)

EXPECTED PERFORMANCE – for the following:
- **Progressive Collapse** – Extensive connection failures. Members & components are likely to remain intact.
- **E. Quake** – Generally good performance - common failure is ductile racking of first story. Racked stories are subject to ratcheting and P-delta collapse in Aftershocks.
- **Explosion** – Walls become disconnected from floors (horizontal diaphragms), leading to part or total collapse.
- **Fire** – Rapid combustion and collapse unless fire resistant.
- **High Energy Impact** – Little resistance to collapse in immediate area. Remainder of structure remains stable.
- **Wind** – Damage is highly dependent on wind speed vs. shape and proper detailing. Tornadoes can destroy even well constructed wood buildings.
- **Struct Overload/Defect** – Roof failures due to snow, especially on longer span roofs.

CHECK POINTS
- Badly cracked and/or leaning walls.
- Cracked, leaning/loose veneer or chimney.
- Offset of building from foundation.
- Separated porches, split level floors/roof.
- Connection failures - nail pullout/bolt pull-through.

HAZARD REDUCTION
- Shut off gas and reduce other fire hazards.
- Avoid or pull-down damaged veneer and chimneys.
- Place vertical and/or lateral (diagonal) shores.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access through floor/roof from above collapsed area.
- Horizontal entry through existing cavities, or through walls.
- Remove or shore hazards near victims, if required.

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US&R SHARING OPERATIONS GUIDE
DISASTER SITE REFERENCE DATA

HEAVY WALL- URM BUILDING (continued)

EXPECTED PERFORMANCE – for the following:
- Progressive Collapse – URM walls likely to disintegrate, and interior structure may stand independently.
- E. Quake - Poor performance - out of plane ext wall failures, loss of connection to floors leading to partial or total collapse. Many lethal Aftershock falling and collapse hazards.
- Explosion – Walls become disconnected from floors (horizontal diaphragms), leading to partial or total collapse.
- Fire – Loss of roof/floors will leave walls unbraced. Collapsing roof/floors can thrust walls in or out.
- Wind – Roof vulnerable to uplift, leading to partial or total collapse or roof & walls. Massive masonry is more resistant.
- Struct Overload/Defect – Roof failures due to ponding and snow. Wood decay, brick disintegration or remodeling in older buildings.

CHECK POINTS
- Loose, broken parapets and ornamentation.
- Connections between exterior walls and roof/floors.
- Cracked wall corners and openings, plus peeled walls.
- Unsupported and partly collapsed roof/floors.

HAZARD REDUCTION
- Shut off gas and reduce other fire hazards.
- Diagonally shore, tie-back, avoid, remove hazardous walls.
- Shore hazardous roof/floor beams, etc.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access through floor/roof from above collapsed area.
- Horizontal entry through existing cavities and openings.
- Remove bricks by hand, excavator, or crane w/clamshell.
- Remove or shore hazards near victims, if required.
COMMON COMBINATION
- Light frame walls & floors – 1-story concrete fill
- Colapsed roof floors, long span collapse is probable.

TYPICAL FAILURE MODES
- Post 1965 and retrofit building show performance better.
- Post 1965 and retrofit building show performance better.

KEY PERFORMANCE ASPECTS
- Opaque, commercial - IL industrial occupancy – to 4 stories.
- Simple performance with each core or rectified CHU walls.
- Long span roof (60ft) and floors (25ft).

CHARACTERISTICS
- Concrete walls, wood floors, some steel fill concrete fill.
- Concrete walls, wood floors, some steel fill concrete fill.

HEAVY WALL - TILL U - BUILDING - HAZARDS

Disaster Site Reference Data
USAR Station Operations Guide
US&R SHORING OPERATIONS GUIDE
DISASTER SITE REFERENCE DATA

HEAVY WALL- TILT UP BUILDING (continued)

EXPECTED PERFORMANCE – for the following:
- Progressive Collapse – Out-leaning wall/walls could progress to roof/floor collapse in bay adjacent to exterior. Remainder could stand independently – but poorly braced.
- E. Quake – Pre 1995 - poor performance – out of plane ext wall failures, loss of connection to roofs leading to partial or total collapse. Lethal Aftershock falling and collapse hazards.
- Explosion – Walls become disconnected from floors (horizontal diaphragms), leading to part or total collapse.
- Fire – Loss of roof/floors will leave walls unbraced. Collapsing roof/floors can thrust walls in or out.
- Wind – Roof vulnerable to uplift, leading to partial or total collapse or roof and walls. Penetration through large doors can lead to critical uplift and blow-out pressures.
- Struct Overload/Defect – Roof failures due to ponding and snow. Wood decay in older buildings.

CHECK POINTS
- Connections between exterior walls and roof/floors.
- Beam to beam and other interior roof connections.

HAZARD REDUCTION
- Diagonal or Raker shore concrete walls.
- Shore hazardous roof/floor beams, etc.
- May pull-down leaning walls after dealing w/roof support.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access through floor/roof from above collapsed area. Horizontal entry through existing cavities and openings.
- Cut holes in wall panels, 2 feet min. from joints.
- Remove large wall panels and roof sections by crane.

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US&R SHORING OPERATIONS GUIDE  
DISASTER SITE REFERENCE DATA

PRECAST BUILDINGS (continued)

EXPECTED PERFORMANCE – for the following:
- **Progressive Collapse** – Failed single story columns have lead to progressive collapse. Heavy elements vs. brittle connections are critical issues. Members retain strength.
- **E. Quake** – Very poor performance – except for multi-wall residence buildings. Failed connections lead to partial or total collapse. Aftershock falling, shifting and collapse hazards.
- **Explosion** – Poor performance due to weak-link connections leading to part or total collapse.
- **Fire** – Could cause annealing of tendons and prestress loss.
- **High Energy Impact** – Impact on ext elements likely to be localized. Brittle connections could be damaged.
- **Wind** – Unlikely to be damaged by wind. Exterior skin and curtain walls could be damaged/destroyed.
- **Struct Overload/Defect** – Failures in connections, leading to cascading structure failure. Members should retain integrity.

CHECK POINTS
- Beam/column connections, broken welds and cracked corbels.
- Column cracking at top, bottom and wall joints.
- Wall connections at floors, columns and foundation.
- Badly cracked walls and columns plus falling hazards.

HAZARD REDUCTION
- Remove/avoid leaning/hanging, concrete elements.
- Shore damaged roof/floor beams, especially next to bad columns.
- Remove/shore unstable wall and floor elements.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access through thin horizontal sections from above.
- Horizontal entry through existing cavities and openings.
- Cut holes in wall panels, 2 feet min. from joints.
- Carefully remove large wall/floor sections by crane.
HEAVY FLOOR BLDGS (CIP non-DUCTILE)  (continued)

EXPECTED PERFORMANCE – for the following:
- Progressive Collapse – Members likely to break into smaller pieces. Rubble piles may shift.
- E. Quake – Very poor performance – Brittle failures of columns and beam/column connections, leading to partial or pancake collapse. Aftershocks cause added collapse, falling hazards and shifting.
- Explosion – Poor slab performance due to reverse gravity loading can lead to loss of column stability and collapse.
- Fire – May cause spalling of concrete cover on all elements.
- Wind – Unlikely to be damaged by wind. Exterior skin and curtain walls could be damaged/destroyed.
- Struct Overload/Defect – Construction falsework failures most common. Members break into pieces w/poor integrity.

CHECK POINTS
- Beam/column connections above and below floors.
- Badly confined concrete in columns (empty basket).
- Diag. shear cracks in beams and cracking in slabs near cols.
- Attachment of URM walls and other heavy objects.
- Cracks in concrete shear walls and stairs.

HAZARD REDUCTION
- Shore/avoid badly cracked slabs, beams and/or column.
- Shore/avoid overloaded slabs due to punching shear.
- Remove/shore unstable wall and floor elements.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access through existing access shafts.
- Vertical access by cutting through slabs from above victims.
- Horizontal entry through existing cavities and openings.
- Cut non-bearing/infill walls after careful assessment.
- Remove large pieces by crane, after rebar has been cut.
HEAVY STEEL FRAME  (continued)

EXPECTED PERFORMANCE – for the following:
- **Progressive Collapse** – Rare, since members maintain integrity even with damaged/failed joints.
- **E. Quake** - Good performance of frame - Failure of diagonal bracing and fracture of welded joints have occurred. Facing, especially PC panels could fall and are danger in Aftershocks.
- **Explosion** – Good performance of frame but wall & floor panels could be dislodged. Frame collapse is unlikely.
- **Fire** – Plastic deformation of floors and some joint failure. Strength is regained upon cooling. Collapse very rare.
- **High Energy Impact** – Impacted members are severed/destroyed. Connection failures near impact only.
- **Wind** – Frame at low risk – Skin, especially glass may be destroyed leading to interior partition failure.
- **Struct Overload/Defect** – Failures during erection and long-span failures are most common. Members maintain integrity with failures at joints.

CHECK POINTS
- Indications of movement – plumb corners, stair and non-structural damage – as clues to potential structure damage.
- Main beam to column connections – remove finishes as required.
- Broken PC floor and miscellaneous beam bolt connections.

HAZARD REDUCTION
- Shore beams near damaged or broken connections.
- Remove/avoid/tieback damaged exterior facing.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access by cutting through slabs from above victims.
- Horizontal entry through existing cavities & openings.
- Remove or shore hazards near victims, if required.

HEAVY STEEL FRAME  (continued)

EXPECTED PERFORMANCE – for the following:
- **Progressive Collapse** – Rare, since members maintain integrity even with damaged/failed joints.
- **E. Quake** - Good performance of frame - Failure of diagonal bracing and fracture of welded joints have occurred. Facing, especially PC panels could fall and are danger in Aftershocks.
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CHECK POINTS
- Indications of movement – plumb corners, stair and non-structural damage – as clues to potential structure damage.
- Main beam to column connections – remove finishes as required.
- Broken PC floor and miscellaneous beam bolt connections.

HAZARD REDUCTION
- Shore beams near damaged or broken connections.
- Remove/avoid/tieback damaged exterior facing.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical access by cutting through slabs from above victims.
- Horizontal entry through existing cavities & openings.
- Remove or shore hazards near victims, if required.
LIGHT METAL BLDGS  (continued)

EXPECTED PERFORMANCE – for the following:
- **Progressive Collapse** – Joint failure and member buckling could lead to part or complete collapse.
- **E. Quake** – Good performance – Failure of rod bracing is common, but collapse is rare. Minor aftershock response.
- **Explosion** – Skin blown away, possibly leading to frame/roof collapse. Entire building blown away in some cases.
- **Fire** – Rapid loss of strength and collapse due to heating. Long span structure could suddenly collapse.
- **High Energy Impact** – Little resistance to impact. Damage may involve several bays of structure.
- **Wind** – At high risk – as skin is blown away, frames/trusses can buckle and collapse. Frames can rack and collapse.
- **Struct Overload/Defect** – Lateral torsion buckling of built-up members. Joint failure and member buckling, leading to part or complete collapse.

CHECK POINTS
- Broken, elongated and/or buckled rod bracing & connections.
- Buckled purlins, truss members, and steel frames.
- Broken and/or elongated bolt connections + anchor bolts.

HAZARD REDUCTION
- Shore and/or diagonally brace racked building frames.
- Remove loose or lightly connected members and sheathing.
- Monitor changes in racked/leaning structures.

VICTIM ACCESS
- Vertical/Horizontal access by removal or cutting sheathing.
- Horizontal entry through existing cavities and openings.
- Remove or shore hazards near victims, if required.
PHONETIC ALPHABET

On-the-Emergency Signaling Procedures
Voice Communications Procedures

The following procedures are intended to promote this

Various USBs lack focus deployed to the
unofficials: DOD personnel, first and federal officers and the
responders and command personnel from the affected and adjacent
environment. This is extremely important for clear, concise
communication between the separate entities or courses
because the communication is vital to the safe and successful

COMMUNICATIONS PROCEDURES

DISASTER SITE REFERENCE DATA
USER SHARING OPERATIONS GUIDE
# US&R SHORING OPERATIONS GUIDE
## DISASTER SITE REFERENCE DATA

## COMMUNICATIONS PROCEDURES (continued)

### VOICE COMMUNICATIONS PROCEDURES

<table>
<thead>
<tr>
<th>What To Do</th>
<th>Why To Do It</th>
</tr>
</thead>
</table>
| 1. LISTEN  | A. To make sure your transmission won't interfere with another communication.  
          | B. To be aware of other things going on.  
          | C. To communicate your idea effectively. |
| 2. THINK   | A. To communicate your idea effectively.  
          | B. To use only the air time needed.  
          | C. To use a procedure that is universally accepted. |
| MAKE THE CALL.  | A. To be clear.  
                 | B. To be understood reliably on the first call.  
                 | C. To use a procedure that is universally accepted. |
| MAKE THE CALL.  | A. To be understood.  
                 | B. To be fast.  
                 | C. To avoid confusion.  
                 | D. To be accurate. |
| USE PHONETICS | A. To be clear.  
                 | B. To be accurate.  
                 | C. To be fast.  
                 | D. To use a procedure that is universally accepted. |

**1-17**
Markings should be placed on nominal address side of the structure.

Building marking system was established to ensure:

Search and Rescue Operations
- FEMA Distribution System
- Structure Identification System
- Incident Command System

There are 4 categories of FEMA User Markings:
- FEMA Regional User Response System
- FEMA National User Response System

A uniform building marking system has been developed by the

GENERAL:

FEMA BUILDING MARKING SYSTEM

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**ON-SITE EMERGENCY SINGNALING PROTOCOLS**

**DIASASTER SITE REFERENCE DATA**

**USER'S OPERATIONS GUIDE**
FEMA BUILDING MARKING SYS (continued)

STRUCTURE IDENTIFICATION MARKING

If at all possible, the existing street name and building number will be used. If some numbers have been obliterated, attempt should be made to reestablish the numbering based on nearby structures. If no numbers are identifiable on a given block, then US&R personnel will assign and identify the street name and numbers based on other structures in the proximity. The structures shall then be numbered to differentiate them (using paint or crayon).

CASE 1 – IF SOME NUMBERS ARE KNOWN, FILL IN BETWEEN

CASE 2 – IF NO NUMBERS ARE KNOWN, FILL IN USE SMALL NUMBERS
The interior of the structure will be divided into Quadrants. The interior of the structure will be divided into Quadrants.

Clockwise manner from Side A:

Other sides of the structure shall be assigned alphabetically in a clockwise manner from Side A:

Disaster Site Reference Data

User: SHARING OPERATIONS GUIDE

FEMA BUILDING MARKING SYS (continued)

(continued)
STRUCTURE I.D. MARKING (continued)

Multi-story buildings must have each floor clearly identified. If not clearly discernable, the floors should be numbered as referenced from the exterior. The Grade (or Street) Level Floor would be designated Floor 1 and, moving upward the Second Floor would be Floor 2, etc. Conversely, the First Floor below Grade (or Street) level would be B-1, the Second B-2, etc. For buildings where the street slopes, all at the incident must be informed as to which level will be called the First Floor.

If a structure contains a grid of structural columns, they should be marked with 2’ high, orange letters/numbers to further identify enclosed areas. If plans are available, use the existing numbering system. If plans are not available, **Letter** the columns across the **Long Side** (Side A in this Example) starting from the left, and **Number** the columns along the **Short Side** (Side B in this example) starting from the front, Side A. The story level should be added to each marked Column, and be placed below the Column Locator Mark. Example: “FL-2” = Floor 2.
new marking made if the original information is now incorrect.

ID number will be made below the previous entry or completely
which must be made on the exterior of the building.

All task force personnel must be aware of the possibility of
and look for other structural/Changes Evaluation marking
of lowest risk exposure to the structural/Changes Evaluation
in a row will be placed next to the box indicating the direction
the point (or panels) would also be made

(Continued on back)

The special marking will be made inside the box to indicate
is important that a barrier is made to mark all corners.

with FEMA IST will see local authority having jurisdiction

in order to avoid confusion with similar looking marking

(See Ex 1 of Page 1-25)

The structural/Changes (other structural/Changes will be 

STANDARD/HAZARDOUS EVALUATION MARKING

FEMA BUILDING MARKING SYs (continued)

DISASTER SITE REFERENCE DATA

US ARMY OPERATIONS GUIDE
**FEMA BUILDING MARKING SYS (continued)**

**STRUCTURE/HAZARDS EVALUATION MARKING**

The depiction of the various markings is as follows:

- **Low Risk** for US&R Operations, with low probability of further collapse. Victims could be trapped by contents, or building could be completely pancaked or soft 1st story.

- **Medium Risk** for US&R Ops, and structure is significantly damaged. May need shoring, bracing, removal, and/or monitoring of hazards. The structure may be partly collapsed.

- **High Risk** for US&R Ops, and may be subject to sudden collapse. Remote search operations may proceed at significant risk. If rescue operations are undertaken, significant and time-consuming mitigation should be done.

Arrow located next to a marking box indicates the direction to the lowest risk entrance to the structure, should the marking box need to be made remote from the indicated entrance.

Indicates that a Hazardous Material condition exists in or adjacent to the structure. Personnel may be in jeopardy. Consideration for operations should be made in conjunction with the Hazardous Materials Specialist. Type of hazard may also be noted.
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STRUCTURE/HAZARDS EVALUATION MARKING (cont.)

STRUCTURE/HAZARDS PLACARD
Should be printed on adhesive backed, 8.5” x 11” heavy white paper, Rite-on paper, or light cardboard. Cut in half to obtain two placards.

White color was selected to avoid being confused with the Green – Yellow – Red Placards that are placed during Safety Evaluation of Structures by non-US&R Engineers.

1-25
AFTER EXITING & DRAWING the 2nd SLASH, add the following INFO:

**TOP QUADRANT** - Time and date that the Search Team personnel left the structure.

**RIGHT QUADRANT** - Personal hazards.

**BOTTOM QUADRANT** - Number of live and dead victims still inside the structure. ["0" = no victims]

When the Recon Team leaves a structure WITHOUT completing the Search (aftershock, end of shift, etc), then the second slash **WILL NOT** be made. A **Solid Circle** is drawn at the mid-length of the First Slash, and Date/Time of Exit, Personal Hazards, & Victim Info will be filled in. Also indication of Quadrants or Floors completed should be added in a BOX below the X, or if the Bldg HAS NOT been entered (as in Hurricanes) mark **No Entry** in the BOX.
The following illustrates the marking system:
- Can or orange flag
- The marking symbols should be made with
- Remover.

Known or potential victim is located and immediately
- Cover or obstruct the location of any victim.
- Location of potential and known victims.
- During the search function it is necessary to identify the
- Victim Location Marking System

Search Assessment Marking System (continued)

FEMA Building Marking System User's Guide

Search Assessment Marking System (continued)
VICTIM LOCATION MARKING SYSTEM (cont.)

Make a large (2’ x 2’) “V” w/orange paint near the location of the known or potential victim. Mark the name of the search team as shown. An arrow may need to be painted next to “V” pointing towards the victims location is not immediately near where the “V” is painted. Show distance on arrow.

Paint a circle around the "V" when a potential victim has been Confirmed to be alive either visually, vocally, or by hearing sounds that would indicate a high probability of a victim. If more than one confirmed live victim, mark total number under the "V".

Paint a horizontal line through the middle of the "V" when a Confirmed victim is determined to be deceased. If more than one confirmed deceased victim, mark the total number under the "V". Use both live and deceased victim marking symbols when a combination of live and deceased victims are determined to be in the same location.

Paint an “X” through the Confirmed victim symbol after all victims have been removed from the specific location identified by the marking.

- Paint new victim symbols next to additional victims that are later located near where the original victim(s) were removed. (assuming original symbol has been “X”ed out).

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Note that the type of search (primary, no entry, or secondary) used for structures by non-USDAR Engineers: Yellow - Red Procedures that are placed during Search/Rescue Evaluation
Orange color was selected to avoid being confused with the Green

Search Assessment Placard

Disaster Site Reference Data

User SHORING OPERATIONS GUIDE

Building Marking SFS (continued)
US&R SHORING OPERATIONS GUIDE
DISASTER SITE REFERENCE DATA

FEMA US&R SHORING SYMBOLS
These symbols were developed by the FEMA US&R Structures Sub-group, and should be used to map locations of US&R Shoring.

- Tee Shore
  - T

- Double T Shore
  - DT

- Vertical Shore (V-3 = 3 posts, V-2 = 2 posts)
  - V-3

- Laced Post Shore (at Plywood Laced Post use PLP in box)
  - LP

- Cribbing
  - C

- Raker Shore
  - Place vertical side of triangle against wall
  - Each triangle represents one Raker
  - Rakers should be installed groups of two or larger

- Horizontal Shore
  - (H - 3 = 3 struts, H - 2 = 2 struts)
  - H-3

- Window or Door Shore (W or D)
  - W or D

1-31
**Quick Weight Estimating (per square foot)**

*Also need to account for heavy loads.*

Add 10 lb to 15 psi for Resourses (4.250 lb in 100 sq ft = 10 psi)

**Rescue Live Loads**

Concrete Floors weigh from 80 to 150 psf
Steel Floors weigh 10 psf to 25 psf (25 with 1/2" concrete)
Normal home office: 10 psf (most for storage)
Innovated wood & metal stud walls: 10 to 15 psf per floor
Concrete Masonry Rubble: 10 psf per linear foot
8" Hollow Concrete Masonry + 6 psf
8" P.C. Hollow Plank = 6 psf
Frame wall with 5/8" Gypsum Side = 8 psf
Frame wall w/1/2" Gypsum Side = 7 psf
5/8" Gypsum Board = 3.5 psf
2 1/4" Wood Framing = 2.5 psf
2 1/2" Wood Framing = 2.25 psf
3" = 1.5 psf

**Disaster Site Reference Data**

User Showing Operations Guide

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<tr>
<td>Concrete Rubble</td>
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<tr>
<td>8&quot; P.C. Hollow Plank</td>
<td>6</td>
</tr>
<tr>
<td>Frame w/5/8&quot; Gypsum</td>
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</tr>
<tr>
<td>Frame w/1/2&quot; Gypsum</td>
<td>7</td>
</tr>
<tr>
<td>Gypsum Board</td>
<td>3.5</td>
</tr>
<tr>
<td>Wood Framing</td>
<td>2.5</td>
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<tr>
<td>Wood Framing</td>
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<tr>
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<td>Wood Framing</td>
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INTRODUCTION to SECTION 2
This section contains General Information, Graphics and Detailed Explanations of how to construct FEMA Vertical Shoring – arranged as follows:

Key Design Parameters. Page 2-1
Estimated time to build Shores & Multi-Story Conditions. 2-2
Shoring Size-up, Inspection, and the Shoring Team. 2-4
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How to construct simple Vertical Shores 2-15
How to construct Laced Post & Ply'd Laced Post Shores 2-30
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How to construct Cribbing +Window and Door Shores. 2-44
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KEY DESIGN PARAMETERS
- How to configure US&R Shoring to ensure a Predictable and Slow initial Failure Mode.
- How to sequence the construction of US&R shoring in order to Minimize Risk.
- Use of the Class 1, 2, and 3 System Approach:
  - Class 1 = 1 Dimensional
  - Class 2 = 2 Dimensional
  - Class 3 = 3 Dimensional
- All posts should be proportioned and/braced so that cupping of the wedges and crushing of header will occur before post buckling. This is assured if post L/D (Ht/Width) is 25 or less.
- Basic construction sequence should proceed as follows:
  - In very dangerous areas, it would be prudent to reduce risk by quickly installing Class 1 Spot Shores.
  - Follow w/ Class 2 (two or more post) Vertical Shores. (In some cases Class 2 shores may be built as initial shoring).
  - Finally, assure that all Shoring has all Posts braced in two directions as Class 3 Shores. An efficient way that this can be achieved is as follows:
    1. Place T or Double T shores initially if very dangerous.
    2. Then place pairs of 2-post Vertical Shores, 4 ft apart.
    3. Lastly tie 2-post vert. shores together as Laced Posts.
**NOTE ON CARRY CONDITIONS**

<table>
<thead>
<tr>
<th>Shoe Type</th>
<th>Installation Time</th>
<th>Door Score</th>
<th>Window Score</th>
<th>Shipped Floor Score</th>
<th>10 x 19 in Height</th>
<th>10 x 15 in Height</th>
<th>8 x 10 in Height</th>
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<td>1-story</td>
<td>10 - 15 min</td>
<td>20 - 30 min</td>
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<td>3-story</td>
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<td>4-story</td>
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**ESTIMATED TIME TO INSTALL SHORES**

**CONSTRUCTING VERTICAL SHORING SYSTEMS**

**USER STRUCTURES SPECIALIST FOC**
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

TIME TO BUILD SHORES - SPECIFIC CONDITIONS

Example 1 (Vert. Crib, Laced Post & Sloped Floor)
Like Pentagon, Puerto Rico, (similar to OKC)
1st & 2nd story, Shore your way in, remove debris as you go.
Material & cutting area within 200-ft outside.
ADD 10 min for 1st floor and 15 min for 2nd floor.
Traveling thru heavy debris add 10 minutes more.

Example 2 (Vert. Crib & Sloped floor)
10 story concrete bldg - Need to carry material upstairs into bldg.
Partly prefab in safe area on same floor. Need to move furniture, desks, etc to go 60 to 100 ft across floor to collapsed area.
ADD 5 min for each additional floor ascended.

Example 3 Each Pair of Raker Shores
12 ft insertion point up Tilt-up wall - AC paving, parking lot next to building not much debris.
Each Pair to be Assembled, Installed & Braced in 30 min.

Example 4 Each Pair of Raker Shores
9 ft insertion point up URM wall w/ some debris.
AC paving or Dirt next to wall.
Use Split sole Rakers w/ sloping sole.
Each Pair to be Assembled, Installed & Braced in 40 min.

MULTI-STORY CONDITIONS & SEQUENCING
When shoring a single damaged floor in multi-story building the following approach may be used:
- For Wood-frame, 1-undamaged fl can support 1-damaged fl.
- For Steel-frame, 2- undamaged floors to support 1- damaged fl.
- For Reinf. Conc, 3-undamaged floors to support 1- damaged fl.
- For Precast Conc, the shoring should extend to the ground.
- This does not apply to structures that are under construction, subject to cascading/progressive collapse, or to structures that have collapsed suddenly, without any apparent cause.
- Usually the best strategy for multi-story shoring is to start directly under the damaged floor, and work down.

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- Usually the best strategy for multi-story shoring is to start directly under the damaged floor, and work down.
1. Use steps, floor edges and guarding for limited fall protection.
2. Use slip resistant floor coverings that support feet and
   legs.
3. Check for sagging guardrails with damaged connections.
4. Railing should be at least 36 inches high, free of
damaged or broken components.
5. Look for broken components or falls of less than 60
   inches.
6. Choose the best floor coverings, if a pump
disconnection.
7. Choose the best floor coverings, if a pump
disconnection.
8. Choose the best floor coverings, if a pump
disconnection.
9. Choose the best floor coverings, if a pump
disconnection.
10. Choose the best floor coverings, if a pump
disconnection.

Shoring Systems

Shoring System Setup

User Structures Specialist Focus

User Structures Specialist Focus

Shoring System Setup

Shoring System Setup

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SHORING SIZEUP (continued)

Prepare the area to be shored:
1. May need to remove debris and floor coverings.
   - Install temporary, spot shores if needed – reduce risk.
2. If soil supported, use an 18”x18” foot under post locations.
3. Consider temporary shores to reduce risk (T or DbI-T).
4. Prefabricate shoring as much as possible to reduce risk.
5. Add bracing after wedges are tightened.

SHORING INSPECTION

Inspect shores every 12 hours (Shift Change), and/or following any known loading change such as:
1. Aftershocks
2. High Winds,
3. Secondary Explosion,
4. Load Shift and/or Change.

Check for proper construction of shore
1. Check to see if posts are straight, plumb, and have full bearing on header and wedges.
2. Are connections tight and wedges snug?
3. Is header in full contact with supported structure?
4. Has sole deflected due to soft soil or support?
5. Are all components of shoring system in place?

Check for signs of overload:
7. Crushing of header at post.
8. Splitting of header at end of overhang.

Actions to be taken if signs of overload are observed,
9. Add additional shoring.
10. Have structure re-evaluated by a SIS to see if it is responding differently than expected.
11. Check assumptions of original shoring design.
THE CUTTING TEAM

- Measure the layout of the cutting station to ensure the layout is correct and clear.
- The layout is in charge of setting up the cutting station and ensuring that the materials are properly arranged.
- The layout is responsible for the measurement and marking of the materials to be cut.
- The layout is responsible for the overall operation of the cutting station.
- The layout is responsible for the overall operation of the cutting station.

THE SHORING TEAM

- The shoring team is responsible for the following:
  1. The Shoring Team - Establishes the equipment area and performs the actual shoring to conduct shoring operations safely and efficiently.
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CONSTRUCTING VERTICAL SHORING SYSTEMS

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THE SHORING TEAMS (continued)
c. **Tools and Equipment** – directs the movement of tools and equipment to be placed where they are requested, anticipates logistical needs of the shoring team and keeps an inventory checklist/log sheet for easier retrieval of tools and equipment at the conclusion of rescue operations.

5. A single Rescue Squad can normally fill the six individual shoring team positions during most shoring operations.

6. Larger or more complex shoring operations may require Two Rescue Squads, with One squad assigned to the Shore Assembly Team and the Other assigned to the Cutting Team.

7. **Shore Assembly Team** with a Six person Rescue Squad:
   a. The **Shoring Officer** (Rescue Squad Officer)
   b. The **Measure**
   c. **Shores**
   d. **Shores**
   e. **Safety**
   f. **Runner** – ensures tools, equipment, and shoring materials are moved from the shoring operation primary access point to the shoring site and assists in the erection of shores as needed.

8. Cutting Team with a complete Six person Rescue Squad:
   a. The **Cutting Team Officer** (Rescue Squad Officer)
   b. The **Layout**
   c. The **Feeder** – moves and feeds measured and marked shoring material from the **Layout** to the **Cutter** and helps secure it when being cut.
   d. The **Cutter**
   e. **Tools and Equipment**
   f. **Runner** – ensures tools, equipment, and shoring materials are moved from the cutting area to the shoring operation primary access point.
2.8

(8 x 2 - 4.5 or 6.0 deg. cracks + adequate bonding)

4k is designated load of single 4x Full H. Raker
24k is designated load of 4x4 Laced Post
24k is designated load of 2x2 Lay-up of 4x4 Curb
24k is designated load of 6x6 Post 15’th Long
8k is designated load of 4x4 Post 8t Long

8.2, 2. 4. 4.

6. Shoring Number to Remember (for No. 1 Douglas Fir)

Grade 60’s. Shown a minimum of 24” into solid of paving.

5. Pictures are 1 x 3”. Min. Grade A-25 plain steel rods of

each member is only capable of resisting Tension

then T, & then they must be considered as shearing. Since

if the length of 2x4 x 2x6 diagonal bracing members is greater

Compression (should be limited to 7-6).”

The piers that are capable of resisting Tension

and members that are capable of resisting Tension

and Compression (should be limited to 7-6).”

3. The piers that are capable of resisting Tension

and members that are capable of resisting Tension

and Compression (should be limited to 7-6).”

2. For each condition, the number should be designated for

4. For each condition, the number should be designated for

5. For each condition, the number should be designated for

6. The size of a header depends on the thickness of the header.

1. The strength of wood systems depend on the following:

NOTES REGARDING SHORE STRENGTH

CONSTRUCTION VERTICAL SHORING SYSTEMS

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CONSTRUCTING VERTICAL SHORING SYSTEMS

NOTES for VERTICAL SHORING DIAGRAMS

1. Maximum Post Heights have been specified as 10'-3", 12'-3", etc., and Shore is then limited to next Full Foot in Height.
2. Design Load (Safe Working Load) for Class 1 & 2 Shores is based on Shore Height. (Not post length).
3. The use of 4x4 & 6x6 Headers is desirable, since this maintains a relatively stable 1 to 1 height to width ratio. This allows the use of one sided connections to headers.
4. It is desirable to use 2-sided connections at Posts to Sole Plates at Wedges. The connectors should be 6"x12", Half Gussets each side, or a 2x Diagonal Brace one side and Gusset to opposite side. Gussets may be cut from 5/8" or 3/4" plywood or Oriented Strand Board (OSB).
5. For wood or light metal floor/roof systems, 1-sided connections, at wedges, may be used in situations where lateral displacement of the shore is unlikely. Displacement may be caused by lateral loads, vibrations, and/or structural shifting.
6. Use of 4x4 Headers for 4ft o.c. Posts and 6x6 for 5ft o.c. Posts is based on supporting Normal Wood Floors and Intact Concrete Floors. For supporting badly cracked Concrete Floors, and for shores with larger post spacing, obtain special design by US&R Structures Specialist.
7. Backing above Headers may be required if one is supporting a badly cracked concrete or masonry structure.
   - May use 2x10 or 2x12, full length centered on top of header, or 8ft long strips of 12" to 16" wide, 3/4" plywood.
8. Backing should be used under the Sole at each post when bearing on soil. Use 3-2x6x18" or 2-layers of 18"x18" x 3/4" plywood centered under posts. See below:

2-9
VALID CONNECTIONS FOR VERTICAL SHORES
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Nailed Standards

14-Nail

11-Nail

8-Nail

Standard 5-Nail

1. Hands of gun driven nails may be used, however gun driven nails are not to transfer direct loads.
2. Full head nails are preferred, but the head is set off-center for producing the least amount of vibration. Palm Nails normally produce less impact vibration. Palm Nails are used in some cases at wedges, in order to allow for pulling the nails when adjusting the wedges.
3. Clip head nails may be used, but care must be taken to not over-drive the nails. NO V head nails should be 0.311 x 3.5 and used in end grain. The preferred 16 ga nail is a 0.148 x 3.50 inch/center/5/32 inch.
4. Most gun nails.
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PLYWOOD GUSSETS and BRACES
Plywood may be 5/8” or 3/4” thick, (or may use OSB where wet conditions will not occur) Use 8d nails.

FULL GUSSET – 12” X 12”

T-Shore – Header/Post
Raker – 3 locations

Half Gusset at Vertical Shore

Dbl Gusset for Dbl T Mid-braces

HALF AND DOUBLE GUSSETS

2-11
PLYWOOD BRACES FOR PLP

1. 6d each end (2-5 patterns + 1 middle)
2. 44" x 2" for 2 ft. side of 2x4
3. plywood laced post (PLP) - middle braces
4. 8" x 4" plywood, top & bottom brace

PLYWOOD BRACES (continued)

CONSTRUCTING VERTICAL SHORING SYSTEMS
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NAILED CONNECTIONS (2x6 and 2x4 braces)

Also note placement of nails away from the ends of the 2x.
NAILED CONNECTIONS of 2x6 and 2x4 to HEADER
2x4 & 2x6 diagonal braces are used here to provide bracing, as well as connect the post to the header. Carefully place diagonal so that required nails can be driven without splitting the post. (For conditions where 5-16d will split the post, 3-16d may be used)
Details at 2x4 or 4x4 g Wedges

Wrong

Under Driven

Full Driven

O.K.

Over Driven

Best

2x4 Wedges are 17" long. 8 4x4 or 4x6 Wedges are 18" long. May use tee duplex keeper nails. Sloped surfaces must be in full contact. Provide duplex keeper nails.

Cutting Table & Jig

CONSTRUCTING VERTICAL SHORING SYSTEMS

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How to Construct Vertical Shores

- T-Shore (4x4)  
  Page 2-16
- T-Shore (4-4x4)  
  2-18
- Double T Shore  
  2-20
- Vertical Shore – Multi Post  
  2-22
- 2-Post Vertical Shore  
  2-26
- Laced Post Shore  
  2-30
- 2’ x 4’ Plywood Laced Post Shore  
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- 4’ x 4’ Plywood Laced Post Shore  
  2-37
- Type 2 Sloped Floor Shore  
  2-40
- Alternate Methods for Vertical Shores  
  2-43
- Type 3 Sloped Post Shore  
  2-44
- Cribbing  
  2-46

Design Loads that are listed herein are for Shores
built using No. 1 Douglas Fir. For Design Loads when
using other lumber species, see page 2-43
Design Load is 4,000 lb. - Only if load is centered.

Maximum Height = 11 ft.

T SPOT SHORE (Vertical Class 1)

Rapidly installed temporary shore, intended to be used only until a complete shoring system can be installed. It can become unstable if it is not centered under the load.
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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE T SPOT SHORE
1. Determine where T Spot Shores should be built in order to quickly reduce risk. (Prior to building more stable shores).
2. Determine height of area to be shored and remove least amount of debris required to place the shore.
3. The 4x4 post should be 10'-3" max long, so that the total height of the shore is not more than 11 feet.
4. Cut header and Sole to 3 feet long.
5. Cut post to proper height (remember to deduct header, sole and wedge height when cutting post).
6. Prefabricate header to post.
   - Toe-nail post to header and make square.
   - Place and nail Full Gusset plate on one side.
   - Flip shore over and place/nail another Full Gusset on other side.
7. Place T Shore in position, centered under the load.
8. Position header across (perpendicular to) the roof/floor joists and position the post directly under a joist.
9. Slide sole plate under T and tap wedges into position.
10. Check for straightness & position directly under the load, and then tighten the wedges.
11. Install bottom Half Gusset; nail 4-8d to post and to sole.
12. Note that a 2 x 4 x 18" cleat may be used, but the 3-16d nails to post and sole may tend to split the cleat. Also the nailing of 16d causes more impact within the danger zone than for 8d nails.
13. Anchor the shore to floor above and sole to floor below, if practical.
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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE 4-4x4 T SHORE
1. Determine height of area to be shored and remove least amount of debris required to place the shore.
2. The 4x4 posts should be 12’ ft max long, so that the total height of the shore is not more than 12'-8"
   - **Note:** For point shore longer than 12'-8" use single 6x6.
   - **Design Load for these heights:** 14ft Long = 15k ; 16ft = 12k; 18ft= 9k; 20ft = 7.5k.
3. Cut Headers and Soles to 3 feet long, and toenail them together in pairs.
4. Cut post to proper height (remember to deduct header, sole and wedge height when cutting post).
5. Prefabricate posts and header to post.
   - Toe-nail all 4 posts together - all 4 sides.
   - Nail 96" long ply tie to posts, all 4 sides. Center on posts.
     - Nail 8d@5"o.c. staggered to each 4x4.
     - Nail 8" ply ties to posts, 2 sides top & bottom 1/2" from ends.
     - Nail 5-8d to each post.
   - Toe-nail posts to headers and make square.
   - Place and nail Full Gusset plate on one side (header to posts).
     - Nail 5-8d to each post and 8-8d to header
   - Flip shore over and place/nail another Full Gusset on other side.
7. Place T Shore in position under the beam or girder
   - Position header directly under beam. Orient header perpendicular to beam, and **exactly centered on beam**
8. Slide double sole plate under T and tap wedges into position.
9. Check for straightness & re-check position directly under the load (**centered on beam**), and then tighten the wedges.
10. Install bottom Gussets each side
    - Nail 5-8d to each post , and 8-8d to sole, each side.
11. Anchor the shore to floor above and sole to floor below, if practical.

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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE 4-4x4 T SHORE
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   - Position header directly under beam. Orient header perpendicular to beam, and **exactly centered on beam**
8. Slide double sole plate under T and tap wedges into position.
9. Check for straightness & re-check position directly under the load (**centered on beam**), and then tighten the wedges.
10. Install bottom Gussets each side
    - Nail 5-8d to each post , and 8-8d to sole, each side.
11. Anchor the shore to floor above and sole to floor below, if practical.
Design Load - based on shore height

16' 000lb - 8 ft, 10' 000lb - 12 ft

DOUBLE T SHORE (Vertical Class 2)

CONSTRUCTING VERTICAL SHORING SYSTEMS
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2 - Double Gusses
2 - Wedge Sets
Header and Sole
2 - Half Gusses

Material List:
This is the most stable shore and much preferred
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HOW TO CONSTRUCT THE DOUBLE T SHORE
1. Determine overall height of area to be shored and remove least amount of debris required to place the shore.
   - The 4x4 post should be 11’-3” maximum long, so the total height of the shore is not more than 12 feet.
2. Measure and cut 4x4 header, sole and post (remember to deduct header, sole and wedge height when cutting post).
   Header and sole are 3 feet long.
3. Prefabricate header to posts.
   - Toe-nail posts to header and make square.
   - Place and nail Double Gusset plate on one side of both posts.
   - Nail 5-8d to each post and 14-8d to header.
   - Flip shore over and place another Double Gusset on other side.
4. Nail mid-height plywood, Double Gusset to one side of posts (8-8d to each post).
5. Place Double T in position, centered under the load.
6. Slide sole plate under Double T and tap 2x4 wedges into position.
7. Check for straightness plus stability, and then tighten wedges.
8. Install bottom Half Gussets and nail 4-8d to each post and sole.
9. Anchor the shore to floor above and sole to floor below, if practical.

3’ to 6’ high 6’ to 12’ high

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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE DOUBLE T SHORE
1. Determine overall height of area to be shored and remove least amount of debris required to place the shore.
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   Header and sole are 3 feet long.
3. Prefabricate header to posts.
   - Toe-nail posts to header and make square.
   - Place and nail Double Gusset plate on one side of both posts.
   - Nail 5-8d to each post and 14-8d to header.
   - Flip shore over and place another Double Gusset on other side.
4. Nail mid-height plywood, Double Gusset to one side of posts (8-8d to each post).
5. Place Double T in position, centered under the load.
6. Slide sole plate under Double T and tap 2x4 wedges into position.
7. Check for straightness plus stability, and then tighten wedges.
8. Install bottom Half Gussets and nail 4-8d to each post and sole.
9. Anchor the shore to floor above and sole to floor below, if practical.

3’ to 6’ high 6’ to 12’ high
**USAR SHORING OPERATIONS GUIDE**

**CONSTRUCTING VERTICAL SHORING SYSTEMS**

**HOW TO CONSTRUCT THE VERTICAL SHORE**

1. Survey, install spot shores (if needed), and remove least amount of debris required to place the shore.
2. Lay the sole plate on the floor or ground directly under and in line where header will be installed. Sole plate should be level. Add 3-2x6x18" (foot) under sole at posts for soft soil conditions.
3. Measure and cut the posts to the proper height:
   - Place the header on top of the sole plate.
   - Place the end of the tape measure on top of the header at both ends and at its middle, to find the distances to the bottom of the structure to be shored. After deducting for wedges, use smallest dimension for all posts. (assumes near-level conditions)
4. If possible, anchor the header to the area that is to be shored, square and in line with the sole plate. Secure it at the lowest point and shim the structural elements down to the header trying to keep it as level as possible.
5. Install the posts between the header and sole plate under each structural element to be supported. 4x4 Posts should be spaced 4 feet on center, maximum.
   - Install first two posts 12" from ends of header.
   - Toe-nail each post to header and sole, and keep the posts in line & plumb with header and sole plate.
6. Install a set of 2x4 wedges under each post, on top of Sole, and tap them together simultaneously until the posts are tight. Toe nail behind the wedges to secure them.
7. Attach the diagonal braces to each side of the vertical shore.
   - Mid-point brace, when needed, should be installed prior to the diagonal braces.
   - The diag. braces should be long enough to span its entire length and be attached to the sole plate and header and each post.
   - If possible, diagonal braces should be installed in a "X" pattern on opposite sides of the system.
   - Vertical shoring systems which are very long may require several sets of diagonal braces.
8. Attach half-gussets to one side of header to post, except where diagonal braces attach. Add Half Gussets to each side of each post to sole plate, except where diagonal braces attach (then only one side). Nail with 8-8d. (Also see note 5. On page 2-9)
2-POST VERTICAL SHORE (VERTICAL CLASS 2)

CONSTRUCTING VERTICAL SHOREING SYSTEMS

USER STRUCTURES SPECIALIST FOG

<table>
<thead>
<tr>
<th>Design Load</th>
<th>4 x 4 Posts</th>
<th>3 for Shore from 17'-11.5&quot; to 20' H</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,000 lb</td>
<td>5 - 4-Hole Gussets</td>
<td>2 for Shore from 17'-11.5&quot; to 17' H</td>
</tr>
<tr>
<td>10,000 lb</td>
<td>1 - Head 8' Long</td>
<td>2 - Wedge Sets</td>
</tr>
<tr>
<td>16,000 lb</td>
<td>4 x 4 Posts is 12'</td>
<td>1 for Shore up to 5' 6&quot; Feel High</td>
</tr>
</tbody>
</table>

Welded Steel (See Additional Information)

This shore is the same as the 2,000 lb. or 4,000 lb. post II can be used.

Max Height for Shore W/ 2 x Diagonal Bracing
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

Design Load 6 x 6 posts:
- Height = 12 feet  40,000 lb
- Height = 14 feet  29,000 lb
- Height = 16 feet  24,000 lb

**HOW TO CONSTRUCT THE 2-POST VERTICAL SHORE**

1. Determine where to erect the 2-Post Vertical Shore, the condition of the supporting structure and/or ground, and remove least amount of debris required to place the shore.
   - If practical, this shore should be partially prefabricated, same as for the Laced Post.
   - If using 4x4 posts, space 4 feet, max on center. 6x6 posts may be 5 feet max on center. If access is limited, Post Spacing may be reduced to 3 feet on center.
   - May build 2-Post Shore in pairs, to later convert two, single 2-post vertical shores into a Laced Post for better stability.

2. Measure and cut the posts to the proper height. (remember to deduct for header, sole & wedges when cutting posts). Also, cut the mid-brace and diagonals to proper lengths.
   - Header shall have a 12 inch overhang each end.
   - Toe-nail posts to header as assembly, first step, then make them square with the header.
   - Nail Half Gussets at posts to header. Make outside edge of half-gusset flush with outside of posts.
   - Nail Mid-Brace to both posts.
   - Nail upper 2x4 diagonal to posts and header.

3. Cut the sole and wedges. Sole is same length as header.
4. Place 2-Post Shore in position, centered under the load.
5. Slide sole plate under shore and tap wedges into position.
6. Check for straightness plus stability, then tighten wedges.
7. Install lower diagonal and half gussets and nail properly.
8. Backing under Sole on Soil:
   - Use 3-2x6x18" under sole centered on each post. (or 2-18"x18"x 3/4" plywood)
9. Anchor the shore to floor above and sole to floor below, if practical.

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CONSTRUCTING VERTICAL SHORING SYSTEMS

Design Load 6 x 6 posts:
- Height = 12 feet  40,000 lb
- Height = 14 feet  29,000 lb
- Height = 16 feet  24,000 lb

**HOW TO CONSTRUCT THE 2-POST VERTICAL SHORE**

1. Determine where to erect the 2-Post Vertical Shore, the condition of the supporting structure and/or ground, and remove least amount of debris required to place the shore.
   - If practical, this shore should be partially prefabricated, same as for the Laced Post.
   - If using 4x4 posts, space 4 feet, max on center. 6x6 posts may be 5 feet max on center. If access is limited, Post Spacing may be reduced to 3 feet on center.
   - May build 2-Post Shore in pairs, to later convert two, single 2-post vertical shores into a Laced Post for better stability.

2. Measure and cut the posts to the proper height. (remember to deduct for header, sole & wedges when cutting posts). Also, cut the mid-brace and diagonals to proper lengths.
   - Header shall have a 12 inch overhang each end.
   - Toe-nail posts to header as assembly, first step, then make them square with the header.
   - Nail Half Gussets at posts to header. Make outside edge of half-gusset flush with outside of posts.
   - Nail Mid-Brace to both posts.
   - Nail upper 2x4 diagonal to posts and header.

3. Cut the sole and wedges. Sole is same length as header.
4. Place 2-Post Shore in position, centered under the load.
5. Slide sole plate under shore and tap wedges into position.
6. Check for straightness plus stability, then tighten wedges.
7. Install lower diagonal and half gussets and nail properly.
8. Backing under Sole on Soil:
   - Use 3-2x6x18" under sole centered on each post. (or 2-18"x18"x 3/4" plywood)
9. Anchor the shore to floor above and sole to floor below, if practical.
Note: Maximum height using 4x4 posts is 12 feet.

4 to 6 high, 6 to 11, 11 to 17, 17 to 20 feet.

- 2x4 for 4x4 posts & 2x6 for 6x6 posts.
- 2x6 for 6x6 posts.
- 2x4 for 4x4 posts.
- Diagonal braces: (Max. length is 7.6 ft.) Each side if header is shorter than wall.

One side if header same size as post, except where diagonal.

5. Head Panels at Top:
   - Then only one side (2x4 for 4x4 posts; 2x6 for 4x6 posts).
   - Each side to continue wedge, except where diagonal connects.

4. Header and Soe:
   - Same size as posts in most cases.

3. Posts: 4x4 or 4x6.
   - Maximum store height for 6x6 posts: 20 feet.
   - Maximum store height for 4x4 posts: 12 feet.

ADDITIONAL INFORMATION - POST STORE

CONSTRUCTING VERTICAL STORAGE SYSTEMS

USER STRUCTURES SPECIALIST FOCG
DESIGN LOAD: 4x4 posts = 32,000lb 6x6 posts = 80,000lb

LACED POST SHORE (VERTICAL CLASS 3)

CONSTRUCTION VERTICAL SHORING SYSTEMS

USER STRUCTURES SPECIALIST FOC
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE LACED POST SHORE
1. Survey, install spot shores (if needed), and remove the least amount of debris required to place the shore.
2. Determine the length and height of the shore.
   • Cut the header and sole plates 24 inches longer than width of the shore to allow for 12 inch overhangs.
   • Cut the posts to allow for header, sole and wedges.
3. Nail posts to header with toenails and keep them square.
   • Check by comparing diagonal, full-height distances (outside top-right to outside bottom-left, should be same as outside top-left to outside-bottom right).
   • If posts are not straight, set both with bow-out.
   • Nail a half-gusset to one post/header joint, then nail the midpoint brace (braces) in position. Re-check diagonal measurement and pull-in any bow-out.
4. Measure and install the top diagonal, so it overlaps and ties into the header. Use proper nail pattern.
5. Measure and install mid-diagonals, if required by height.
6. Fabricate the second section, using first as template.
7. Have the horizontal tie-in braces precut for ease of assembly.
8. Bring both sections and the sole plates into position and place the prefabricated units on top of the sole plates.
9. Install wedges under each post, and check post spacing.
10. Nail the horizontal braces to the two sections on both sides. Start with the lowest mid-brace and work up.
11. Measure for all the diagonals, and configure in K or parallel layout, as best works for the situation.
   • Avoid intersecting too many diagonals on a post at a single location.
12. At the sole plate, make sure the bottom diagonal extends past the post and nails into the sole plate.
   • Place a half-gusset plate onto the opposite side of this post and to each side of the other posts at the base. (Outside edge flush)
13. Anchor the shore to the ceiling and floor, if practical.
14. Make sure all wedges are snug and the proper nail patterns were used.

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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE LACED POST SHORE
1. Survey, install spot shores (if needed), and remove the least amount of debris required to place the shore.
2. Determine the length and height of the shore.
   • Cut the header and sole plates 24 inches longer than width of the shore to allow for 12 inch overhangs.
   • Cut the posts to allow for header, sole and wedges.
3. Nail posts to header with toenails and keep them square.
   • Check by comparing diagonal, full-height distances (outside top-right to outside bottom-left, should be same as outside top-left to outside-bottom right).
   • If posts are not straight, set both with bow-out.
   • Nail a half-gusset to one post/header joint, then nail the midpoint brace (braces) in position. Re-check diagonal measurement and pull-in any bow-out.
4. Measure and install the top diagonal, so it overlaps and ties into the header. Use proper nail pattern.
5. Measure and install mid-diagonals, if required by height.
6. Fabricate the second section, using first as template.
7. Have the horizontal tie-in braces precut for ease of assembly.
8. Bring both sections and the sole plates into position and place the prefabricated units on top of the sole plates.
9. Install wedges under each post, and check post spacing.
10. Nail the horizontal braces to the two sections on both sides. Start with the lowest mid-brace and work up.
11. Measure for all the diagonals, and configure in K or parallel layout, as best works for the situation.
   • Avoid intersecting too many diagonals on a post at a single location.
12. At the sole plate, make sure the bottom diagonal extends past the post and nails into the sole plate.
   • Place a half-gusset plate onto the opposite side of this post and to each side of the other posts at the base. (Outside edge flush)
13. Anchor the shore to the ceiling and floor, if practical.
14. Make sure all wedges are snug and the proper nail patterns were used.
Note: Maximum height using 4 x 4 posts is 17' 7" high
4' to 6' high; 6' to 11'; 11' to 17'; 17' to 20' high.

**Configuration shown below (equally spaced):**
- 8' Mid-point braces and horizontal struts: 2 x 4, 2 x 6 in.
- 2 x 4 for 4 x 4 posts.
- 7' Diagonal braces:
  - Each side where no diagonals.
  - One side (internal) at diagonal.
  - 6' Half-cussels at bottom.
  - 5' Half-cussels at top.
  - 4' Header and sole: same size as posts.
  - 6 x 6 posts: Maximum 5 feet on center.
  - 4 x 4 posts: Maximum 4 feet on center.
  - 3' Posts: Same spacing each way.

**Additional Information - Laced Post Shore**

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**Construction Vertical Shore Systems**
**US&R SHORING OPERATIONS GUIDE**
**CONSTRUCTING VERTICAL SHORING SYSTEMS**

**MOST COMMON CONFIGURATION – LACED POST SHORE**

<table>
<thead>
<tr>
<th>Material List: (for 6ft to 1ft high)</th>
<th>2 each Header &amp; Sole</th>
<th>8 Half gussets</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Posts</td>
<td>4 Wedge Sets</td>
<td></td>
</tr>
<tr>
<td>Diagonal and</td>
<td>4 for shore up to 6 feet high</td>
<td></td>
</tr>
<tr>
<td>Horizontal Bracing</td>
<td>8 for shore from 6ft to 11 ft</td>
<td></td>
</tr>
<tr>
<td>(number for each)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Design Load: 4x4 Posts = 32,000lb  6x6 Posts = 80,000lb
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE 2' X 4' PLY LACED POST
1. Survey, install spot shores (if needed), and remove least amount of debris required to place the shore.
2. Determine the height of the shore.
   • Cut the header and sole plates to 4 feet in length. (12" O.hangs)
3. Nail posts to header with toenails and keep them square.
   • Check by comparing diagonal, full-height distances (outside top-right to outside bottom-left, should be same as outside top-left to outside-bottom right).
   • If posts are not straight, set both with bow-out.
   • Nail a double gusset: header to both posts.
   • Nail the plywood mid braces in position. Re-check diagonal measurement, & if posts bow-out, pull them in with the plywood braces. Use proper nail pattern.
4. Fabricate the second section, using first as template.
5. Have the plywood braces precut for ease of assembly.
6. Bring both sections and the sole plates into position and place the prefabricated units on top of the sole plates.
   • Make sure that the prefabricated units are spaced 4 foot out to out, to allow for 4 ft plywood braces.
7. Install wedges under each post, and check post spacing.
8. Nail the plywood braces to the two sections on both sides (start with lower ones and climb up).
9. Nail the top and bottom plywood braces in place.
   • Place a half-gusset plate on each side of each post to sole, with outside edge of gusset flush w/ post outside face.
10. Anchor the shore to the ceiling and floor, if practical.
11. Make sure all wedges are snug and the proper nail patterns were used.
10. Plywood backing configuration for various heights is shown.
9. All plywood may be 5/8" or 3/4" (or OSB for dry conditions).
8. Plywood middle brace: 24" x 24" x 48" plywood.
7. Plywood top and bottom brace: 6" x 48" plywood.
6. Halflug, each side of each post at bottom.
5. Double gusset on outside at top, header to both posts.
4. Header and sole: same size as posts.
3. Posts: 4 x 4 and 6 are spaced the same.

ADDITIONAL INFORMATION - 2x4 Plywood Laced Post
### US&R SHORING OPERATIONS GUIDE
### CONSTRUCTING VERTICAL SHORING SYSTEMS

#### 4" x 4" PLYWOOD LACED POST (Vertical/Class 3)

<table>
<thead>
<tr>
<th>Material List:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2- each Header &amp; Sole</td>
</tr>
<tr>
<td>4 – Posts</td>
</tr>
<tr>
<td>8” x 48” top/bottom braces</td>
</tr>
<tr>
<td>24” x 48” ply mid-braces</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

High Capacity four post system, similar to standard Laced Post, but braced together with plywood.

Design Load: 4 x 4 posts = 32,000 lb   6 x 6 posts = 80,000 lb
HOW TO CONSTRUCT THE 4’ X 4’ PLAY LACED POST

1. Make sure all wedges are snug and the proper nail patterns
2. Punch a half-gusset plate on each side of each post to 3/4".
3. Nail the 4x4 and 4x4's to the posts and check for square.
4. Check by comparing diagonal. ll-hs should be same as outside top.
5. Cut a half-gusset from header into bottom post.
6. Nail a half-gusset from header to bottom post.
7. Cut the header and set pile to 6 feet into ground. (1/2" O-Hangs)
8. Define the length and width of the shoe.
9. Remove all debris required to place the shoe.
10. Install spot shores (if needed) and remove least.

CONSTRUCTION VERTICAL SHOULDER SYSTEMS

HOW TO CONSTRUCT THE 4’ X 4’ PLAY LACED POST

1. Make sure all wedges are snug and the proper nail patterns
2. Punch a half-gusset plate on each side of each post to 3/4".
3. Nail the 4x4 and 4x4's to the posts and check for square.
4. Check by comparing diagonal. ll-hs should be same as outside top.
5. Cut a half-gusset from header into bottom post.
6. Nail a half-gusset from header to bottom post.
7. Cut the header and set pile to 6 feet into ground. (1/2" O-Hangs)
8. Define the length and width of the shoe.
9. Remove all debris required to place the shoe.
10. Install spot shores (if needed) and remove least.
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CONSTRUCTING VERTICAL SHORING SYSTEMS

ADDITIONAL INFORMATION – 4’x4’ Plywood Laced Post
1. Maximum shore height for 4 x 4 posts: 17 feet.
2. Maximum shore height for 6 x 6 posts: 17 feet.
3. Posts: 4 x 4 and 6 x 6 are spaced the same.
   • Space 4 foot x 4 foot out to out (to match plywood).
4. Header and Sole: same size as posts.
5. Half Gusset on outside at top for each post.
6. Half Gussets each side each post at bottom.
7. Plywood top and bottom braces: 8” x 48” plywood.
8. Plywood middle braces: 24” x 48” plywood.
   • Distance from top or bottom of shore to nearest middle brace for
     9 ft to 17 ft heights shall be 2’-0” maximum.
   • There shall be a middle brace placed, centered at the half-
     height of the shore for 13 ft to 17 ft heights.
9. All plywood may be 5/8” or 3/4” (or OSB for dry conditions).
10. Plywood bracing configuration for various heights is shown below:

![Diagram of different shore heights with bracing configurations.]

4’ to 9’ high  9’ to 13’  13’ to 17’ high

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DEPARTMENT OF CONSTRUCTION MANAGEMENT
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT SLOPED FLOOR SHORE—TYPE 2
(May be constructed on Paving or on Soil)

1. Survey, install spot shores (if needed), and remove least amount of debris required to place the shore.
2. Determine length and width of shore and post locations.
   - Header overhang is 12 inch maximum. Sole must extend 30" longer from front of longer post, to allow for cleat & anchors.
   - Shore is built as pair of 2-post sections, like laced post.
   - The 2 sections should be placed from 4 ft to 8 ft on center
3. Cut and install the headers and soles.
   - If shore is installed on soil, the standard 18" x 18" foot should be placed under sole at each post. (3-2x6x18" or 2-layers 3/4" ply)
4. Measure and install the two posts at each section.
   - Make angle and return cuts similar to rakers.
   - Toe-nail posts to headers, and drive bottoms of posts tight and toe-nail.(no wedges, since they get in the way of the braces)
5. Install bottom cleats tight against each post.
6. Anchor the sole plates, as follows:
   - Anchor sole using drilled-in anchors into concrete, or 1"dia. X 36" pickets to anchor to paving or soil, based on Structures Spec. recommendations. (2 minimum per 2-post section).
   - See page 3-9 for alternate Sole Plate Anchor system.
7. Measure for diagonal braces inside and outside each section.
8. Install 2x6 diagonal braces in position and nail to posts, headers and sole plates.(may use 3-16d into posts to limit splitting)
   - Cleat/Half Gusset plate the opposite side of the posts, top and bottom, using the 4 and 4 nail pattern.
   - Need to place Half Gussets to clear the horizontal and diagonal braces (to be installed next), or use 2x cleats instead of gussets.
9. Tie the two sections together, same as in Laced Posts. (See Additional Information for alternatives).
   - Ties are placed between posts at the taller and the shorter ends of each shore section.
   - Use a wide piece of 5/8" or 3/4" plywood (12" to 24" wide) if short end of shore is too short to fit X braces.
   - The plywood or 2x6 bracing may be installed on the inside of the shorter posts, if that is easier.
10. Attach to the floor and ceiling. (If possible).
**US&R SHORING OPERATIONS GUIDE**  
**CONSTRUCTING VERTICAL SHORING SYSTEMS**

**ALTERNATE METHODS for building VERTICAL SHORES**

1. **Shoring Lumber**: If No 1 Douglas Fir is not available
   - Use S. Pine, Hem-Fir or Spruce-Pine-Fir, at 85% Design Load
   - Also may use Eastern Softwoods, Western Cedar, & Western Woods, by reducing the Design Load to 75%.
   - This applies to 1x4, 2x4, 2x6, 4x4, and 6x6 lumber.
   - May use 19/32 CDX plywood or Oriented Strand Board (OSB)

2. If 4 x 4 lumber IS NOT available, may use 3-2x4s:
   - For Posts, Headers, & Soles in Vertical, Sloped Fl, & Window Shores, each 2x4 must be full length.
   - Nail 3-2x4s together with 16d sinker/cooler @ 5"o.c. stagger. thus: \(\ldots\) from each side. (.148 x 3.25” coated nails)
   - If using 8ft long (3-2x4) for Raker Wall & Sole Plates: stagger all joints by 2ft min, and locate only one joint in any location.
     - 12ft long example:
       - \(\begin{array}{c|c|c|c|c|c|c|c}
         6" & 8" & 4" & 6" & 8"
       \end{array}\)
       - Locate splice within 2ft of brace point. See Structures Spec.

3. **Sloped Floor Shore Special Notes**:
   - If taller than 8ft for 4x4 & 12ft for 6x6 Posts:
     - Add mid-point bracing and sets of diagonals same as for Laced Posts. See page 2-30.
     - Post spacing is 4ft o.c. for 4x4 and 5ft o.c. for 6x6.
     - Maximum height is 12ft for 4x4 and 16ft for 6x6.
   - If slope of structure is greater than 45 deg., build shores to be more like Rakers, spaced at 4ft o.c.
     - Provide mid-brace if Raker/Post is more than 8ft long.
     - Consult Struct Spec. for cleat nailing & sole anchors.
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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT SLOPED FLOOR SHORE–TYPE 3
1. Survey, install spot shores (if needed), and remove debris.
2. Determine length and width of shore and post locations.
   • Shore is built as pair of 2-post sections, like laced post.
   • The 2 sections should be placed from 4 ft to 8 ft on center
   • Header overhang is 12 inches on shorter end, but should be increased to 30" at higher end for cleat and anchors. Sole plates should extend 12 inches beyond each post.
   • Install headers and sole plates, and anchor header.
   • If shore is installed on soil, the standard 18" x 18" foot should be placed under the sole at each post.
3. Measure, angle/return cut, and install the two posts for each section; toe-nail to header, then drive posts tight and plum. **Wedges are optional**, but may be used as with vertical shores.
4. Make sure posts are plumb, and install remaining 18" top cleats.
5. Attached header to ceiling/slab bottom with 2 - 1 1/2" x 8 1/2" wedge anch., or 1/2" rebar/plain bar x 8" min. (embed at least 4")
6. Anchor the sole plate, and re-check/re-drive the post tight.
7. Measure for the diag. braces inside/outside of each section.
8. Install 2x6 diagonal braces in position and nail to posts, header, and sole plate. (may use 3-16d into posts to limit splitting)
   • Place Half-Gusset plate the opposite side of the posts, top and bottom, and complete gusset nailing – 4 & 4, 8d.
   **Note:** Half-Gussets may be installed with posts – partly nailed.
   • Need to place Half-Gussets to clear the horizontal and diagonal braces (to be installed next) -
9. Tie the two sections together, same as in Laced Posts. (See Additional Information for alternatives)
   • Ties are placed between posts at the taller and the shorter ends of each shore section.
   • Use a wide piece of 5/8" or 3/4" plywood (12" to 24" wide) if short end of shore is too short to fit X braces.
   • The plywood or 2x6 bracing may be installed on the inside of the shorter posts, if that is easier.
10. Attached to the floor and ceiling. (If possible).
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CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT CRIBBING
1. Survey, install spot shores (if needed), and remove debris.
2. Determine where Spot Shores should be built in order to quickly reduce risk.
3. Determine overall height of area to be shored and remove least amount of debris required to place shore.
4. Determine the desired width dimensions of the crib.
5. Determine the size of the members to be used, and the configuration of the crib layers.
   • Use 6x6 members if crib needs to be more than 4 ft high.
   • Note that the 3-member x 3-member configuration is more than 2 times as strong as 2-member x 2-member.
6. Decide if the first layer needs to be a solid layer, depending on the type of bearing material. (soil or other surface softer than a concrete slab.
   • If the supporting surface is concrete, make sure that it has the required stiffness and capacity, and there is not a basement story below.
7. Carefully slide the members in for each layer, and keep the crib aligned and as square as possible.
8. When the crib reaches required height, add shims to make sure that all intersections of crib members are in solid contact with the supported structure.
9. Attach the crib to the supporting surface (or confine its movement), if practical.
10. Where vibration and aftershocks may occur, interconnect the crib layers with 3/8” min x 16” long plywood strips that are 1.5 times as high as the cribbing members.
    • The plywood strips need to be placed on all 4 sides of the crib.
    • Nail plywood strips at top and bottom edges to crib members with 8d at 3 inches on center as shown below:

US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT CRIBBING
1. Survey, install spot shores (if needed), and remove debris.
2. Determine where Spot Shores should be built in order to quickly reduce risk.
3. Determine overall height of area to be shored and remove least amount of debris required to place shore.
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   • Use 6x6 members if crib needs to be more than 4 ft high.
   • Note that the 3-member x 3-member configuration is more than 2 times as strong as 2-member x 2-member.
6. Decide if the first layer needs to be a solid layer, depending on the type of bearing material. (soil or other surface softer than a concrete slab.
   • If the supporting surface is concrete, make sure that it has the required stiffness and capacity, and there is not a basement story below.
7. Carefully slide the members in for each layer, and keep the crib aligned and as square as possible.
8. When the crib reaches required height, add shims to make sure that all intersections of crib members are in solid contact with the supported structure.
9. Attach the crib to the supporting surface (or confine its movement), if practical.
10. Where vibration and aftershocks may occur, interconnect the crib layers with 3/8” min x 16” long plywood strips that are 1.5 times as high as the cribbing members.
    • The plywood strips need to be placed on all 4 sides of the crib.
    • Nail plywood strips at top and bottom edges to crib members with 8d at 3 inches on center as shown below:
CONSTRUCTION: VERTICAL SHORING SYSTEMS

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ADDITIONAL INFORMATION - CHIPPING
Cribbing can be built under a concrete sloped floor. Wedges and shims should be added to each layer in order to achieve the slope gradually. The Max. Slope should be 30% off the horizontal (about 15 deg). The Max. Height should be 4ft when using 4x4 lumber, and 6ft for when using 6x6 lumber.

Material List:
Depends on height, number of pieces per layer and the height of each piece. See configurations below.
### Window and Door Shore (Vertical Class 2)

**Construction Vertical Shoring Systems**

**User Structures Specialist FOC**

<table>
<thead>
<tr>
<th>Material List</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Cleats</td>
<td>Shims as required</td>
</tr>
<tr>
<td>2 Posts</td>
<td>1 Hairpinner</td>
</tr>
<tr>
<td>Header and Sole</td>
<td>4 Wedge Seeds</td>
</tr>
</tbody>
</table>

Design Load: 4 x 4 ft (not used for access)
6 x 6 = 6000 lb

This shore is used in LRM buildings to support loose masonry over openings. May be used in other building types where door/window headers are damaged.
US&R SHORING OPERATIONS GUIDE  
CONSTRUCTING VERTICAL SHORING SYSTEMS

HOW TO CONSTRUCT THE WINDOW/DOOR SHORE
1. Survey, remove finishes (if required), and remove debris.
2. Measure and cut the sole plate and header to the proper length deducting the width of the wedges to be used.
3. Make header 1" deep for every foot of opening; 4x4 min.
4. Have StS design header for opening over 4ft wide.
5. Measure and cut the posts to the proper height.
   • Place the header on top of the sole plate.
   • To determine post height, place the end of the tape measure on top of the header where the posts are to be installed, slide the tape up to the bottom of the structural element to be shored deducting the thickness of the wedges to be used. (Use the shorter of the two measurements).
6. Install the sole with a set of wedges at one end and tap them together simultaneously until the sole is tight.
7. The sole should be as level as possible: use shims as necessary under the sole plate.
8. Install the header with a set of wedges at the opposite end of the sole and tap them together until the header is tight.
9. The header should be as level as possible; use shims as necessary above the header.
10. Install the posts between the header and sole, and against the sides of the opening.
11. Install the first post under the wedge side of the header to prevent movement if the header wedges loosen.
12. Keep posts in line and plumb with header and sole.
13. Install a wedge set under each post, on top of the sole. Wedges are then tightened to lock shore in place.
14. Attach cleat and half-gusset to at least one side of the header and posts and nail in place.
15. Confine the wedges by placing a cleat against the inside face of each post at the bottom and nail them in place with 3-16d nails to each post and 2-16d toe nails to the sole.
   • May use duplex nails for future adjustment of the wedges.
CONSTRUCTION VERTICAL SHORING SYSTEMS

USER STUDY DEPARTMENT

1. Pre-constructed Window/Door Shores may be pre-constructed as shown in next page(s).

2. Pre-constructed Window/Door Shores must be pre-constructed as shown in next page(s).

### WARNING

- The use of air pressure to raise these
counterweighted vertical shores should be limited to no more than 2 ft. Some manufacturers provide a header rail that may be used to alter the height of the shores.

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**US&R SHORING OPERATIONS GUIDE**
**CONSTRUCTING VERTICAL SHORING SYSTEMS**

**PREFABRICATED WINDOW/DOOR SHORE**
Alternate to built in-place Window/Door Shore. Main advantage is to allow pre-construction a safe distance from the collapse zone. Also the shore can be reused.

<table>
<thead>
<tr>
<th>Material List:</th>
<th></th>
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<tbody>
<tr>
<td>Header and Sole</td>
<td>4 - Wedge Sets</td>
</tr>
<tr>
<td>2 - Posts</td>
<td>8 - Half Gussets</td>
</tr>
</tbody>
</table>

Design Load: 4x4 Header = 2,000 lb  6x6 = 6000 lb
CONSTRUCTING VERTICAL SHADING SYSTEMS

USER'S GUIDE TO SPECIAST FOG

HOW TO CONSTRUCT THE PREFA: WINDOW/DOOR STORER

1. Measure and cut post length should allow for the thickness of
   the header and the header and wall stud connections.
2. Measure opening and check to see if it is square or level.
3. Measure opening and check to see if it is square or level.
4. Measure and cut post length should allow for the thickness of
   the header and the header and wall stud connections.
5. Place one hard gusset from each post to header and to floor.
6. Turn over and place a hard gusset on opposite side of
   header.
7. Carry over to opening and install one wedge set under the sole
   of the gusset.
8. Install one wedge set between header and door/window side
   edge.
9. Install one wedge set between sole and door/window side
   edge.
10. Place trim between top of header and top edge of opening.

CONSTRUCTING VERTICAL SHADING SYSTEMS

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US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

VERTICAL SHORING USING PNEUMATIC STRUTS

Pneumatic Strut Manufacturers have developed special configurations that may be used to construct Vertical Shores. See following pages for configurations.

1. Struts may be configured as T, Dbl-T, Vertical 2-post and Multi-Post Shores. In addition there are special configurations such as: 3-Post Column, Sloped Floor Shore, Window/Door Shore, and Laced Post Shore.

2. Wood headers are used in most cases, and Wood Soles are needed when the load needs to be spread-out on the structure that is supporting the shore.

3. The standard Pneumatic Shore Base Plates may be used when shore in bearing on an adequate concrete slab. Consult qualified Structures Specialist.

4. The Design Load of these shores may be determined by knowing the height and number of struts that are used. The Strut Load Tables are shown in Sect 4 of SOG & Sect 7 of FOG. Consult qualified Structures Specialist, since other factors such as header or sole strength may govern the shore capacity.

5. Low pressure air (50psi max) may be used to extend the struts, but care must be taken to not impact the structure.

6. Use hand tightening to snug-up all joints.

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US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

VERTICAL SHORE
Use 3 or more struts with header, sole and X-bracing as shown.

Design Load may be based on the length of the struts as given in the table in Sect 7.

2-POST VERTICAL SHORE
Use 2-vertical struts, plus a diagonal strut that must be configured to resist both tension & compression.

STD. Rigid or Swivel Base w/ Nails

Angle of abt 35°

2x6 Diagonals (1 each side)

Nails

6x Header

6x Sole

Angle Base or Channel Base w/nails

US&R SHORING OPERATIONS GUIDE
CONSTRUCTING VERTICAL SHORING SYSTEMS

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6x Sole

Angle Base or Channel Base w/nails
SLOPED FLOOR SHORE

Connected to the structure.

Supposedly, they remain.

Design load is limited.

Temporary. Spot Shoring.

Uses a minimum of 2.

STREET COLUMN

Concrete support:

3" x 2" square

4 layers of steel tubing:

16 gauge

Top and bottom

Wood cap:

4 layers of plywood:

16 gauge

Foundation under:

3" x 2" square

Concrete:

3-STORY COLUMN

May also need:

3" x 2" square

Concrete cap:

3-STORY COLUMN

Design load is limited.

Flexible Shoring:

Uses a minimum of 2.

SLOPED FLOOR SHORE

in Section 7.

Tension is given in the table

based on the length of the
depth of the structure.

Design load may be

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16 gauge

Top and bottom

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Concrete:

3-STORY COLUMN

May also need:

3" x 2" square

Concrete cap:

3-STORY COLUMN

Design load is limited.
WINDOW OR DOOR SHORE
This shore uses 2-pneumatic struts with wood header / sole. It would be used as a temporary shore when wood posts were not available.

Shore capacity would be based on the size and strength of the wood header. A qualified Structures Specialist should be consulted if a Design Load of more than 2,000lb is needed to support the opening.
All horizontal and diagonal members must be special stubs.

Each still will need a metal, manufactured base.

This shore should only be used when its specified and supervised by a qualified Shoreside Specialist.

4x6 wood or steel tube headers.
INTRODUCTION to SECTION 3

This section contains General Information, Graphics and Detailed Explanations of how to construct FEMA Raker and Horizontal Shoring – arranged as follows:

- Raker Shore – General Information
  - Types of Rakers  page 3-2
  - Raker Cleats & Gussets  3-3
  - How to determine Raker Angle & Length  3-4
  - Raker Shore Bracing  3-6
  - Backing for Rakers at Special Walls, & Raker Splice  3-8
  - Trough Base and Sole Anchor  3-9
  - Use of Framing Square  3-10

- How to construct Raker Shores  3-11
  - Flying Raker – Spot Shore  3-12
  - Raker with backing for Wood or Masonry Walls  3-15
  - Solid Sole Raker  3-16
  - Split Sole Raker  3-20
  - Double Raker  3-23
  - Alternate – Using 3-2x4 studs to build Rakers  3-25

- How to construct Horizontal Shores  3-26

- Tiebacks and Alternate Raker Systems  3-29

- Pneumatic Strut Systems: Horizontal & Raker Shores  3-31

Note: See Sect 2 for Size-up, and General Information and Shoring Details.
### Raker Shores: General Information

**ConstrucTing Lateral Shoring Systems**

**User's Shoring Operations Guide**

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Material List</td>
<td>See each individual system.</td>
</tr>
<tr>
<td>Soils and Soil Slope</td>
<td>All have unique characteristics.</td>
</tr>
<tr>
<td>Load in Earth and Rescue Inclines to Stabilize Learning</td>
<td></td>
</tr>
</tbody>
</table>

#### Class 3 Systems

- To the wall. Build as many of class 3 systems as next to the wall. When there is soil, use tenters. One system, Solid. (Full Tension)
- Raker: Solid Saddle

- To the base, if on or adjacent to the wall, when cracks next to the wall. Temporary, solid raker. (Full Tension)
- Raker: Flying (Full Tension)

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**US&R Shoring Operations Guide**

**Constructing Lateral Shoring Systems**

**Raker Shores: General Information**

1. Raker Shores may be built in a progression, starting with Flying Raker, to stabilize the wall, followed by a group of Full Triangle Rakers (Since Full Triangle Rakers are mostly pre-fabricated, they may be installed without first installing Flying Rakers).

2. **Top Cleat for 4 x 4 Raker**
   - 24 inches with 14 – 16d nails for 45 degree rakers.
   - 30 inches with 20 - 16d nails for 60 degree rakers.

3. **Top Cleat for 6 x 6 Raker**
   - 24 inches with 20 – 16d nails for 45 degree rakers.
   - 30 inches with 29 - 16d nails for 60 degree rakers.

4. **Bottom Cleat**
   - 24 inches with 14 – 16d nails for 4 x 4 rakers.
   - 24 inches with 20 - 16d nails for 6 x 6 rakers.

5. **Plywood Gussets**: 5/8” or 3/4” (OSB if not wet area).

6. **Sole Anchor**: All rakers need a Sole Anchor. (shown later)

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Determining Raker Shore Angle & Length

Construciting Lateral Shoreline Systems

User's Operating Guide
USAR SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

RAKER LENGTH BASED ON INSERTION POINT HEIGHT

<table>
<thead>
<tr>
<th>Insertion Point</th>
<th>45° Raker L Inches / Feet</th>
<th>60° Raker L Inches / Feet</th>
<th>60° Horiz. Dist. Inches / Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ft</td>
<td>51&quot; / 4'-3&quot;</td>
<td>42&quot; / 3'-6&quot;</td>
<td>21&quot; / 1'-9&quot;</td>
</tr>
<tr>
<td>4</td>
<td>68&quot; / 5'-8&quot;</td>
<td>56&quot; / 4'-8&quot;</td>
<td>28&quot; / 2'-4&quot;</td>
</tr>
<tr>
<td>5</td>
<td>85&quot; / 7'-1&quot;</td>
<td>70&quot; / 5'-10&quot;</td>
<td>35&quot; / 2'-11&quot;</td>
</tr>
<tr>
<td>6</td>
<td>102&quot; / 8'-6&quot;</td>
<td>84&quot; / 7'-0&quot;</td>
<td>42&quot; / 3'-6&quot;</td>
</tr>
<tr>
<td>7</td>
<td>119&quot; / 9'-11&quot;</td>
<td>98&quot; / 8'-2&quot;</td>
<td>49&quot; / 4'-1&quot;</td>
</tr>
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<td>8</td>
<td>136&quot; / 11'-4&quot;</td>
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</tr>
<tr>
<td>9</td>
<td>153&quot; / 12'-9&quot;</td>
<td>126&quot; / 10'-6&quot;</td>
<td>63&quot; / 5'-3&quot;</td>
</tr>
<tr>
<td>10</td>
<td>170&quot; / 14'-2&quot;</td>
<td>140&quot; / 11'-8&quot;</td>
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</tr>
<tr>
<td>11</td>
<td>187&quot; / 15'-7&quot;</td>
<td>154&quot; / 12'-10&quot;</td>
<td>77&quot; / 6'-5&quot;</td>
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<tr>
<td>12</td>
<td>204&quot; / 17'-0&quot;</td>
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<td>306&quot; / 25'-6&quot;</td>
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</table>

Vertical, force from Raker trends to cause Wall Plate to move up the wall. Need to anchor Raker to wall with Steel Bar Anchors, or bear part of wall plate on existing wall projection.

INSCRIPTION POINT
Horizontal force from Raker trends to keep wall/bldg from moving.

Horizontal force from Raker must be resisted by Sole Anchor, or Steel Pickets.

Vertical force from Raker must be resisted Paving, or special foot on soil.

FORCES in RAKER SHORES

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CONSTRUCTING LATERAL SHORING SYSTEMS

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<td>238&quot; / 19'-10&quot;</td>
<td>119&quot; / 9'-11&quot;</td>
</tr>
<tr>
<td>18</td>
<td>306&quot; / 25'-6&quot;</td>
<td>252&quot; / 21'-0&quot;</td>
<td>126&quot; / 10'-6&quot;</td>
</tr>
<tr>
<td>19</td>
<td>323&quot; / 26'-11&quot;</td>
<td>266&quot; / 22'-2&quot;</td>
<td>133&quot; / 11'-1&quot;</td>
</tr>
<tr>
<td>20</td>
<td>340&quot; / 28'-4&quot;</td>
<td>280&quot; / 23'-4&quot;</td>
<td>140&quot; / 11'-8&quot;</td>
</tr>
</tbody>
</table>

Vertical, force from Raker trends to cause Wall Plate to move up the wall. Need to anchor Raker to wall with Steel Bar Anchors, or bear part of wall plate on existing wall projection.

INSCRIPTION POINT
Horizontal force from Raker trends to keep wall/bldg from moving.

Horizontal force from Raker must be resisted by Sole Anchor, or Steel Pickets.

Vertical force from Raker must be resisted Paving, or special foot on soil.

FORCES in RAKER SHORES
3.6
directly over other nails

骄傲 it the horizontal nails to the rakers. (The nails
adhesive to which the horizontal nails to the rakers. (The nails
the second adhesive to all nails to the horizontal braces just
Place the first adhesive of each set directly against the rake. Place
rakers. X-spacing should be no more than 2 ½ feet on center;
Nombrly the X-spacing should be situated between the ends of the
mid-line. X-spacing is shown by dashed lines. 
This is an example of a four raker system, when the rakers have a

*Required: See each individual system.

Trough base and sole anchors

Bearing against wall and raker splice

Bearing between rakes

Most all raker installations have multiple numbers of

RAKER SHORES: Multi-Shore Bracing, Backing.

CONSTRUCTION LATERAL SHORING SYSTEMS

USER SHORING OPERATIONS GUIDE
BRACING BETWEEN RAKERS
1. Rakers are normally spaced at 8 feet on center maximum. However, actual conditions may require closer spacing.
2. Lateral Bracing between rakers is normally built using 2x6 horizontals and X-bracing.
3. Depending on height of insertion point, rakers may have mid-bracing to reduce to potential of buckling. In this case the lateral bracing will have a horizontal placed near the intersection of mid-brace and raker, and there will be two levels of X-bracing.
4. Horizontal Bracing: 2 x 6 or 2-2x4.
   - Butt splice at center of raker. Preferred if 16ft long.
   - 3 – 16d nails at each horizontal brace to each raker.
   - Cover each splice with Half Gusset, 8-8d.

5. Middle Horizontal Bracing: (If raker has mid-point brace).
   - 4 x 4 raker: required if length of raker > 11 feet.
   - 6 x 6 raker: required if length of raker > 16 feet.

6. Diagonal Bracing
   - "X" bracing: Use 2 x 6 or 2-2x4 (side by side). Allow no more than 32 ft (4 bays) between bracing bays. 5-16d each end each brace, and where they cross. (X-bracing 40 ft max o.c.)
   - "V" bracing: Same as "X" bracing, but one member of the "X" is placed on the next bay. Allow no more than three un-braced bays between a "V" brace. (40 ft max. o.c.)
Raker Splice

1. Locate center of splice within one foot each side of where mid-foot splice should be prelocated on raker prior to assembling the wall.

2. Point face connections to raker.

BACKING FOR RAKERS & SPECIAL WALLS (see page 3-15)

CONSTRUCTING LATERAL SHORING SYSTEMS

USER SHORING OPERATIONS GUIDE
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

TROUGH BASE
1. Used as base for Split Sole and Flying/Friction Raker.
2. Place 18" x 18" foot under Trough for bearing on soil.

Material List:
- 2–2 x 6 x 36" side pieces. 7-16d to bottom each side and 5-16d to raker each side.
- 1 – 2 x 4 or 2 x 6 x 36" bottom piece (match raker width).
- 1 – 2 x 4 or 2 x 6 x 18" cleat (match raker width), and place flush with end. 5-16d to bottom.

SOLE ANCHORS
3. Keeps rakers from moving away from wall. Length = 4ft min
- **Pickets** are 1” dia. x 36” min., Grade A-36 plain steel rods or Grade 60 rebar, driven a minimum of 24” into soil or paving.
- Use 4 x 4 or 6 x 6 with at least 2 pickets placed in pre-drilled holes through-it if high winds or aftershocks are possible.
- Pickets may be placed behind in other conditions, however the pre-drilled timber can act to guide pickets and keep them plumb.
- Use 2 x 4 or 4 x 4 wedges. May use 2 x 6 wedges against 6 x 6.
- **Pickets per raker**: Use 3 into Paving & 6 into Cohesive Soil.
- **Cohesionless soils** (sands) Don’t adequately support Pickets.

6x6 Sole Anchor
4x4 Sole Anchor

TROUGH BASE
1. Used as base for Split Sole and Flying/Friction Raker.
2. Place 18" x 18" foot under Trough for bearing on soil.

Material List:
- 2–2 x 6 x 36" side pieces. 7-16d to bottom each side and 5-16d to raker each side.
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- Use 2 x 4 or 4 x 4 wedges. May use 2 x 6 wedges against 6 x 6.
- **Pickets per raker**: Use 3 into Paving & 6 into Cohesive Soil.
- **Cohesionless soils** (sands) Don’t adequately support Pickets.
TO DETERMINE THE APPROXIMATE LENGTH OF A RAKE

1. Measure the length of the rake in feet.
2. Multiply the length by 2.
3. Cut the rake to the length obtained in step 2.

TO SCORNE THE CUT ANGEL ON A RAKE

1. Measure the angle of the rake in degrees.
2. Cut the rake to the angle obtained in step 1.

USING STEEL FRAMING SQUARE

CONSTRUCTING LATERAL SHORING SYSTEMS

USER SHORING OPERATIONS GUIDE
HOW TO CONSTRUCT RAKER SHORES:
Flying Raker – Spot Shore page 3-12
Raker With Backing For Walls 3-15
Solid Sole Raker 3-16
Split Sole Raker 3-20
Double Raker 3-23
Alternate-Using 3-2x4 Studs for Rakers 3-25

HOW TO CONSTRUCT OTHER LATERAL SHORES:
Horizontal Shores page 3-26
Tiebacks 3-29
Raker Shores Using Pneumatic Struts 3-31
3-12
Design Load is 1,000lb per Raker

Flying Raker (Friction) Shore (Lateral class 1)

Contracting Lateral Shoring Systems
User Shoring Operations Guide

Material List:
- 2 - 2 x 6 x 4" braces
- 1 - 2 x 4 or 4 x 4 Wedge Set
- 4 x 4 x 24" Cleat

Scale Anchor with 2 - 1 x 36" Pickets

Tough base (see pg. 3-9)

Flying Raker (Friction) Shore (Lateral class 1)

Contracting Lateral Shoring Systems
User Shoring Operations Guide

Material List:
- 2 - 2 x 6 x 4" braces
- 1 - 2 x 4 or 4 x 4 Wedge Set
- 4 x 4 x 24" Cleat

Scale Anchor with 2 - 1 x 36" Pickets

Tough base (see pg. 3-9)
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

HOW TO CONSTRUCT THE FLYING RAKER
1. The area adjacent to where walls need support by rakers should be considered as very hazardous. Pre-construct each Flying Raker beyond the fall zone, and do not attempt to remove any debris that has fallen next to the damaged wall.
2. Determine where to erect the Flying Raker and the height required to support the wall. Determine height of Insertion Point.
   • Flying Rakers may be used as single, spot shores, or may be built in pairs with horizontal & X bracing between them.
3. Flying Raker order of construction outline is as follows:
   • In order to pre-fabricate, Cut Raker, Wall Plate and Bottom Brace to proper length, and perform angle cuts on Raker.
   • Prefabricate the Shore, Trough Base, & Anchor. (page 3-9)
   • Fit the shore into the Trough Base.
   • Place the Anchor for the Trough.
   • Install wedge and/or shims.
   • Attach to wall with 1/2” drill-in anchors (or nails for wood walls).
   • Retighten the wedges.
4. Layout Wall Plate, Raker and Bottom Brace at selected angle, and toe-nail Raker to Wall Plate. (60 or 45 degree angle OK)
5. Nail-on Top Cleat, then gusset to one side of this joint.
6. Nail one-Bottom Brace to Wall Plate in position to clear debris, but only tack-nail it to Raker.
7. Turn shore over and nail-on other gusset plus other Bottom Brace. (nailed to Wall Plate, tack to Raker)
8. Anchor the Trough, then carry the partly assembled Raker into place. Snug-up the Wedges, and complete the nailing of Bottom Brace to Raker. See page 3-9 for sole anchor.
9. Make whatever connection to wall that is selected, see ADDITIONAL INFORMATION.
10. Retighten the Wedges.
RAKER BACKING – USED WHEN SUPPORTING WOOD WALLS

See page 3-8 for detail information including nailing.

- The plywood backing shown may be also used with Split Sole and Flying Rakers.
- Plywood is 24" high x 36" wide x 3/4" or 5/8" thick.
- Nail 16-16d from ply into back of wall plate, and 8-16d each side of raker into studs and/or edge of floor.
- The top of the plywood backing should be placed at the Insertion Point. Center Raker on a stud.

Raker Backing – Used when supporting badly cracked Concrete and Masonry Walls

- Plywood is 48" high (minimum) x 48" wide x 3/4" thick.
- Nail 16-16d from ply into back of wall plate.
- Connect Raker to wall using 2 or more 1/2" x 5 1/2" wedge anchors, or 1/2" x 8" rebars (or smooth steel bars) through the backing material into the concrete wall (4" min. embed. in wall) on each side of the Raker.
SOLID SOLE RAKER (LATERAL/CLASS 3)
CONSTRUCTION LATERAL SHOULDER SYSTEMS
USER SHOULDER OPERATIONS GUIDE

For Clearing 8’ Nailing: Use 4x6 Wall Plate
Material List: For 6x6 Raker see pg 2, 3
Raker using 4x4 is shown and noted in

2 - 3’ x 12” x 18” square plywood
Foot at soil surface 2 x 6 x 18” or
Sole Anchor: 3’ Nailing extensions in cohesive soil

1 = Sole Plate
Top clear is 30”, 20-16 for 60
2 = Mid-Plate
6 = Full Plate

Material List: (per raker - need two or more)

as Class 3 System with lateral bracing.
and are built at 12”, 50 degree angle in groups of 2 or more.

Welds Solid steel full nailing, not to exceed 1/8 of the
Use in buildings to office building panels and一幕ed
HOW TO CONSTRUCT A SOLID SOLE RAKER
1. Determine where to erect the raker shores, the height of supported wall, and the height of Insertion Point.
2. If area is not clear of debris, consider Split Sole Raker.
3. Select angle of Raker, then measure and cut the Wall Plate, Sole Plate and Raker to the proper length.
   - Sole and Wall Plate extends at least 30° from where the raker intersects them to allow for the Cleats.
   - Angle-cut ends of raker with 1½" return cuts for full contact with the wall and sole plates, cleats and wedges.
4. Pre-fabricate Wall Plate, Raker, Sole, and Sole Anchor.
   - Toe-nail Sole to base of Wall Plate, square inside to 90deg, and secure with gusset plate on one side.
   - Layout Raker at selected angle, intersection with Wall Plate and Sole. Anchor to Wall Plate with 16d nail, install top cleat and nail-on gusset one side.
   - Nail one Sole Gusset to Raker, but not to Sole at this time, since Raker may need later adjusting.
   - Mark Sole for position of Bottom Cleat, allowing for Wedges.
   - Flip Raker Shore over and nail gussets on opposite side, but remember to nail the Raker to Sole Gusset, to Raker only, not to Sole to allow for later adjustment.
5. Carefully move the partially prefabricated Rake Shore in place at the wall and make sure it is plumb (side to side).
   - With Raker Shore placed against the wall, the Sole should be carefully driven-in so the Wall Plate is snug against the Wall, and then the Bottom Cleat should be completely nailed, allowing space for the Wedges.
   - Full contact must be maintained between the wall plate and the insertion point as well as at base of wall. (If the wall bulges out, add shims to maintain full contact)
6. After anchoring Sole Plate (see 12.), install wedges between the bottom cleat and base of the Raker and tighten them slightly.
   - After adjusting the shims/spacers (if any) between the wall plate and the wall being shored to ensure full contact, above, finish tightening wedges and complete nailing of gusset on each side.
HOW TO CONSTRUCT A SOLID SOLE RACKER (cont.)
ADDITIONAL INFORMATION – Solid Sole Raker

1. Design Load for one Raker.
   - 4x4 Raker = 4,000lb
   - 6x6 Raker = 5,600lb

2. Raker information:
   - 4 x 4 maximum length without mid-brace: 11 feet.
   - 6 x 6 maximum length without mid-brace: 17 feet.

3. To attach wall plate directly to a concrete/masonry wall use 1/2” drill-in anchors as noted below:
   - Place a minimum of two 1/2” x 8 1/2” wedge anchors, or 1/2” x 8” long rebar or smooth bar (4” min embed in wall) through wall plate for 45 deg rakers. Use 3 anchors for 60 deg rakers.
   - At concrete walls, if 3/4” plywood backing is needed, attached it to wall plate with 16-16d nails, and use at least two 1/2” x 5 1/2” wedge anchors, or 1/2” x 8” rebar/smooth bar through backing into concrete wall (4” min embed) each side of Raker.

4. To attach the wall plate directly to a wood framed wall.
   - Use 2 ft high x 3ft wide (min) x 3/4” or 5/8” ply backing nailed with 16-16d to the wall plate. Center raker on a stud, and use at least 8-16d nails through the backing material into studs and/or edge of floor, each side of Raker.

5. Place an 18” x 18” Foot under the sole at intersection of raker, when bearing on soil.
   - Taper 3 – 2 x 6 x 18” or 2 – layers of 3/4” x 18” x 18” plywood.

6. A Sole Anchor can be secured to the ground or floor behind the sole plate to prevent sole plate from backing away from the wall.
   - Timber Anchors should be at least 4x4 size lumber, (6x6 is better). Place 6 – 1” diameter x 36” pickets per raker, spaced about 12” o.c. into Cohesive Soil, and as noted on page 3-9.
   - Three pickets may be used into concrete or paving.
   - Specially made steel anchor brackets may be used with a minimum of 2- 1/2” x 5 1/2” wedge anchors into concrete.
   - Concrete curbs, walls and other nearby secure structures may also be used.
HOW TO CONSTRUCT A SPLIT SOLE RAKER

1. Determine where to erect the raker shoes and the height of the sole bearing
2. Block the sides of the bore, placing the shoes at the required height
3. Position the raker shoe in the bore
4. Secure the raker shoe with wedges

SOLE RAKER (Protect/Class 3)

CONSTRUCTING ULTRAFIT SHROUDING SYSTEMS

USER SHROUDING OPERATIONS GUIDE
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

2. Select angle of Raker, then measure and cut the Wall Plate, Raker, and Bottom Brace to the proper length.
   • If there is rubble next to wall, wall plate will not extend to ground, and Bottom Brace will be attached at bottom of Wall Plate, and slope to within 6" of Trough Base.
   • Raker angle may be 45 or 60 deg into Trough Base.
   • Angle-cut both ends of Raker with 1½" return cuts for full contact with wall plate, top cleat, and Trough Cleat.
3. Pre-fabricate and cut, Raker, Wall Plate, Bottom Brace, and Sole Anchor to proper length, and perform raker angle cuts.
   • Layout Wall Plate, Raker and Bottom Brace at selected angle, and toe-nail Raker to Wall Plate.
   • Nail-on Top Cleat, then gusset to one side of this joint.
   • Nail one-Bottom Brace to Wall Plate, 6" from bottom, or in position to clear debris, but only tack-nail it to Raker.
   • Turn shore over and nail-on other gusset plus other Bottom Brace to Wall Plate.
   • Tack-nail Bottom Braces to Raker, so it can be moved to wall.
   • Assemble the Trough, as well as the 18" x 18" foot (if bearing on soil), and place in approximate position.
4. Move the partially prefabricated Split Sole Raker Shore in place at the wall and make sure it is plumb (side to side).
   • After securing the Sole Anchor, adjust the Trough, and drive wedges slightly against it.
   • Maintain full contact between the wall plate at the insertion point and at base of wall plate and the wall.
   • For bulging walls, add tight shims/spacers, then finish tightening wedges & finish nailing of Bottom Braces.
   • Anchor shore to concrete or masonry walls, by placing 2- 1/2" drill-in anchors for 45 deg. & 3- 1/2" anchors for 60 deg through the wall plate into wall, per ADDITIONAL INFO. 3. For wood walls, center raker on stud and see ADDITIONAL INFO. 4.
   • Place the Mid-Brace, if required by length of Raker, and erect the Horizontal and X-bracing, per Solid Sole.
   • Secure the Sole Anchor as shown on page 3-9, and as noted in ADDITIONAL INFORMATION 6 on next page.

3-21
also be used.
• Convert cups, ml, and other ready to serve structures may
  speciﬁcally made speciﬁc to service with a
• The shelf may be used, and the concept of
  about 12" o.c. and decorative soffit, and not used on page 9.
• timber anchors should be at least 4 x 4 x 42x length (6x is
  the wall
To prevent the shelf from breaking away from
the soffit, use 3 x 2 x 6 or 2 - layers of 3/4 x 18 x 18 plywood.
Place a 18 x 18 foot under trough base, when bearing on
the trough base with a sole anchor.
5. Floor, each side of shed.
• To ensure the wall is directly to a wood framed wall.
• To convert the wall to the ﬁnished height of 12" x 12" x 6. 3-44, or 3-45
4. To attach the wall directly to a wood framed wall.
• into the concept wall (4" x 4") wood and ready side of
  where anchor, or 3/4 x 6" x 8\x201d plywood, at the height
  speciﬁcation of the wall
where anchor, or 3/4 x 6\x201d plywood, at the height
• ensure the wall is directly to a wood framed wall.
3. To convert the wall directly to a structural masonry wall use 12/37. 6 x 6 mix length, w/mix ratio: 1:3.
2. Four-Raet = 4.000 lb 6x Raet = 5.600 lb
1. Design load for one Raet: ADDITIONAL INFORMATION – Split Raet
### US&R SHORING OPERATIONS GUIDE
#### CONSTRUCTING LATERAL SHORING SYSTEMS

**DOUBLE RAKER** (May make from 4x4 or 6x6)

<table>
<thead>
<tr>
<th>Material List: (per raker – need two or more)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Wall Plate (4x4, 4x6)</td>
</tr>
<tr>
<td>2 Rakers (4x4, 6x6)</td>
</tr>
<tr>
<td>2 - Midpoint braces*</td>
</tr>
<tr>
<td>&quot; = 4 Mid-braces if Insertion Pt is 16ft+</td>
</tr>
<tr>
<td>1 - Sole Plate</td>
</tr>
</tbody>
</table>

#### Insertion Point up to 16 ft

Insertion Point - 16 ft to 24 ft for 4x4 Rakers (see pg 3-24)

---

**DOUBLE RAKER** (May make from 4x4 or 6x6)

<table>
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<tr>
<td>1 - Sole Plate</td>
</tr>
</tbody>
</table>

#### Insertion Point up to 16 ft

Insertion Point - 16 ft to 24 ft for 4x4 Rakers (see pg 3-24)
DOUBLE RAKER NOTES

1. For 4x4 DL Raker with Insulation P1 over 18 ft, must add 2 sets

Location of Raker & Wall Plane

Location of Raker & Wall Plane

For Clear 8" Nailing use 6x6 Wall Plate Metal Studs, for 6x6 Raker see pg. 2-3.

For Clear 8" Nailing use 6x6 Wall Plate Metal Studs, for 6x6 Raker see pg. 2-3.

CONSTRUCTION LATERAL SHORING SYSTEMS
USER SHORING OPERATIONS GUIDE

DOUBLE RAKER (continued)
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

ALTERNATE- USING 3-2x4 STUDS for RAKERS
(Only if 4x4 lumber is NOT available)

- The following applies to Solid, Split-Sole, & Flying Rakers.
- If No.1 Douglas Fir is not available, construct rakers using Southern Pine, Hem-Fir and/or Spruce-Pine-Fir and reduce Design Load to 85%. If Eastern Softwoods, Western Cedar, or Western Woods are used, must reduce Design Load to 75%
- Raker may be made from two 3-2x4 pieces that are required length to have splice located above mid-brace intersection. Use Std plywood splice, per pg 3-9
- Wall Pl & Sole Pl are made from 3-2x4 staggered 2ft minimum thus:

\[
\begin{array}{c|c|c}
| 8' | 2' Typ. stagger | 8' |
\end{array}
\]

- Nail 16d cooler/sinkers at 5" o.c. stagger thus: (.148 x 3.25")

3-25
## 3.26

### Horizontal Shore - 3 - Shoring Systems

**Material List:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2 x 4</td>
<td>14 &quot; Flare Cleat at each wedge set</td>
</tr>
<tr>
<td>1 - 9.9 cm Flare Cleat at each wedge set</td>
<td></td>
</tr>
<tr>
<td>2 X 4 &quot; Flare Cleat at each Shink</td>
<td></td>
</tr>
<tr>
<td>2 X 4 &quot; Flare Cleat per Shink</td>
<td></td>
</tr>
<tr>
<td>1 - 2 x 4</td>
<td>14 &quot; Flare Cleat at each wedge set</td>
</tr>
<tr>
<td>2 X 4 &quot; Flare Cleat at each Shink</td>
<td></td>
</tr>
</tbody>
</table>

**This shore can be used to stabilize parallel vertical walls.**

- Especially walls that are bulging.

**Constructing Lateral Shore Systems**

**User'S Shoring Operations Guide**
HOW TO CONSTRUCT HORIZONTAL SHORE

1. Determine where to erect the horizontal shore.
   - After initial temporary shoring has been installed as needed, clear the area of debris.
   - A clearance of three to four feet wide is usually adequate.
2. Measure and cut the wall plates & struts to the proper length.
3. Place both wall plates next to each other and attach 2 x 4 x 18” cleats and single 4x wedges to the wall plates w/ 5-16d each, just below where the struts will be installed.
   - If 4x wedge is not available, use 2x wedge on top of a 2x cleat, and nail with 5-16d.
4. Place the wall plates in the area that is to be shored, square and  in line with each other and as plumb as possible by shimming any void spaces behind the wall plates.
5. Install the struts between the wall plates. Keep the struts in line and plumb with the wall plates.
6. Install a set of wedges horizontally between the Wall Plate and each Strut, then tap them together simultaneously until the struts are tight.
   - Toenail the wedges from top into wall plate. May need to use duplex nails for future adjustment.
   - Add 2 x 4 x 14” cleats on top of struts at wedge end, and secure with 3-16d to strut plus 2-16d toenails to Wall Plate.
7. At non-wedge end of strut, place half gusset one side.
8. If possible, attach the wall plates to the walls. (as for rakers)
9. Attach the diagonal braces to each side of the horizontal shore when not used for access or egress.
   - The diagonal braces should be long enough to span entire length and be attached to both wall plates and each strut.
   - When used, diagonal braces should be installed in a "X" pattern on opposite sides of struts. 5-16d each end.
HORIZONTAL SHORE - 2-Strut, Access Type

- Wedges: 3.75x6 nails, add half gauge on side.
- Place 2x4, 1/4" thick, dead opposite end of strut from 16" on top of strut with 3-16d to 16d each end.
- Wedges are installed 1-16d nails.
- Place one half of 4x wedges set under end of strut where x - backfill is 2x 6 with 5-16d each end.

4. Miscellaneous:

- Spacing for 6x6 struts: Maximum 5 feet on center.
- Spacing for 4x4 struts: Maximum 4 feet on center.

3. Wall Plates: 4x4 x 6, 6 x 6.

2. Maximum Shore width for 6x6 struts: 16 feet.
1. Maximum Shore width for 4x4 struts: 10 feet.

ADDITIONAL INFORMATION - Horizontal Shore
WALL TIEBACKS
Tiebacks may be used to stabilize hazardous walls that are above the height that can be braced by Raker Shores. Tiebacks are constructed using the following:

- **Strong-backs** that extend from at least one floor to the one above or below. This allows the force placed in the strong-back by the tiebacks to be resisted by the floors of the structure.
- **Strong-backs** may be made from 4x4, 4x6, or double 2x8 or 2x10, depending on floor height. (depending on need)
- **Tiebacks** may be made from very strong rope or wire rope cable. (1/4" to 1/2" diameter wire rope cable)
- **Cable tiebacks** can be anchored to the tiebacks using a double basket or choker hitch. (Dbl basket is twice as strong as choker)
- **Loops** may be made in cable using Wire Rope Clips to facilitate the connections.
- **Cables** may be anchored to concrete structure using swivel hoist rings and drilled-in anchors.

**WALL TIE-BACK BRACING**

![Diagram of 4-story U.R.M. Building with wall tiebacks](image)
Recommendations:

Install and locate per manufacturer's

Note: Make sure that proper pins (by manufacturer) are

STANDARD BRACES • TILT-UP WALL CONSTRUCTION

LATERAL WALL BRACING

RAKER SHORE ALTERNATIVES

CONSTRUCTING LATERAL SHORING SYSTEMS

USER SHORING OPERATIONS GUIDE
RAKER & HORIZ. SHORES w/ PNEUMATIC STRUTS

Pneumatic Strut Manufacturers have developed special configurations that may be used to construct Raker and Horizontal Shores. See following pages for configurations.

- Individual Rakers can be configured from two struts plus a special wall plate rail, and special connections.
- Manufactured base plates can be connected into paving with 1" x 36" steel pickets driven through existing base plate holes.
- When system is constructed on soil, a special angle must be added to the base plate in order to bear on a standard Sole Anchor. (see page 3-9).
- A pair of Strut Rakers can be configured as a braced system, using wood X bracing that is connected to special clamp-on brackets that have wood nailers.
- When the Raker Strut is longer than 11 feet a mid-brace must be used, and the cross bracing must be a Double X. Note that the mid-brace must be a special strut that is able to resist both tension and compression.
- One manufacturer has developed a strut bracing system where the braces can resist both tension and compression forces.
- The Raker Rails must be connected to concrete/masonry walls using a minimum of two-1/2" x 5 ½" wedge anchors, or 1/2" x 8" rebar/smooth steel bars with 4" min. embedment in wall. (Two bars for 45 deg., and three bars for 60 deg. rakers).
- When supporting wood walls the Raker Rail must be carefully centered on a stud, and two 1/2" x 5" lag screws placed through the pre-drilled holes in the rail. 3/8" lead holes should be drilled at least 4" into the stud.
- Low pressure air (50psi max) may be used to extend the struts, but care must be taken to not impact the structure.
- Use hand tightening to snug-up all joints.
- See Section 7 for the tabled that give the Design Strength for Strut Raker Systems. Note that the connections that anchor the systems to wall and to ground may limit the strength. Consult a qualified Structures Specialist.
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

For this Raker, Strut Manufacturer needs to provide Mid-Point Brace with special connections
Conn. Wall Plate to wall w/min. of 2-1/2” Anch.
2x6 Diag & Horiz. Brac’g 5-16d ea. end into special nailers on Struts by Mfrs

Dbl’X’ Bracing to add support where Mid-Point Brace connects to Raker

Special Base Plate, Bearing Angle, and Connections by Strut manufacturer
Sole Anch with Steel Pickets

FULL TRIANGLE STRUT RAKER
In this case the Raker Strut is longer than 11 feet, so a mid-brace must be used as well as Double X-bracing.
Full Triangle Strut Raker - All Struts

Compression forces. But remain rigid so that they can resist both tension and
be special struts that can be adjusted for length.

Note that the mid-ridge, horizontal braces and diagonal
are used as well as double X-bracing using struts.

Photo of raker strut that is longer than 11 feet, and a strut
US&R SHORING OPERATIONS GUIDE
CONSTRUCTING LATERAL SHORING SYSTEMS

This Raker needs special horizontal Brace/Strut with special connections
Conn. Wall Plate to wall w/min. of 1-1/2' anchor
2 x 6 Diag & Horiz. Brac'g 5-16d ea. end into special nailers on Struts by Mfrs
Need Dbl 'X' Brac'g to add support where Horiz. Strut/Brace connects to Raker

Special Base Plate, Bearing Angle, and Connections by Strut Manufacturer
Sole Anchor with Steel Pickets

FLYING STRUT RAKER
This raker may be used as an initial, spot raker when there is a significant amount of debris at the base of the wall.

3-35
Horizontal Shore Using Struts

This shore would only be used if 4x4 wood strips were not available. As an alternative, if no wood was available, one could use the struts with a roller rail against each wall.

Horizontal Shore Using Struts

This shore would only be used if 4x4 wood strips were not available. As an alternative, if no wood was available, one could use the struts with a roller rail against each wall.
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

INTRODUCTION to SECTION 4


The Repair Techniques are arranged as follows:

- Non-Contact Fiber Wrap  
- Epoxy Concrete Repair  
- Steel Jacket Column Repair  
- Steel Jacket Joint Repair  
- Column Stability Repair  
- Spray Applied Concrete Repair  
- Steel Straps Used To Confine Concrete  
- Protected Entry  
- Protective Barriers  

The FAQ are arranged as follows:

- Headers  
- Posts  
- Laced Posts  
- Cribbing & Window Shores  
- Nails  
- Raker Shores  
- Diagonal Bracing  
- Lumber Grade Adjustments  
- Shoring Construction Sequence  

The Glossary of Terms is arranged alphabetically, starting on Page 4-33.

Useful Engineering Tables are shown, starting on page 4-42 with a list of the included tables including page numbers.
They are presented so that the user has a toolbox of alternatives to operations.

Following are examples and ideas that can be or have been used:

- Time and risk
- Design solutions, coordination with contractors and consideration of jobs and systems during disaster operations requires involvement of structural members, components.

Introduction

Repairs, FaD, Glossary, & Engineering Tables

USER SHARING OPERATIONS GUIDE
Installation Sequence:
1. Trowel on 2-part epoxy.
2. Initially place FRP cylindrical shell.
3. Adjust the shell so the 2 layers are in contact.
4. Place ratchet straps to temporarily hold the shell’s shape.
5. Mix and pour the non-shrink grout, and use small vibrator or rod to consolidate.
EPOXY CONCRETE REPAIRS

Reparas, Faq, Glossary & Engineering Tables
User Guide
Repair of Badly Damaged Column in Puerto Rico

- Carefully pour clean, small aggregate in form to fill all voids.
- Inject low viscosity epoxy into aggregate, starting from bottom. (It takes 24 hrs to develop reasonable strength - at 20°C)

Existing Beam
Plaster covered, metal lath form to contain aggregate

Existing Beam, badly distorted and surrounded by fragmented concrete
Metal wire to tie form at bottom

Concrete Column
In this installation, note that the steel encasement is stacked two
port to port. This photo shows a set of half-round steel encasements just
Encasement should clear damaged column by at least 3 (60 mm)
Steel encasement is ≥1.76 to 1.4 (4 to 6 mm) thick
in danger area during erection
and/or welded together. Bonding is preferred since less time is spent
Completion Professional Engineer is required for use
Condition/limitations

Column (concrete, steel, etc.)

Primarily used for damaged columns. Applicable to any type of
Applications

See IS Trus. Spec for local contractor & fabrication shop.

Reinforcement Method: Concrete filled Steel Jacket

Stucco, concrete or structural steel for stability and/or strengthening
Jacket a damaged column with full height steel shield and fill with

Reinforcement Method: Concrete filled Steel Jacket

User SHORING OPERATIONS GUIDE

RePAIRS, FG, CL, PASSAR, & ENGINEERING TABLES

RePAIRS, FG, CL, PASSAR, & ENGINEERING TABLES

RePAIRS, FG, CL, PASSAR, & ENGINEERING TABLES

RePAIRS, FG, CL, PASSAR, & ENGINEERING TABLES

RePAIRS, FG, CL, PASSAR, & ENGINEERING TABLES

RePAIRS, FG, CL, PASSAR, & ENGINEERING TABLES
Damaged columns with completed encasement
STEEL JACKET JOIN REPAIR

REPAIRS FOR GLASSFIBER & ENGINEERING TABLES

User SHARING OPERATIONS GUIDE

---

The steel jacket may be heavy, with each side weighing 100 lbs.

The jacket is secured by means of two straps, one on each side of the jacket. These straps are adjustable and can be tightened to ensure a proper fit. The jacket should be secured using a pair of heavy-duty clamps. The strap should be adjusted to ensure a snug fit before securing the jacket with the clamps.

The jacket should be checked for any sign of damage or wear before use. If any damage is found, the jacket should be replaced.

---

STEEL JACKET JOIN REPAIR

REPAIRS FOR GLASSFIBER & ENGINEERING TABLES

User SHARING OPERATIONS GUIDE

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This steel jacket was used to provide strengthening at several column joints at the bomb damaged Murrah Federal Office Building in Oklahoma City.

It was placed where the concrete floor beam had been blown away from the concrete column, leaving a badly cracked, and unbraced joint.
mis-aligned, the design force should be 5 percent minimum.

The minimum design force for the braces should be at least 2

tonnes. This design force must be adequately strong and rigid.

Braces need to be positively connected at each end and the

braces need to be of sufficient size to resist both compression and

tension forces. Possible

If direction at each level where the floors have been displaced. If

direction at each level where the floors have been displaced. If

Column Preparation

Enginee is required for use.

Members:

Steel pipes or tubes are commonly used for bracing.

Application:

Applicable

See IS: 180: Spec. for Local contractor & fabrication shop.

Manufacure:

Supporting columns and reducing the column length with bracing.

Column Preparation: Column Length Bracing

Reparation Repairs FG Glossary & Engineering Tables

Repairing Operations Guide
This cross-section at the Murrah Federal Office Building in Oklahoma City shows how a truss work of pipes was used to laterally brace Columns F22 and F20. The floors on all sides of these columns had collapsed up to the 4th Fl, and they were in danger of collapsing as the debris was being removed to access the buried victims.

This schematic, partial cross-section of the World Trade Center Basement following the 1993 Truck Bombing shows the configuration of steel tube bracing that was used to brace the steel basement columns after the basement parking garage concrete floor slabs had collapsed, leaving the steel columns standing 70 ft tall without lateral support.
SPRAY-APPLIED CONCRETE REPAIR
REPAIRS, FAQ, GLOSSARY & ENGINEERING TABLES
USER'S MANUAL FOR CONCRETE REPAIR

SPRAY-APPLIED CONCRETE REPAIR
REPAIRS, FAQ, GLOSSARY & ENGINEERING TABLES
USER'S MANUAL FOR CONCRETE REPAIR

For greater reliability an above grade footing should be poured.
Seal coat and/or keeping the surface damp.
The structure should be cured by applying a moisture preserving
sealant and/or leaving the surface damp.

Application of coatings is essential to determine their effectiveness.
Comprehensive professional engineering is required for use.

- Local conditions, especially those with swimming pool experience.
- Membrane's components and systems.
- Consultation with a professional concreter.

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REPAIRS, FAQ, GLOSSARY & ENGINEERING TABLES
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USER'S MANUAL FOR CONCRETE REPAIR

See next page for use of shouce in New Zealand: March 2011.
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

Wall Before Shotcrete

Wall After Shotcrete

Overall View of Repair Using Shotcrete

Wall Before Shotcrete

Wall After Shotcrete

Overall View of Repair Using Shotcrete
Column F-22 at the Murrah Federal Office Building in Oklahoma City, where the Third Floor used to be. Steel strapping was used as a temporary measure prior to installing a grout filled steel jacket.
Typical Concrete Pipe Configuration

Order to get it into place:
Precautions may need to enter the pipe to remove collected debris. In places:
- Pipe should be at 1/2" (13 mm) thick.
- Steel, ductile iron pipe, or steel casing should be a minimum of 1/2" (13 mm) thick.
- Steel, ductile iron pipe, or steel casing should be a minimum of 1/2" (13 mm) thick.
- Steel, ductile iron pipe, or steel casing should be a minimum of 1/2" (13 mm) thick.

Conduit/ductile iron:
- Ladder or overhead:
- Order to excavate:
- These conduits using heavy equipment such as: locally. Front end loaders, excavators, and their attachments. Be sure that no damage will occur to any public utilities. The excavation crew may be contactable.
- Applications:
- Local contractors: See Internet.

Hazard:
The rigid pipe or flexible pipe to provide access for access:

Protection Method: Use rigid piping for access.

User Shocking Operations Guide

Repair, Fitting, Fitting, & Engineering Tables

Order to get it into place:
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User Shocking Operations Guide

Repair, Fitting, Fitting, & Engineering Tables
PROTECTIVE BARRIERS

Repair/Retrofit Method: Use Rigid Containers & Boxes as Barriers.
Use shipping containers and/or rigid boxes as protective barriers.

Manufacturers/Distributors:
Shipping companies, Concrete vault suppliers, and waste disposal companies. See internet

Applications
Use shipping containers, dumpsters, and/or concrete vaults as barriers adjacent to hazardous buildings and vulnerable rock faces.

Considerations/Limitations
Easy to use, and available locally.
Shipping containers are available in 20, 40, 45 and 48 foot lengths.
Steel debris boxes (dumpsters) may also be used, and are available in 3, 5, 8, 15, 18, 20, 30, and 40 cubic yard sizes.
These rigid containers can be ballasted with heavy objects, such as water bladders, sand bags, and steel scrap, in order to add sliding and overturning resistance.
Containers may be stacked up to 3-high, but should be connected together using chains or high strength straps.
Containers may be placed 2-wide to improve resistance.
FREQUENTLY ASKED QUESTIONS
REPAIRS FAQ, GLOSSARY, & ENGINEERING TABLES
USER SHARING OPERATIONS GUIDE
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

POSTS

Question P-1 If only 2x4, 2x6, 2x8 and 4x4 are available, how to create a 6x6 or 8x8 post?

Ans. P-1a To construct a 6x6 one may use the following:
Build-up 4-2x6 to form a 5⅜" x 6" net post. Inter-nail with 16d@5" o.c. staggered plus add ½" carriage bolt 6" from each end and 3ft o.c. As alternate to the bolts add 6" x ¾" x 12" plywood gussets on 6" faces at same spacing
As a less desirable option, add 2x6 to side of 4x4, plus 2x4 +½" plywood fill to adjacent side. Inter-nail with 16d@5" o.c.

Ans. P-1b To construct an 8x8 one may use the following:
Build-up 5-2x8 and inter-nail with 16d@5" o.c., plus add ½" carriage bolt 6" from each end and 3ft o.c. As alternate to the bolts add 6" x ¾" x 12" plywood gussets on 8" faces at same spacing
or
Build-up 4-4x4 to from a 7" x 7" net post. Place 8ft" long x ¾" plywood gussets on all 4 sides at mid-height, plus 16" long x ¾" ply, all 4 sides near each end. Nail each gusset to each 4x4 with 8d @ 3"o.c. stagger.

Question P-2 What to do if post spacing is not exactly as shown in FOG?

Ans. P-2 Most types of shores that we build have posts spaced at between 30° and 4ft o.c. and headers should be sized accordingly (as indicated in Ans. H1 through H3). The total capacity of the posts should always be more than the total load. Remember that the capacity of a 4x4x8ft high post is 8000lb and a 6x6x12ft high post is 20,000lb.

• If the post spacing is more than 5ft o.c. the header size should be increased, or the capacity should be decreased. Decrease capacity 10% for a 6" increase in post spacing , and 25% for a 1ft increase in spacing.
Excited to develop a control system with Kapacitor? This guide is for you.

Question 1.1: What is the correct configuration of the LED positions?

Answer 1.1: The following standards have been adopted:

LED Positions

<table>
<thead>
<tr>
<th>Position</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Red</td>
</tr>
<tr>
<td>A2</td>
<td>Green</td>
</tr>
<tr>
<td>A3</td>
<td>Blue</td>
</tr>
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CRIBBING

Question CB-1 Maximum height to width ratio is specified as 3 to 1 in the Shoring Training (SCT, Mod 2) and 2 to 1 in Lifting and Moving Training (SCT Mod 4), which is correct?

Ans.CB-1 Actually, both are correct. For normal shoring where Cribbing is constructed to support a damaged structure the 3 to 1 ratio may be used, assuming that the Crib is being loaded, more or less, uniformly.

- When Cribbing is being used in a “Lift a little and Crib a little” application the 2 to 1 ratio is more appropriate due to the more dynamic nature of the potential loading.
- For both cases the height of cribbing should be minimized, since differences in the hardness of adjacent pieces of wood can cause differential deflection that can lead to instability. Therefore it is recommended that cribs using 4x4 lumber be limited to 4ft in height (6x6 limit to 6ft in height). If greater height is needed, these effects can be minimized by using a 3 member x 3 member layout.

WINDOW SHORES

Question W-1 Why do we need to provide wedges in both Horizontal and Vertical directions for these shores?

Ans.W-1 The need for the wedges in the Vertical direction is easily understood. The wedges that bear on the Sides of the openings at top and bottom are very important is situations where the Openings will tend to Rack or Bulge, such as Earthquakes, and the Window Shore should be strongly “X” braced in this case.

US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

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From these tests using common nails.

Training. There was no significant difference in test results.
Laced fasts that have been used during construction are specialist
in strength without significant reduction in strength.
These coated nails may be used in FEMA
splicing and drive easier. These coated nails cause much less
wood in nailed joints, and TD families cause much less

Ans N-3: Yes, since it is very important to minimize the splitting of

instead of TD common (1/2 X 3 1/2).

Question N-3. Can we use 16d cooler nails (1 1/2 X 3 1/2)

conclusions. This is close enough.

Ans N-2: The strength of these nails is 77% since the immediate

since the embedment is only 1 1/2 in.

Question N-2. What embedment is required to develop full

value of a nail?

Question N-1. What embedment is required to develop the full
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

NAILS (continued)

Question N-4 What nailing should be used if No. 1 Douglas Fir or Southern Pine lumber is unavailable? (Design Load for Nails is shown on page 7-12)

Ans.N-4 As previously discussed, the nail strength value is approximately based on the density of wood, therefore reduce all nail values for the following:

• For Hem-Fir and Spruce-Pine-Fir use 85% of full strength.

• For Eastern Softwoods, Western Cedar & Western Woods use 75% of full strength.

This means that one should, accordingly, reduce the capacity of shoring, built using these species. However, for Raker Shores, since the strength is effectively based on the Cleat nailing or the Picket/Soil strength, one may add 3-nails to the 17-nail pattern when using species with either 85% or 75% strength reduction species listed above.

Question N-5 What nailing should be used to connect rough cut 2x lumber, that is a full 2” thick?

Ans.N-5 In order to obtain adequate embedment, one should use 20d box nails instead of 16d. The 20 box nail has about 90% the strength of 16d common and same as the 16d cooler.

4-25
Question R-3: What is the best configuration of the Raker (or)

Answer R-2a: The dependency of the wall will depend on the condition of the wall. If the wall is in a good condition, the Raker would be appropriate to place the first Raker.

Answer R-2b: When well corners have little damage, the first Raker may be placed from all to all from the corner.

Answer R-2c: How far should a Raker be spaced from the corner?

Note: The spacing should not be spaced more than 5 feet.

Question R-1: Which is the most appropriate spacing for Raker?
RAKER SHORES (continued)

Question R-4 When should one use a 30 degree Raker?

Ans. R-4 The 30 degree Raker is the most efficient Raker, since the flatter angle allows the horizontal resistance to be 86% of the Raker Force, and the Vertical lift is only 50% of the Raker Force. However, access, and height of insertion point may not allow the 30 degree configuration to be easily constructed.
- Also it takes a longer Raker to reach the same insertion point as for 45 & 60 degree Rakers.
- 30 degree Rakers should be considered when bracing a One-Sided Trench or Basement Excavation.

Question R-5 How should one connect the upper end of a 60 degree Raker, since we no longer recommend that the wall plate has been notched out 1 inch?

ANS. R-5 The 1" notch is no longer recommended for 60 degree Rakers. Use a 2x4x30" cleat with 20-16d nails for a 4x4 Raker System, and a 2x6x30" cleat with 29-16d nails for 6x6 Raker.

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The page contains text that appears to be repetitive and lacks clear meaning. It seems to include multiple instances of phrases such as "Ano DB-2," "Question," and "Diagonal BRacing." The text is not legible, and the content cannot be accurately transcribed.
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

LUMBER GRADE

Question L-1 What adjustments are needed if No. 1 Douglas Fir is not available? (Applies to Vertical and Laced Post Shores, Cribbing, Sloped Floor and Raker Shores)

Ans. L-1 Design Loads and nail strength values, in general, are based on the density of the wood species. The following reduction in values should be used:

- For Southern Pine, Hem-Fir and Spruce-Pine-Fir, reduce Design Load to 85% (of the values given for Doug Fir No.1)
- For Eastern Softwoods, Western Cedar & Western Woods, reduce Design Load to 75%

This means that the Design Load should be proportionally reduced or the post spacing should be proportionally reduced.

Example 1: 85% of 4 ft post spacing, would be 3’ - 6”, and 75% of 4 ft would be 3 ft.

Example 2: For Laced Post, 85% of 32k = 27k, & 75% = 24k
For Raker Shores, 85% of 4k = 3.4k, & 75% = 3k

Question L-2 What is strength reduction if pressure treated lumber is used? (may be called CCA, Wolmanized, NatureWood, Natural Select, etc.)

Ans. L-2a Most all commercially treated sawn lumber that has been treated with a "Preservative" to reduce its susceptibility to insects and decay, has been embedded with some sort of Copper-based preservative or with Creosote. Chromated Copper Arsenate (CCA) has been the most common for sawn lumber, but due to environmental concerns, other preservatives are being introduced.

Ans. L-2b No "Significant" reduction in wood strength occurs due to treatment using Copper based or other preservative compounds. However, most pressure treated sawn lumber will be sold in a "Dry" condition which makes it more susceptible to splitting caused by nailing. Also some treated wood may be split and or warped. One should use a "Common Sense" approach and avoid badly split or warped wood, especially for critical parts of shoring like Raker Cleats and the Diagonals in Laced Post Systems.
Question M-2: Should we secure the edge of a spilled floor?

**ANS. M-2:** No, if the spill is small, clean it up as soon as possible. If the spill is large, it may be necessary to secure the area.

**Question M-3:** Should we place the weight of the door on the top of the door?

**ANS. M-3:** No, the weight of the door should not be placed on the top. The top of the door is the weakest part and can easily be damaged.

**Question M-4:** Could it be very beneficial to secure the edge of a spilled floor?

**ANS. M-4:** Yes, securing the edge of a spilled floor can prevent further spillage and keep the area clean.

**Question M-5:** Should we use a steel bar joist from the bottom of the roof?

**ANS. M-5:** No, it is not recommended to use a steel bar joist from the bottom of the roof. The roof may not be strong enough to support the weight.

**Question M-6:** What is the possibility that the bottom will become submerged?

**ANS. M-6:** The possibility is low, but it is still a concern. It is recommended to use waterproofing materials to prevent water from entering the bottom.

**Question M-7:** Should we run a waterproofing product on the roof when there is a lot of rain coming down?

**ANS. M-7:** Yes, it is recommended to run a waterproofing product on the roof to prevent water from entering.
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

PREFERRED SHORE CONSTRUCTION SEQUENCE

Shoring during long-term incidents should be constructed with as much prefabrication as practical, and in a sequence that provides an increasingly safer rescue environment.

However, there will be many incidents that have a relatively short duration, and may only require spot shores and/or 2 and 3 post vertical shores. In these and other cases it also may not be practical to prefabricate the shoring.

The “Preferred Sequence” that is suggested here, should be followed, only if it is practical, as in a damaged concrete structure that requires a prolonged shoring operation.

- Vertical Shoring should begin with the installation of spot shores, such as a Tee Shore, Double Tee Shore, Pneumatic Struts or a single post.
  - These may be called Class 1 Shores (one dimensional).
  - Class 1 shores are intended to quickly reduce risk, for a short period of time.
  - The Double Tee is actually more like a Class 2 Shore.
- If the Rescue Scenario is prolonged, then one should further reduce risk by installing 2-Post Vertical Shores (or single Sloped Floor Shores).
  - The 2-Post Vertical is just half of a Laced Post, and can be partly prefabricated, and quickly carried into place.
  - These may be Class 2 Shores (two dimensional).
  - Vertical Shores with 3 or more posts are difficult to prefabricate and to develop into a full 3-Dimensional Systems. However they may be very useful in providing continuous support under damaged beams or a series of broken wood, floor joist.
Prefered Shore Construction Sequence (contd)

Repairs, FAQ, Glossary & Engineering Tables

Prefered Shore Construction Sequence (contd)

Repairs, FAQ, Glossary & Engineering Tables
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES
GLOSSARY OF TERMS

Arch- A curved structure used as a support over an open space. It produces an outward thrust as well as downward forces at its supported ends.

Axial load- A tension or compression load which passes through the center of a structural member (like a column, beam, truss member, diagonal brace or hanger rod).

Bay- The space between beams/trusses or between rows of columns considered in transverse planes.

Beam- A horizontal structural member, subject to compression, tension, and shear, usually found in any one of three different configurations: cantilever, continuous, and simple.

Bearing Wall- An interior or exterior wall that supports a load in addition to its own weight.

Brick Veneer- A single thickness of brick wall facing placed over frame construction or structural masonry.

Buttress- A wall reinforcement or brace built on the outside of a structure, sometimes called a "wall column." When separated from the wall and connected by an arch at the top, it is called a flying buttress.

Cantilever Beam- A beam that has two or more supports but extends beyond one end support and ends in clear space (similar to a diving board).

Cavity Wall- A wall of two parallels wythes (vertical wall of bricks, one masonry unit thick) separated by an air space. Wythes are connected by metal ties.

Chair- A device of bent wire used to hold reinforcing bars in position.

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the floors or ground below into a pancake configuration.

**Pancake Floor Collapse** - Collapse of one or more floors upon building collapse over.

**Ground Collapse** - Can occur in severe or moderate buildings.

**Overt floor collapse** - The building fails satisfactory along the floor line, the structural columns that support the floor and the floor system are involved.

**Overt floor collapse** - The building fails satisfactory along the floor line, the structural columns that support the floor and the floor system are involved.

**Floor collapse** - The building fails satisfactory along the floor line, the structural columns that support the floor and the floor system are involved.

**Ceiling collapse** - The building fails satisfactory along the floor line, the structural columns that support the floor and the floor system are involved.

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REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

Collapse – continued

Soft 1st Story Collapse – Occurs when only the first story of a building collapses (usually due to earthquake) due to the weakness and/or reduced stiffness of the 1st story when compared to the remainder of the building.

Collapse Zone – usually defined as the area that will be occupied on the ground when a structure completely collapses.

Column- Vertical structural member subject to compressive forces.

Compression- Force that tends to push the mass of a material together.

Concentrated Load- A load applied at one point or within a limited area of a structure.

Concrete –

Definition- A material used in construction that is extremely versatile and relatively noncombustible. Extremely effective in compression, but weak in tension and requires the use of reinforcing steel, either rebar or high strength cable.

Post-tension- Tension is applied to the reinforcing steel cable after the concrete is hardened and anchored only at the ends of the structure.

Poured in place- Concrete that is poured into the location where it is going to exist.

Precast- Concrete that is cast, allowed to harden, and then erected as part of a structure.

Pretension- Tension is applied to the reinforcing steel cable in a factory, prior to pouring the concrete. The concrete is then poured and bonded to the reinforcing.

Confined Space- Any space that lacks ventilation; usually the space is larger in area than the point of entry.

Continuous Beam- beam supported at both ends and at one or more interior supports.

Cornice- A horizontal projection which crowns or finishes the eaves of a building.
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**REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES**

**Footing** - The part of a building which rests on the bearing soil and is wider than the foundation wall. Also the base for a column.

**Furring** - Wood strips fastened to a wall, floor, or ceiling for the purpose of attaching covering material.

**Girder** - A structural element that supports a floor or roof beam.

**Gusset Plate** - A metal fastener in the form of a flat plate used to connect structural members. (also the plywood gusset plate connections used for US&R shoring)

**Header Beam** - A support used to reinforce an opening in the floor of a wood frame, ordinary, or heavy timber building.

**Hollow Wall** - A wall of two parallel wythes which are separated by an air space between them, but lack ties to hold the wythes together.

**Hydraulic Shoring** - Trench shores or jacks with movable parts that are operated by the action of hydraulic fluid.

**Impact Load** - A sudden load applied to a structure suddenly, such as a shock wave or a vibrating load.

**Joist** - A piece of lumber used as a floor or roof beam.

**Kiln-Dried Lumber** - Lumber that is artificially dried in an oven-like structure.

**Kip** - One thousand pounds.

**Knot** - A hard, irregular lump formed at the point where a branch grew out of a tree.

**Nonbearing Wall** - A wall that supports only its own weight.

**Open Web Joist** - A lightweight steel truss used as a floor or roof beam. It is made from a steel bar, bent at 90 degree angles, and welded between angle irons at the top and bottom bar bends.

**Operating Radius** - The horizontal distance from the centerline of rotation (the center pin of the cab) to a vertical line through the center of the sheave at the end of the boom.

---

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**REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES**

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Pneumatic Shopping - Trend shear of jacks with moveable parts

The next story is framed with a second wall, with joist and

floor joists bear on the top plates, and they are sheathed with

sliding on the slope and having the double plates on top.

mechanical part of the inside of a masonry wall

as well as other masonry components of a building. Also a

a supporting section of wall between two stories. Also a

of a masonry column. Also a deep concrete foundation.

a wall that lies on a common line for two buildings

a wall that lies on a common line for two buildings

an interior wall, not more than one story in height.

User, Shopping Operations Guide

Repair's FAQ Glossary & Engineering Tables
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

Rafter- A 2x or 3x member, usually spaced at 16” or 24” that supports a sloped roof, and may form a simple truss.

Restrained beam- A beam who’s ends are so securely welded or bolted so that they cannot rotate.

Ridgepole- (Ridge Beam) A horizontal timber that frames the highest point of a peak roof. Roof rafters fastened to the ridgepole.

Sandwich Wall- A nonbearing wall whose outer faces enclose an insulating core material. (some may be used as bearing walls)

Scab- A short piece of lumber generally cut from 2” x 4” stock, that is nailed to an upright to prevent the shifting of a shore.

Screw Jack- A trench shore or jack with threaded parts. The threading allows the jack to be lengthened or shortened.

Secondary Collapse- A collapse which follows the initial collapse. Can be caused by application of additional loads (aftershocks, wind snow, etc. rescue equipment, rescuers, etc.), settling of collapsed structures, drying of the soil, Secondary Collapse can occur if significant Potential Energy is still present in the structure. Potential Energy may be characterized as heavy structure and objects that remain elevated and may move downward under force of Gravity.

Sheathing- The covering applied to the floor/roof or wall framing of a building to which siding is applied.

Sheeting- Generally speaking, wood planks and wood panels that support trench walls when held in place by shoring.

Shoring- The general term used for lengths of timber, screw jacks, hydraulic and pneumatic jacks and other devices that can be used to hold sheeting against trench walls. Individual supports are called shores, cross-braces, or struts.

Simply Supported Beam- A beam supported at both ends.

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**REPAIRS FAQ GLOSSARY & ENGINEERING TABLES**

**USER SHOOTING OPERATIONS GUIDE**

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**Suspension ceiling** - A ceiling built several inches or feet below the floor making up the walls and partitions in a frame building.

**Stud** - Vertical structural members (2x4, 2x6 spaced 16", 24")

---

**Tension** - Stress placed on a structural member by the pull of another (shear). Beam, shear, slab, framing shear, concrete slabs, or shear parts of the structure slice past one another.

**Shear** - A stress causing a structure to collapse when member fail shear stress is adverse on a structural member.

**Compresssion** - A stress causing a structure to collapse when member fail shear stress is adverse on a structural member.

---

**Static load** - A load that remains constant.

**Splay** - The sill of the window above.

---

**Splay** - The top part of a wall between the head of a window and the sill of the window above. The force is expressed as force per lineal foot. Common for use in buildings where the roof overhangs the window or deck. 1/2" of wood, and the long axis of the member. (smooth or rough加大):

**Splay** - The expansion of the member of the window or deck below the window or deck above. 1/2" of wood, and the long axis of the member. (smooth or rough加大):

---

**Repaired** - A word or steel shell single-ply block that can be pressed into the structure to accept a top of a column.

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**US&R SHORING OPERATIONS GUIDE REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES**

**Tensile Strength** - The rated strength of a structural element or rope when it is loaded in tension. (Also Breaking Strength)

**Torsional Load** - A load that creates a twisting stress on a structural member. **Example**: when a pipe wrench is used to tighten or loosen the pipe or end fitting, it exerts a Torsional Load on the pipe.

**Truss** - A braced arrangement of steel or wood frame work made with triangular connecting members.

**Vertical (or Wall) Collapse Zone** - The expected ground area that a falling wall will cover when it collapse. For safety, it is normally estimated as 1.25 to 1.5 times the height

**Wane** - An edge or corner defect in lumber characterized by the presence of bark or the lack of wood.

**Web** - The wide vertical part of a steel beam between the flanges.

(Steel beams that are called I or W Beams have a thicker steel Flange at top and bottom with a thinner Web that is the vertical member between the Flanges.)

**Web member** - Secondary members of a steel or wood truss contained between chords, usually configured diagonally.

**Wind load** - Horizontal and vertical pressure imposed on a structure by the wind. The Wind Pressure is proportional to the Speed Squared. (for twice the speed there is four times the pressure)

**Wood frame** - Type of construction using small wood, horizontal and vertical members, usually spaced at 16 to 24 inches, that is then covered by some sort of sheathing.

**Wythe** - A single vertical stack of bricks that are most often found in a multi-brick wall.
INTRO TO USEFUL TABLES - CRANE & RIGGING

USER SHARING OPERATIONS GUIDE

things to know when choosing a crane rental with the Crosby Group

The Crosby Group Inc. P.O. Box 3128 Tulsa, OK

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Concealed Screws

Wedge anchors

Hoist Rings & Eye Nuts

Spherical Shafts

Termination

Wedge Pins

Wedge Rings

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## Working Load Limit or Design Load

Given in terms of Diameter $^2$.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Working Load in Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire Rope (S.F.=5)</td>
<td>$D^2 \times 9$ Tons</td>
</tr>
<tr>
<td>Wire Rope Slings</td>
<td>$D^2 \times 8.5$ Tons</td>
</tr>
<tr>
<td>Shackles (Alloy)</td>
<td>$D^2 \times 12.5$ Ton</td>
</tr>
<tr>
<td>Shackles (carbon)</td>
<td>$D^2 \times 8.5$ Tons</td>
</tr>
<tr>
<td>Chain Slings (I. D. as Type A)</td>
<td>$D^2 \times 24$ Tons</td>
</tr>
<tr>
<td>Turnbuckles</td>
<td>$D^2 \times 5$ Tons</td>
</tr>
</tbody>
</table>

(Improved Plow, IWRC Wire Rope)

## Crane Stability

Percent of Tipping & Safety Factor (for leveled crane).

<table>
<thead>
<tr>
<th>Crane Type</th>
<th>% of Tipping</th>
<th>S.F.</th>
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</thead>
<tbody>
<tr>
<td>Locomotive</td>
<td>85%</td>
<td>1.18</td>
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<tr>
<td>Crawlers</td>
<td>75</td>
<td>1.33</td>
</tr>
<tr>
<td>Mobile (on O. Riggers)</td>
<td>85</td>
<td>1.18</td>
</tr>
<tr>
<td>Mobile (on Tires)</td>
<td>75</td>
<td>1.33</td>
</tr>
<tr>
<td>Boom Truck</td>
<td>85</td>
<td>1.18</td>
</tr>
</tbody>
</table>
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

WIRE ROPE SLINGS CAPACITIES – FLEMISH EYE
Allowable Loads in Lbs (S.F. = 5) – 6 x 19 Improved Plow

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1/4</td>
<td>1120</td>
<td>800</td>
<td>2200</td>
<td>1940</td>
<td>1500</td>
<td>1120</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5/16</td>
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<td>1280</td>
<td>3400</td>
<td>3000</td>
<td>2400</td>
<td>1740</td>
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<td>1840</td>
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<td>11200</td>
<td>9600</td>
<td>7900</td>
<td>5600</td>
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<td>9600</td>
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<td>9600</td>
<td>26400</td>
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<td>13200</td>
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<tr>
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<td>30000</td>
<td>24000</td>
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<tr>
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<td>40000</td>
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<td>52000</td>
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<td>36700</td>
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</tr>
<tr>
<td>1 3/8</td>
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<td>24000</td>
<td>60000</td>
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<td>42400</td>
<td>30000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A Basket Hitch has Twice the Capacity of a Single Leg only if the D/d Ratio is 25/1 and the Legs are Vertical

In order for ANY of the above Sling Capacities to be correct the Size of any SHACKLE used Must be One Size GREATER or LARGER
Presentation of data indicating load capacity at various angles for choke hitch reduction due to angle.
Keep rope well lubricated inside and out in proper

While the rope and its bitter ends are pulled through the

Note that broken wires should not be cut due to sharp

Disembursed conditions

- Discard rope suffering -

7. A corded, knitted, cut, cut off, heat, twisted, or breaking into the

6. Normal strength for new ropes can be expected to:

3/32" for larger ropes

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3/32" for larger ropes

5. Reduction in rope diameter should not exceed:

4. If any wire in a strand is worn by 1/3 its diameter

3. If any wire breaks in the valley between strands.

2. One or more broken wires at a fitting

1. See criteria above

Replace it:

3 broken wires in one strand in one lay

6 broken wires in one lay

3 broken wires in one strand in one lay

6 broken wires in one lay

Replace rope if these are:
WIRE ROPE SOCKET TERMINATIONS
- Swaged & Spelter Sockets are used on standing ropes and permanent ropes like pendants.
- Wedge Sockets are used to attach Crane Whip Line to the Headache Ball, etc.
  Do not attach dead end to live with wire rope clip.

WIRE ROPE LOOP TERMINATIONS
- Without thimble, eye efficiency may be reduced as much as 10%.
- Wire Rope Clips must be properly installed.
Wrong

1. Use two loop ends with thimble eye
2. Overlap rope, use twice number clips needed for 1 loop
3. Clips must be properly installed

Wire Rope Clip Installation

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**REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES**

**SYNTHETIC SLING INFORMATION**

- Must include manufacturer’s sewn on Tag.
- (Gives Fiber Type & Safe Working Load)
- Provided with seamless protective cover.
- Use corner protection.
- Need careful Inspection.
- Slings stretch as much as 10%, Polyethylene 1%.

---

**ENDLESS ROUND SLING CAPACITY**

<table>
<thead>
<tr>
<th>COLOR</th>
<th>Wt #/ft</th>
<th>Vertical</th>
<th>Choker</th>
<th>Basket</th>
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</thead>
<tbody>
<tr>
<td>Purple</td>
<td>0.2</td>
<td>2,650 lb</td>
<td>2,120</td>
<td>5,300</td>
</tr>
<tr>
<td>Black</td>
<td>0.25</td>
<td>4,000</td>
<td>3,200</td>
<td>8,000</td>
</tr>
<tr>
<td>Green</td>
<td>0.3</td>
<td>5,300</td>
<td>4,240</td>
<td>10,600</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.4</td>
<td>8,400</td>
<td>6,720</td>
<td>16,800</td>
</tr>
<tr>
<td>Tan</td>
<td>0.55</td>
<td>10,600</td>
<td>8,500</td>
<td>21,200</td>
</tr>
<tr>
<td>Red</td>
<td>0.6</td>
<td>13,200</td>
<td>10,560</td>
<td>26,400</td>
</tr>
<tr>
<td>White</td>
<td>0.9</td>
<td>16,800</td>
<td>13,400</td>
<td>33,600</td>
</tr>
<tr>
<td>Blue</td>
<td>1.0</td>
<td>21,200</td>
<td>17,000</td>
<td>42,400</td>
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<tr>
<td>Grey</td>
<td>2.15</td>
<td>31,000</td>
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<td>62,000</td>
</tr>
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</table>

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### Eye Nuts

**Recommended for Vertical or Tension Load**

- Vertical Tension Load
- Tension Load is same as anchor
- Seat working load for vertical
- Place over installed wedge
- Forged, Quenched & Tempered

### Cast Steel Hoist Rings

<table>
<thead>
<tr>
<th>Allowable Tension &amp; Shear Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion Working Load Required</td>
</tr>
</tbody>
</table>

**Wedge Anchor**
- Comes with ring
- Replace bolt that
- Bushing finish
- Use washer that

---

**Repairs, FAQ, Glossary & Engineering Tables**

**User's Operating Guide**
## WEDGE ANCHORS

### Kwik-bolt, Wedge-all or Tubolt

#### Allowable Tensile Loads (lbs)

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Embedment</th>
<th>Required Torque (ft-lb)</th>
<th>t&lt;sub&gt;1&lt;/sub&gt; = 2000 psi</th>
<th>t&lt;sub&gt;1&lt;/sub&gt; = 3000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8&quot;</td>
<td>1 1/8&quot;</td>
<td>use 25</td>
<td>530</td>
<td>605</td>
</tr>
<tr>
<td></td>
<td>2 1/8&quot;</td>
<td></td>
<td>1130</td>
<td>1210</td>
</tr>
<tr>
<td></td>
<td>4 1/8&quot;</td>
<td></td>
<td>1200</td>
<td>1230</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>2 5/8&quot;</td>
<td>use 50</td>
<td>3870</td>
<td>4730</td>
</tr>
<tr>
<td></td>
<td>3 5/8&quot;</td>
<td></td>
<td>1750</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>6 5/8&quot;</td>
<td></td>
<td>1790</td>
<td>2170</td>
</tr>
<tr>
<td>3/16&quot;</td>
<td>2 3/4&quot;</td>
<td>use 100</td>
<td>1430</td>
<td>1690</td>
</tr>
<tr>
<td></td>
<td>4 3/4&quot;</td>
<td></td>
<td>2170</td>
<td>2670</td>
</tr>
<tr>
<td></td>
<td>7 3/4&quot;</td>
<td></td>
<td>3300</td>
<td>3270</td>
</tr>
<tr>
<td>1/8&quot;</td>
<td>3 1/4&quot;</td>
<td>use 225</td>
<td>150</td>
<td>1850</td>
</tr>
<tr>
<td></td>
<td>3 1/8&quot;</td>
<td></td>
<td>2750</td>
<td>3630</td>
</tr>
<tr>
<td></td>
<td>4 1/16&quot;</td>
<td></td>
<td>3750</td>
<td>4630</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>4 1/2&quot;</td>
<td>use 350</td>
<td>2300</td>
<td>3650</td>
</tr>
<tr>
<td></td>
<td>6&quot;</td>
<td></td>
<td>4000</td>
<td>5310</td>
</tr>
<tr>
<td></td>
<td>9&quot;</td>
<td></td>
<td>6070</td>
<td>7070</td>
</tr>
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</table>

#### Allowable Shear Loads (lbs)

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<tr>
<th>Diameter</th>
<th>Embedment</th>
<th>t&lt;sub&gt;1&lt;/sub&gt; = 2000 psi</th>
<th>t&lt;sub&gt;1&lt;/sub&gt; = 3000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8&quot;</td>
<td>1 1/8&quot;</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2 1/4&quot;</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
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<td>2 1/2&quot;</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
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<tr>
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<td>4 1/2&quot;</td>
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<tr>
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<td>6&quot;</td>
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</tbody>
</table>
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

HURST- AIRSHORE RESCUE STRUT
- Adjustable aluminum, pneumatic struts. (May use up to 50 psi air pressure to gently extend these struts).
- See Section 2 & 3 for other recommendations.
- Struts are available in various ranges of length (F strut = 7 to 11 ft, E strut = 4 to 7 ft, long) see Manufacturers Data for available lengths.
- Use adjustable collar and double pin system to transfer load from inner to outer tube.
- Listed loads are for use of 3 ½” O.D. struts with SWIVEL ENDS and WITH or WITHOUT ONE 6ft, or 4ft EXTENSION placed on large (3 ⅛”) end.
- Adequacy of supporting material under strut, and need for header and sole should be verified by a competent Professional Engineer.

RECOMMENDED DESIGN STRENGTH
AIRSHORE STRUTS USED IN US&R

<table>
<thead>
<tr>
<th>Length Feet</th>
<th>Recommended Load lbs (kg)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 ft</td>
<td>3000lbs (1350 kg)</td>
<td>Use strut plus extension</td>
</tr>
<tr>
<td>15</td>
<td>3400 (1530)</td>
<td>or single adjustable strut</td>
</tr>
<tr>
<td>14</td>
<td>3800 (1710)</td>
<td>&quot;</td>
</tr>
<tr>
<td>13</td>
<td>5000 (2250)</td>
<td>&quot;</td>
</tr>
<tr>
<td>12</td>
<td>7000 (3150)</td>
<td>&quot;</td>
</tr>
<tr>
<td>11</td>
<td>10,000 (4500)</td>
<td>&quot;</td>
</tr>
<tr>
<td>10</td>
<td>12,000 (5400)</td>
<td>Do not use extensions</td>
</tr>
<tr>
<td>9</td>
<td>14,000 (6400)</td>
<td>&quot;</td>
</tr>
<tr>
<td>8</td>
<td>15,000 (6800)</td>
<td>&quot;</td>
</tr>
<tr>
<td>7</td>
<td>18,000 (8200)</td>
<td>&quot;</td>
</tr>
<tr>
<td>6 ft &amp; less</td>
<td>20,000 (9100 kg)</td>
<td>Max. Recommended Load for Airshore Strut</td>
</tr>
</tbody>
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<td>20,000 (9100 kg)</td>
<td>Max. Recommended Load for Airshore Strut</td>
</tr>
</tbody>
</table>
### AIRSHORE RAKER SHORE SYSTEM

#### RECOMMENDED DESIGN STRENGTH

**Note:** Horizontal load at point of insertion

Use 1,000 lbs per raker (per raker).

<table>
<thead>
<tr>
<th>Load (lbs)</th>
<th>Height (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>8.5</td>
</tr>
<tr>
<td>7,000</td>
<td>9.0</td>
</tr>
<tr>
<td>5,000</td>
<td>9.5</td>
</tr>
<tr>
<td>4,000</td>
<td>10.0</td>
</tr>
<tr>
<td>3,000</td>
<td>10.5</td>
</tr>
<tr>
<td>2,000</td>
<td>11.0</td>
</tr>
</tbody>
</table>

**Notes:**
- The rakers should be placed so as to avoid interference with the ground surface and excavation.
- A horizontal load at the point of insertion.
- Provide a vertical bearing surface.
- The rakers are placed with the ground surface and excavation.
- The rakers should be configured with the angle between the ground surface and excavation.
- System is made from 2 rakers spaced 4 ft or 6 ft.
- See section "x".

### AIRSHORE RAKER OPERATION

**Note:** User manual for operation guide.

---

**Notes:**
- System is made from 2 rakers spaced 4 ft or 6 ft.
- See section "x".

---

**Notes:**
- System is made from 2 rakers spaced 4 ft or 6 ft.
- See section "x".
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

PARATECH LONG SHORE STRUTS (GOLD ANODIZED COLOR)

- Adjustable aluminum, pneumatic struts. Use Acme Nut to transfer load from inner to outer tube. (May use up to 50 psi air pressure to gently extend these struts)
- See Section 2 & 3 for other recommendations.
- Struts are available in three ranges of length. (10 ft to 16 ft, 8 ft to 12 ft, and 6 ft to 10 ft long)
- Listed loads are for use of 3 1/2” O.D. struts with SWIVEL ENDS and WITH or WITHOUT ONE 6 ft, 4 ft or 2 ft EXTENSION.
- Listed loads are NOT for Paratech 3” O.D. LOCK STRUT & ACME THREAD, RESCUE STRUT. See 2nd page following for Paratech Rescue Struts.
- Adequacy of supporting material under strut, and need for header and sole should be verified by a competent Professional Engineer.

RECOMMENDED DESIGN STRENGTH PARATECH LONG SHORE STRUTS USED IN US&R

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<td>&quot;</td>
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<tr>
<td>10 ft</td>
<td>12,000 (5400)</td>
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</tr>
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<td>9 ft</td>
<td>16,000 (7200)</td>
<td>&quot;</td>
</tr>
<tr>
<td>8 ft</td>
<td>20,000 (9100)</td>
<td>&quot;</td>
</tr>
<tr>
<td>7 &amp; 6 ft</td>
<td>22,000 (10,000)</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

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REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

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<tr>
<td>7 &amp; 6 ft</td>
<td>22,000 (10,000)</td>
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</tbody>
</table>
US&R SHORING OPERATIONS GUIDE
REPAIRS, FAQ, GLOSSARY, & ENGINEERING TABLES

PARATECH RESCUE STRUTS
(DARK GREY ANODIZED COLOR)

- Adjustable aluminum, pneumatic struts. Use Acme Nut to transfer load from inner to outer tube.
- See Section 2 & 3 for other recommendations.
- Struts are available in 1.5 to 2 ft, 2 ft to 3 ft, 3 ft to 5 ft, & 5 ft to 7.2 ft ranges of length. (12", 24" & 36" extensions are also available).
- Listed loads are based on 3" O.D. struts, tested with swivel ends, with and without one extension.
- See Pg 4-40 for Paratech 3 ½" O.D. Long Shore (Gold Color) Struts
- Adequacy of supporting material under strut, and need for header and sole should be verified by a competent Professional Engineer.
- The following Load Table is based on tests performed by PARATECH and reviewed by Wiss, Janney, Elstner, Assocs., Engineers

PARATECH RESCUE STRUTS LOAD TABLE
Based on compression tests using swivel bases

<table>
<thead>
<tr>
<th>Length Feet</th>
<th>Average Failure Strut Force (Ultimate strength)</th>
<th>Design Strength based on the following Safety Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 ft</td>
<td>87,000 lbs</td>
<td>3 to 1</td>
</tr>
<tr>
<td>4 ft</td>
<td>71,750 lbs</td>
<td>3 to 1</td>
</tr>
<tr>
<td>6 ft</td>
<td>56,500 lbs</td>
<td>3 to 1</td>
</tr>
<tr>
<td>8 ft</td>
<td>48,100 lbs</td>
<td>3 to 1</td>
</tr>
</tbody>
</table>
RETURN BOOM
EXTEND BOOM
TELESCOPING BOOM - 1 HAND
TELESCOPING BOOM - 2 HANDS

DO EVERYTHING
STOP
TRAVEL

STOP
MOVE SLOWLY
RAISE LOAD
LOWER BOOM
RAISE BOOM
LOWER LOAD
SWING BOOM
USE MAIN HOIST
USE WHIP LINE

FROM HOIST BLOCK OR BOOM BE SURE TO STAY A SAFE DISTANCE OF YOUR CRANE HOST ENGINEER ALWAYS STAND IN CLEAR VIEW

CRANE SIGNALS

REPAIRS FAQ, GLOSSARY & ENGINEERING TABLES
USER SHARING OPERATIONS GUIDE

CRANE SIGNALS

REPAIRS FAQ, GLOSSARY & ENGINEERING TABLES
USER SHARING OPERATIONS GUIDE
INTRODUCTION to SECTION R

This section contains information that provides useful data for the Rescue Specialist at the US&R Disaster Site, listed as follows:

- Personnel Assignments  Page R-2
- Radio Channels  R-3
- Team briefing Components  R-4
- Squad POA Requirements  R-5
- Rescue Team Manager Duties  R-6
- Rescue Squad Officer Duties  R-8
- Medevac Procedures  R-9
- BOO Requirements  R-10
- Strategic Considerations  R-21
- Initial Rescue Site Tasks  R-22
- Site Assessment Form  R-23
- LCES and Cribbing Information  R-24
- ICS 214: Unit Activity Log Example  R-26
Personnel Assignments

Rescue Squad:
Squad Personnel
Officer:
1 (ASL):
2:
3:
4:
5:
HM:
Medic:
TFL 1:
TFL 2:
LOG 1:
LOG 2:
<table>
<thead>
<tr>
<th>Radio Channels</th>
<th>TFL 1</th>
<th>TFL 2</th>
<th>RTM 1</th>
<th>RTM 2</th>
<th>LOG 1</th>
<th>LOG 2</th>
<th>MED 1</th>
<th>MED 2</th>
<th>BOO 1</th>
<th>BOO 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFL 1</td>
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<td>LOG 1</td>
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<td>MED 2</td>
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<td></td>
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</tr>
<tr>
<td>BOO 1</td>
<td></td>
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<td></td>
<td></td>
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</table>
### Team Briefing Components

<table>
<thead>
<tr>
<th>Sketch/Notes:</th>
<th>Communications:</th>
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</thead>
<tbody>
<tr>
<td>Situation / Hazard Evaluation:</td>
<td>HAZ MAT Concerns:</td>
</tr>
<tr>
<td>EMS Plan:</td>
<td>Emergency Signals / Procedures:</td>
</tr>
<tr>
<td>Logistical Support:</td>
<td>Site Control / Required PPE:</td>
</tr>
<tr>
<td>Operational Period Objectives:</td>
<td>Situation / Hazard Evaluation:</td>
</tr>
</tbody>
</table>
Squad POA Requirements

- Sign in/Check in
- Personal Pack inspection
- Vehicle keys
- Contact Information sheet
- Family Support Team information sheet
- Medical review/Shot Record
- MRE/Water
- Communications equipment issue
- Passport (if required)
- Brief Relief issue
Rescue Team Manager

General Duties

Reports
Provide situation updates and maintain
Brief assigned personnel
Receive briefings and SITREPs from TFL
Determine logistical and organizational

Prepare evaluations for assigned personnel
Provide input to assist the tactical objectives
Coordinate and supervise operations
developing the tactical objectives
Provide input to assist the TFL in
Reports to TFL
Rescue Team Manager
On Site Duties

- Overall assessment process to determine:
  - Functional requirements
  - Work schedules and rotation periods
  - Adequacy of support facilities
- Coordinate activities with Search & Recon
- Assist in development of team action plan
- Coordinate objectives and personnel assignments
- Ensure proper worksite setup, control & safety
- Evaluate operations and modify as needed
- Evaluate capacity of resources to complete assignment
- Order additional resources as needed
- Resolve coordination, personnel and communication issues
- Provide periodic progress reports to the TFL
- Identify completion of assignments
- Identify availability of resources
- Submit daily reports to Plans
- Ensure proper information exchange at relief or demob
- Notify Logistics of equipment, supply or maintenance issues
Rescue Squad Officer

General Duties

- Reports to Rescue Team Manager
- Appoint Assistant Squad Leader (ASL)
- Determine rescue component of the Team
- Prepare evaluations for assigned personnel
- Ensure proper information exchange at the Rescue Team Manager
- Submit daily reports and records to Plans
- Coordinate logistical requirements with the Rescue Team Manager and Logistical
  Services
- Coordinate and Supervise assigned personnel
- Determine organizational and logistical needs
- Provide situation updates and maintain reports
- Evaluate and modify rescue tactics and needs
- Determine availability of resources
- Evaluate capacity to complete assignment
- Order additional resources as needed
- Determine availability of personnel
- Coordinating logistical requirements with the Rescue Team Manager and Logistical Services
- Implement rescue component of the Team
- Assist the Assistant Squad Leader (ASL)
- Reports to Rescue Team Manager

On Site Duties

- Coordinate logistical requirements with the Rescue Team Manager and Logistical Services
- Determine availability of resources
- Evaluate capacity to complete assignment
- Order additional resources as needed
- Make periodic progress reports to the Rescue Team Manager
- Submit daily reports and records to Plans
- Ensure proper information exchange at the Rescue Team Manager
- Submit daily reports and records to Plans
- Coordinate logistical requirements with the Rescue Team Manager and Logistical Services
- Coordinate and Supervise assigned personnel
- Determine organizational and logistical needs
- Provide situation updates and maintain reports
- Evaluate and modify rescue tactics and needs
- Determine availability of resources
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- Order additional resources as needed
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- Coordinating logistical requirements with the Rescue Team Manager and Logistical Services
- Implement rescue component of the Team
- Assist the Assistant Squad Leader (ASL)
- Reports to Rescue Team Manager
Medevac Procedures

Select and Secure Landing Site:

- Size depends on number and type of aircraft
- Ground slope <15 degrees
- Ensure surface free of rocks and debris
- Avoid dust, sand and snow
- Ensure ground firm enough to prevent aircraft from bogging down during loading/unloading
- At approach/departure ends, clearly mark obstructions that cannot be removed
- Ensure 10:1 horizontal clearance to vertical obstructions
- Mark landing/touchdown site
- Use smoke, signalman and or lights
- When dark, mark touchdown point with inverted “Y” composed of four lights
Medevac Procedures

Night Marking of Landing Zones

Note: The touchdown point will be midpoint of the legs of the "Y". If more than 1 small aircraft will land, add 1 additional light at the exact point each is to land. If more than 1 large aircraft will land, add 2 lights placed 10mm apart aligned in the direction of flight.

Helicopter Hand Signals

Direction of Flight

Left Stem

Right Stem

14 Meters

7 Meters
BOO Site Requirements
Preferred Size 200x200ft (61x61m)
Minimum size 110x150ft (33.5x46m)
- Cultural/social considerations
- Access to work sites
- Runoff/flooding
- Noise considerations
- Utilities
- Damaged structures
- Prevailing winds/air hazards

BOO Setup Priorities

<table>
<thead>
<tr>
<th>Task</th>
<th>Priority</th>
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<tbody>
<tr>
<td>Cache setup and organization</td>
<td>1</td>
</tr>
<tr>
<td>Task Force Command Center</td>
<td>1</td>
</tr>
<tr>
<td>Medical</td>
<td>1</td>
</tr>
<tr>
<td>Personnel Shelters</td>
<td>1</td>
</tr>
<tr>
<td>Sanitation/Hygiene</td>
<td>2</td>
</tr>
<tr>
<td>Community Tent</td>
<td>3</td>
</tr>
<tr>
<td>Canine Shelter</td>
<td>3</td>
</tr>
<tr>
<td>Security/Hazards (constant)</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Squad 1:
Personnel Shelter setup (Priority 1)
Assigned to tent ________________

Squad 2:
Cache setup & organization (Priority 1)
Assigned to tent ________________

Squad 3:
Cache setup & organization (Priority 1)
Assigned to tent ________________

Squad 4:
Cache setup & organization (Priority 1)
Assigned to tent ________________
BOO Setup Responsibilities

- **Site Requirements (Immediate)**
  - Task Force Leader, Rescue Team Manager, Log Chief & Comm Specialists
- **Cache Setup and Organization (Priority 1)**
  - Log Chief, Log Specialists, Squads 3 & 4
- **TFCC Setup (Priority 1)**
  - Task Force Leader, Plans Chief, Comm Specialists, Technical Info Specialist & Safety
- **Medical Treatment Area Setup (Priority 1)**
  - Medical Manager & Medical Specialists
- **Personnel Shelter Setup (Priority 1)**
  - Squad 2
- **Sanitation/Hygiene Issues (Priority 2)**
  - Safety
- **Canine Exercise Area (Priority 3)**
  - Search Team Manager & Canine Specialists
- **Community Tent Setup (Priority 3)**
  - Log Chief & Technical Info Specialist
BOO Setup Procedure

(Preferred Size, 200x200ft (61x61m))

Minimum Size, 110x150ft (33.5x46m)

Utilize Advance Team Kit

- 2 - 100ft tapes, roll fireline tape, BOO signs
- Digital camera, vests, chalk, binoculars & paint
- Minimum size, 10x15ft (3.35x4.6m)

- Lay out and identify sections with signs and fireline tape
- Entrance should be adjacent to main access or travel route
- Mark ground for location, dimension and spacing of each section and tent
- Ensure fire extinguishers and signs are present
- Generators placed on perimeter near section to be powered

- Post signs for all sections and each tent
- Identify remote fuel storage area
- Identify travel/access routes
BOO Setup (Cache) Procedures

- Size (approximately) 50x60ft (15x18m)
- Layout/mark Cache area adjacent to BOO entrance and main travel/access
- Post conspicuous sign
- Mark perimeter with fireline tape and establish entry control point
- Mark location/layout for cache setup
  - 4 rows Rescue
  - 1 row Technical
  - 1 row WMD (as needed)
  - 1 row Logistics
- Erect 19x35ft Western Shelter tent for weather sensitive equipment and office
- Provide electricity and light
- Identify empty boxes for counter space/seating
- Provide tarps/sheeting for weather/security
BOO Setup (TFCP) Procedures

- Plans/Technical Information Workspace
- Equipment setup
- Communications Workspace
- Command and Control
- Establish the following:
  - Retrieve/setup all office supplies and forms
  - Provide electricity and light
  - Erect 2 19x19ft Western Shelter tents
  - Identify high ground/elevated structures for communications
  - Mark perimeter with fireline tape and post sign
  - Size (approximately) 40x30ft (12x9m)
BOO Setup (Medical) Procedures
- Size (approximately) 25x50ft (7.5x15m)
- Mark perimeter with fireline tape and post sign
- Erect 19x35ft Western Shelter tent
- Provide electricity and light
- Establish the following:
  - Patient treatment area, with privacy
  - Acute care equipment
  - Office workspace with shelving and seating

BOO Setup (Shelter) Procedures
- Size (approximately) 80x110ft (24x33.5m)
- Mark perimeter with fireline tape and post sign
- Erect Personnel Shelter tents
- Provide electricity and lighting
- Provide smoke & carbon monoxide detectors and fire extinguishers
- Affix identification signs to tents
- Consider weather and runoff issues
BOO Setup (Sanitation/Hygiene) Procedures

- Size (approximately) 25x25ft (7.5x7.5m)
- Mark perimeter with fireline tape and post sign
- Setup a minimum of 4 "Brief Relief" stations
- Provide lighting
- Set up hand washing and or wet wipe stations
- Place trash receptacles throughout BOO
- Provide lighting
- Setup up Gross decon station at BOO entry points
- Request trash collection from local resources
- Segregate food scraps

BOO Setup (Community Tent) Procedures

- Size (approximately) 25x35ft (7.5x10.5m)
- Mark perimeter with fireline tape and post sign
- Erect 19x35ft Western Shelter Tent
- Provide electricity and lighting
- Establish seating/eating area
- Establish hand washing/clean up area
- Setup up task force bulletin boards
- Request "Port-A-Potties" from local resources
BOO Setup (Security/Hazards) Procedures

- Identify/Mark Hazards within or adjacent to the BOO
- Isolate fuel storage
- Provide fire extinguisher at fuel storage and refueling locations
- Post “No Smoking” signs as appropriate
- Cover cache, supplies and equipment as appropriate
- Request additional generators/lighting for improved safety/security
- Post and announce plan for evacuation and assembly points
- Identify availability of local police/military

**BOO Setup Tent Assignments**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Tent</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFL, RTM, Safety, Plans, TIS ENG</td>
<td>A</td>
</tr>
<tr>
<td>TFL, RTM, Safety, Plans, TIS ENG</td>
<td>B</td>
</tr>
<tr>
<td>Squad 3 &amp; HM Specialist</td>
<td>C</td>
</tr>
<tr>
<td>Squad 1 &amp; HM Specialist</td>
<td>D</td>
</tr>
<tr>
<td>Squad 4 &amp; Driver/Mechanic</td>
<td>E</td>
</tr>
<tr>
<td>Squad 2 &amp; Driver/Mechanic</td>
<td>F</td>
</tr>
<tr>
<td>Canine Specialists &amp; Canines</td>
<td>G</td>
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<tr>
<td>STM, Search Specs. &amp; HER Spec.</td>
<td>H</td>
</tr>
<tr>
<td>Non-Task Force Personnel</td>
<td>I</td>
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<tr>
<td>Medical Personnel</td>
<td>Medical</td>
</tr>
<tr>
<td>Communications Personnel</td>
<td>Comm</td>
</tr>
<tr>
<td>Logistics Personnel</td>
<td>Log</td>
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<td>Logistics Personnel</td>
<td>Log</td>
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Strategic Considerations: The most effective rescue strategy should blend all viable tactical capabilities into a logical plan of operation. The general strategic considerations are outlined as follows:

Rescue Site Management and Coordination: Each rescue work site must have one person in charge to maintain unity of command. The Rescue Squad Officer of each rescue squad is responsible for all activities of the assigned rescue site including safety when a single squad operates alone. At large or complex rescue operations that require the commitment of two or more rescue squads to a single operation, the Rescue Team Manager may assume command or assign one of the Rescue Squad Officers to be in charge of the site. A Safety Officer should be identified at each rescue site.

Search Phases: There are generally five phases of organized search and rescue operations at collapse incidents:

- **Phase One:** Assessment of the collapse area.
- **Phase Two:** Removal of all surface victims as quickly and safely as possible.
- **Phase Three:** Search and rescue of victims from accessible void spaces.
- **Phase Four:** Selected debris removal to locate and rescue victims.
- **Phase Five:** General debris removal. Usually conducted after all known victims have been removed.
Initial Rescue Site Tasks

Rescue Site Management
- Communicate findings to appropriate manager
- Sketch search area and record information

Victim Location Identification
- Assess void space and atmospheric conditions
- Search/assessment marking

Area/building search
- Best access

Collapse type, and Void Locations
- Hazard locations, and Mitigation notes

Building type/shape, and configuration, include size, section
- Building sketch/plan, Include building cross section

Structural/hazard evaluation and marking
- Structure (if no Rapid Area Sketch/map and building ID (if no Rapid).
# Site Assessment

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Site#:</th>
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<table>
<thead>
<tr>
<th>Type of Occupancy:</th>
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<table>
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<tr>
<th>GPS:</th>
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<table>
<thead>
<tr>
<th># of levels:</th>
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<table>
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<tr>
<th>Above ground:</th>
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<table>
<thead>
<tr>
<th>Below ground:</th>
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<table>
<thead>
<tr>
<th>Possible # of victims/location:</th>
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<table>
<thead>
<tr>
<th>Hazards:</th>
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<table>
<thead>
<tr>
<th>Utilities controlled:</th>
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<table>
<thead>
<tr>
<th>Electricity</th>
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<tbody>
<tr>
<td>Gas</td>
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<table>
<thead>
<tr>
<th>Water</th>
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<table>
<thead>
<tr>
<th>Other</th>
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</thead>
</table>
Lookouts
- Appoint site Safety Officer
- Observe only

Communications
- Request radio channel(s)
- Review evacuation signals

Escape Routes
- Pre-established path to safe area

Safe Zones
- Pre-established areas of refuge
- Pre-identified assembly area

Cribbing
- 4x4 - 6000lbs (2700kg) per full contact point
  (Recommended Maximum Height = 4'-0'"
- 6x6 - 15,000lbs (6750kg) per full contact point
  (Recommended Maximum Height = 6'-0'"
- Overlap corners by 4” (10cm)
- Up to 15 degree slope max. (3 feet in 10 feet)

Allowable Height to Width Ratios
- All bearing 3 to 1
- Lifting or moving 2 to 1
- 2 of 4 bearing 1.5 to 1
- 1 of 4 bearing 1 to 1
<table>
<thead>
<tr>
<th>Unit Activity Log 1.</th>
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<tbody>
<tr>
<td>Incident Name:</td>
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<tr>
<td>Date:</td>
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<tr>
<td>Time:</td>
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<tr>
<td>ICS 214</td>
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<td>Rescue Squad:</td>
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<tr>
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<td>Operational Period:</td>
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<tr>
<td>Rescue Squad Roster</td>
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<td>RS 1 (ASL):</td>
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<tr>
<td>RS 2:</td>
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<tr>
<td>RS 3:</td>
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<td>RS 4:</td>
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<td>RS 5:</td>
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<tr>
<td>Medic:</td>
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<td>Activity Log (cont. on reverse)</td>
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<td>Time:</td>
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<td>Major Events:</td>
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