LESSON

09

SHORING METHODS

Lecture: 02 Periods, Practical: 09 Periods Total: 11 Periods

LESSON OBJECTIVES

Upon completing this lesson, you should be able to:

1. Define shoring and identify its components.
2. List the factors that determine the design and method of shoring.
3. Describe four types of shoring.
4. List the positions and functions of the members of a shoring team.
5. List the procedures for building a window/door shore and a vertical shore. Demonstrate these procedures in a practical exercise.

Instructor Activity

▶ *PPT 9-1 to 9-3*

Introduce yourself and your assistant.

Present the lesson topic, explain the relevance of the lesson to the course, state the duration, and describe scheduled activities and method of evaluation.

Comment on the importance of CSSR teams being well trained in shoring, which will allow them to secure the work site and protect themselves, and therefore reach trapped victims more safely and efficiently. Once they have reached the victim, shoring also provides protection for them and allows for better and safer mobility during the extrication.

Present lesson objectives. Ask a participant to read them aloud from the workbook.

Ensure that the objectives are clear to all participants.

Ask participants to close their workbooks.

1

Shoring

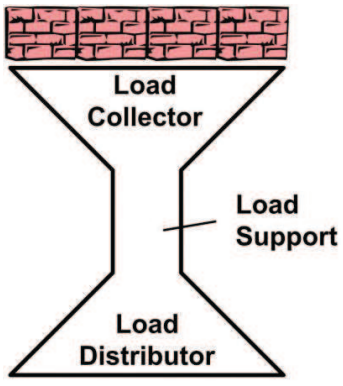
The temporary support of only that part of a damaged, collapsed, or partly collapsed structure that is required for conducting search and/or rescue operations at reduced risk to the victims and rescue team.

Shoring can also be applied to the following:

1. Structures with severely damaged panels
2. Structures with loose pieces of concrete
3. Cracked or broken pre-fabricated panels
4. Cracked masonry walls

Shoring follows a **Double-Funnel Principle**, which means that a shore collects a load, channels it and redistributes it safely to another surface or structure that can support it.

Figure 1 ▶
Double-funnel principle



Instructor Activity

Open a group discussion by asking them what they understand by **shoring**, to share any possible experiences with shoring or what they may have otherwise read or learned about it.

Ask participants to share their ideas on the purpose of shoring.

Keeping workbooks closed, ask the group to come up with a definition for shoring.

▶ *PPT 9-4*
Ask a participant to read the definition for shoring out loud.

Read from RM 9-1.

Discuss with participants what types of spaces are those where shoring is most effective and likely to be used, with regard to affected/damaged structures.

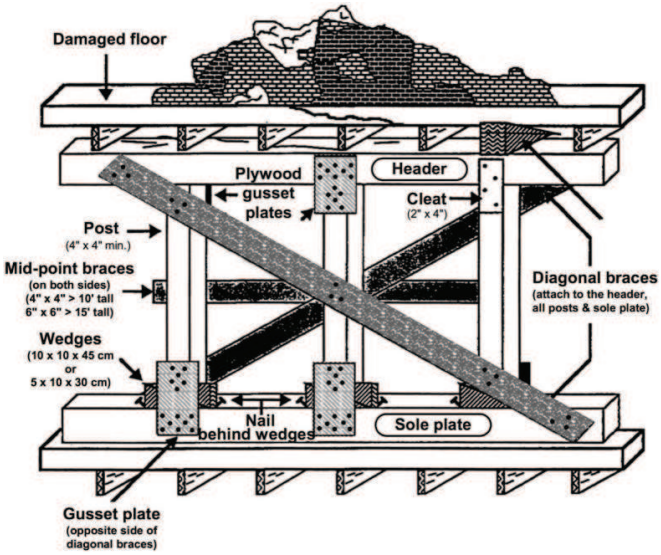
▶ *PPT 9-5*

Discuss the double-funnel principle, and how a shore must satisfy the three functions of this principle.

2 Shoring (Cont.)

Components of a Shore

Figure 2 ▼
Sample vertical shore



Label the components of the vertical shore above as the instructor describes them and write in their descriptions and functions below.

- **Sole plate:** provides a **foundation** for the shoring system by supporting the weight being transferred from above and **distributes** it over a wider area.

_____

_____

- **Header beam:** collects the weight from **above** and spreads it throughout the shoring system.

_____

_____

- **Post:** supports the weight collected by the **header** and transfers it to the **sole plate** where it is distributed.

_____

_____

Instructor Activity

▶ *PPT 9-6*
Review the individual components, allowing the participant's time to label the graphic in their workbooks.

Discuss each component in-depth and how they relate to the double-funnel principle described earlier.

Clarify that this is not necessarily the order in which the shore is assembled; rather, they are the basic components of all vertical shores.

Continue describing components of a shore.

2

Shoring (Cont.)

- **Diagonal bracing:** locks the entire shoring system together as one unit, supporting against possible **eccentric** loads. It is the last component to be installed.

- **Gusset plate:** a small piece of 13 mm or 18 mm plywood nailed to the **top** and **buttom** of posts to aid in placement of the header and secures the posts to the header and sole plate.

- **Wedges/shims:** two wooden inclined planes married together and placed under the bottom of the **posts**. These provide compression for the shoring system. The shim is a single wedge used to fill in gaps above the shoring system.

- **Cleat:** a 5 cm x 10 cm wooden piece nailed to the post and header or sole plate to secure the shoring; small pieces of wood used to secure other parts of a shoring system. A cleat should be 30 cm long or they will tend to split.

Instructor Activity

▶ Continue describing components of a shore.

2 Determining Factors

A variety of factors will determine what method of shoring is required in a particular situation.

2.1 Weight of construction materials

2.2 Weight of the structural elements to be supported

2.3 The normal load capacity of the existing undamaged structure

2.4 Condition of the structure to be supported

2.5 Condition of the foundation and floor/surface angle to determine stability of shoring

2.6 Availability of shoring materials

2.7 Lateral and vertical instability

Instructor Activity

▶ *PPT 9-7*

Discuss the various factors that will determine the method of shoring required in a particular situation.

Complete the discussion on determining factors in shoring.

Explain that in real-life situations a detailed system must be used that factors in the weight of materials being supported, capacity of the shore, the condition of the structure, etc.

Allow time for questions and comments.

Refer to RM 9-1.

3 Types of Shoring

3.1. Vertical

The main purpose of the vertical shore is to **stabilise** damaged floors, ceilings or roofs. It can also be used to **replace** missing or unstable bearing walls or columns.

Instructor Activity

▶ *PPT 9-8*
Discuss purpose of vertical shoring.

▶ *PPT 9-9*
Review the various specifications for different sizes of vertical shores.

VERTICAL SHORE SPECIFICATIONS with 10x10 cm post, header and sole plate

Maximum Height	Maximum Distance Between Posts	Maximum Overhang	Load-Bearing Capacity per Post
2.5 m (8'0")	1.25 m (4'0")	60 cm (2'0")	3,600 kg (8,000 lbs.)
3.0 m (10'0")	1.50 m (5'0")	80 cm (2'6")	2,270 kg (5,000 lbs.)
3.7 m (12'0")	1.80 m (6'0")	90 cm (3'0")	1,600 kg (3,500 lbs.)

- **Tubular poles made up of mild steel of different diameters as used in form work, scaffolding may also be used as post for vertical shoring**

3 Types of Shoring (Cont.)

3.2 Window/Door

This type of shore supports a window or door that is in danger of collapse. Diagonal braces are only used when the opening is not needed for **access** or **egress**.

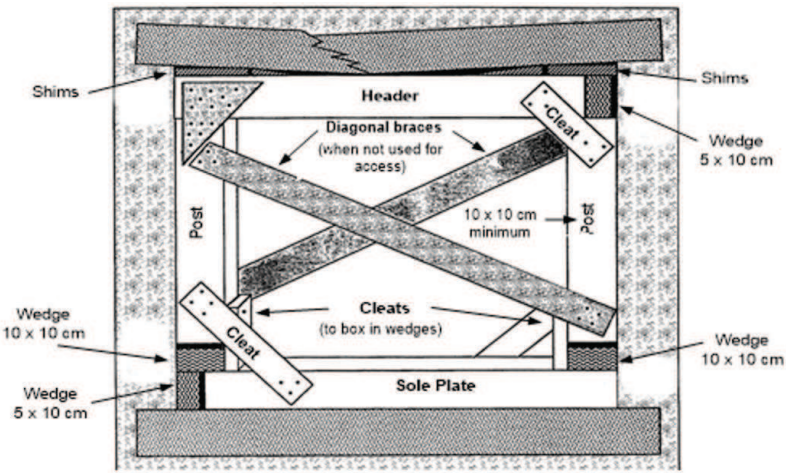


Figure 3 ▲
Typical window/door shore

3.3 Other Types of Shoring

Several additional types of shores can be used in collapsed structures, though they will not be taught in this course. Your reference material discusses them in further detail. Some examples include:

- **T-Spot Shore:** The main purpose of the T-shore is to initially stabilise damaged floors, ceilings or roofs, so that the more substantial shoring can be constructed at less risk. This shore is **quickly placed** and only **temporary**, also used during quick extrication of a victim.

Instructor Activity

Discuss purpose of window/door shoring and when it can and cannot be used.

▶ *PPT 9-10*
Review the components in the graphic of a **window/door shore.**

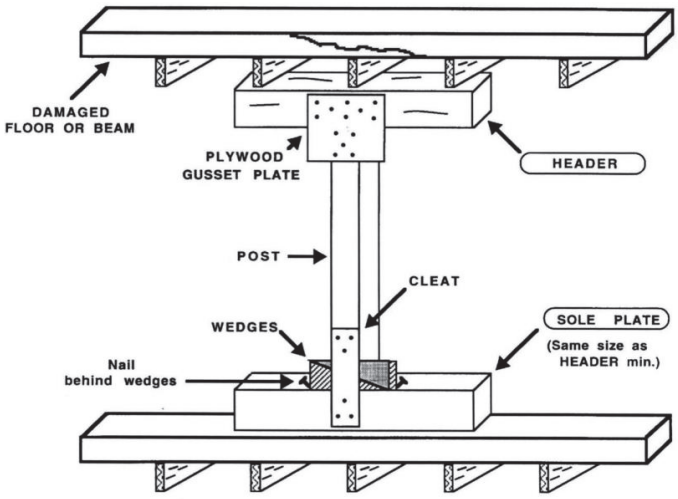
Point out to participants that though they will not be building these types of shores in this course they can find additional information on these and other types of shores by referring to RM 9.
(See RM 9-15.)

▶ *PPT 9-11*
Discuss T-spot shore.

3

Types of Shoring (Cont.)

Figure 4 ▼
T-Spot shore

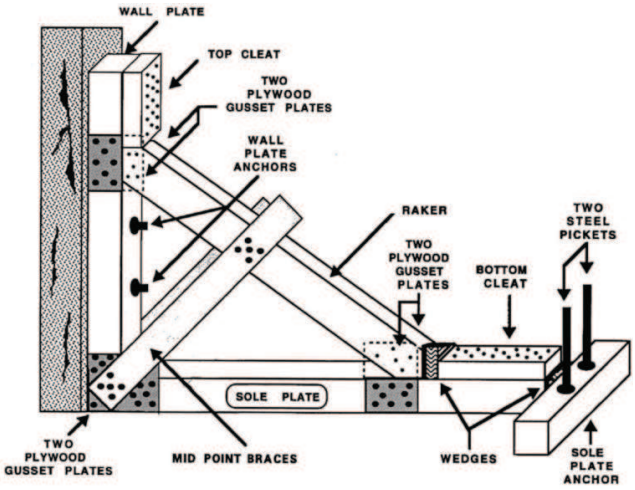


Instructor Activity

- **Raker Shore:** A triangular system of shoring used to support leaning or unstable walls or columns. Rakers must always be installed in series; at least **two** must be erected in any given situation.

▶ *PPT 9-12*
Discuss raker shore.

Figure 5 ▼
Raker shore



3

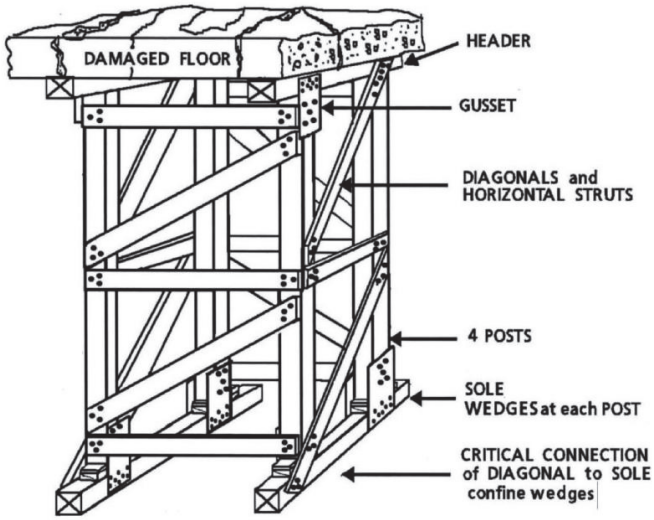
Types of Shoring (Cont.)

- **Laced Post Shore:** A high-capacity, four-post system that is used to support sagging floors and ceilings, or other overhead hazards. It can be used as a safe haven.

Instructor Activity

▶ *PPT 9-13*
Discuss laced-post shore.

Figure 6 ▼
Laced post shore

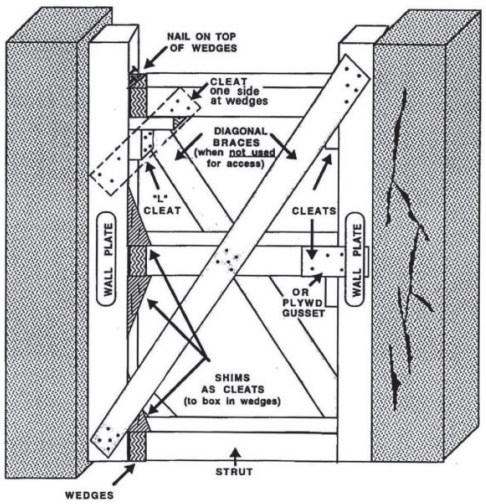


Review graphics of laced-post and horizontal shores and allow for questions and comments.

- **Horizontal Shore:** Used to stabilise a damaged wall against another undamaged wall in hallways, corridors or between buildings.

▶ *PPT 9-14*
Discuss horizontal shore.

Figure 7 ▶
Horizontal shore



4 Types of Shoring (Cont.)

Sometimes people have to improvise shoring methods, as dictated by the availability of materials. A building shored with bamboo is shown in the pictures below.

Figure 8 ▼
Improvised bamboo shores

Instructor Activity

▶ *PPT 9-15 to 9-16*
Discuss improvised shoring as shown in the pictures of bamboo shoring.

4 Members and Functions of a Shoring Team

If sufficient manpower were available, a shoring team could be organised using two separate 6 person squads, one squad as an assembly team and another as a cutting team. However, a single squad may be required to perform both sets of duties.

4.1 Assembly Group

Perform actual shoring size up and construction of shore. Whenever possible, the members of the Assembly Group should be assigned the following functions:

- **Shoring Officer (Rescue Squad Officer):** is in charge of the operation. Also works with structural specialists (if available) to determine where to place shores. If a Safety cannot be designated, the Shoring Officer will also take on this role.

_____

- **Measurer:** measures all shoring components and relays the information to the layout person of the cutting team.

_____

- **Two Shorers:** these work together assembling and erecting shores in place.

_____

- **Safety:** responsible for overall safety of the assembly team.

_____

- **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.

_____

Instructor Activity

Briefly comment on the air shore, and other manufactured shoring devices, mentioning that though not used very often, they are just as effective.

Complete discussion of other types of shoring.

▶ *PPT 9-17*
Explain the functions of the assembly group.

▶ *PPT 9-18*
Explain each of the position of the assembly team.

4

Members and Functions of a Shoring Team (Cont.)

4.2 Cutting Group

Establish the equipment area and cut the shoring lumber. Whenever possible, the members of the Cutting Group should be assigned the following functions:

- **Cutting Group Officer (Rescue Squad Officer):** in charge of selecting the cutting site. The site should be close to the shoring operation. The Cutting Team Officer doubles as the Safety.

- **Layout:** sets up the cutting station and records measurements. Performs all measuring and layout of angles.

- **Feeder:** moves and feeds measured and marked shoring material from the Layout to the Cutter and helps secure it during cutting.

- **Cutter:** cuts the measured materials.

- **Tools and equipment person:** directs where materials and equipment are to be placed and moved, and is responsible for keeping track of all tools. This person is assigned to both the Cutting Group and the Assembly Group.

- **Runner:** ensures tools, equipment and shoring materials are moved from the cutting area to the shoring operation primary access point.

Instructor Activity

▶ *PPT 9-19*

Discuss composition of **cutting group** and describe the functions of each of the positions described.

Furthermore, there is a TEA person assigned to both groups. Explain the function of this position.

4 Members and Functions of a Shoring Team (Cont.)

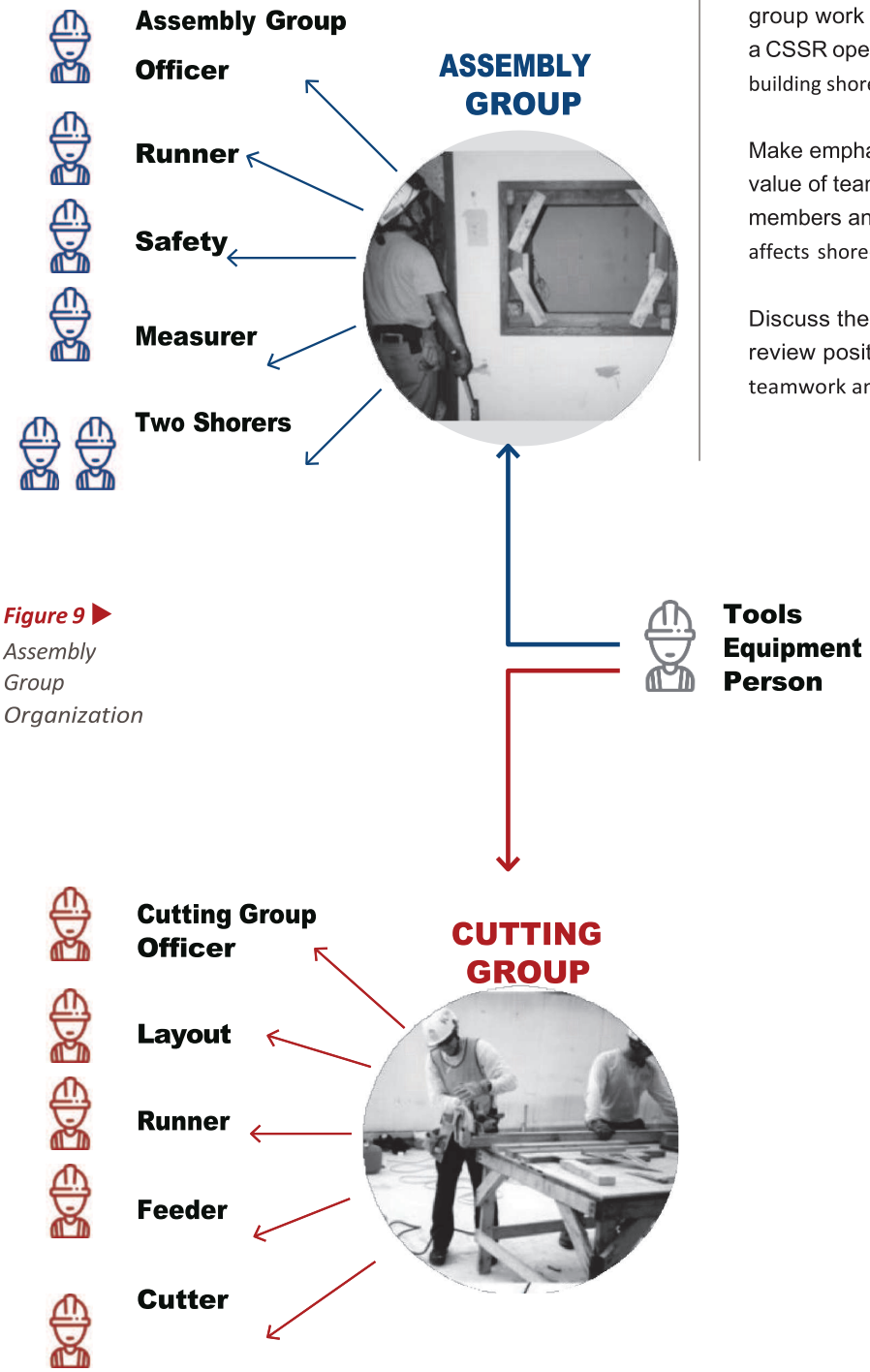


Figure 9 ▶
Assembly Group Organization

Instructor Activity

▶ Discuss how the assembly group and the cutting group work together in a CSSR operation when building shores.

Make emphasis on the value of teamwork among members and how it affects shore-building.

Discuss the graphic and review positions and teamwork among groups.

5

Building Shores (Two Types)

5.1. Nail Specifications

For the CSSR Course, duplex/common (double-headed) nails of two sizes will be used. Using these nails makes disassembly easier. However, under actual rescue conditions, common nails of a similar size can be used.

All plywood (gusset plates) must be nailed using 8d common nails only.

Figure 10 ▶

8d nail, approximately actual size (6.5 cm.)

All dimensional wood must be nailed using 16d common nails only.

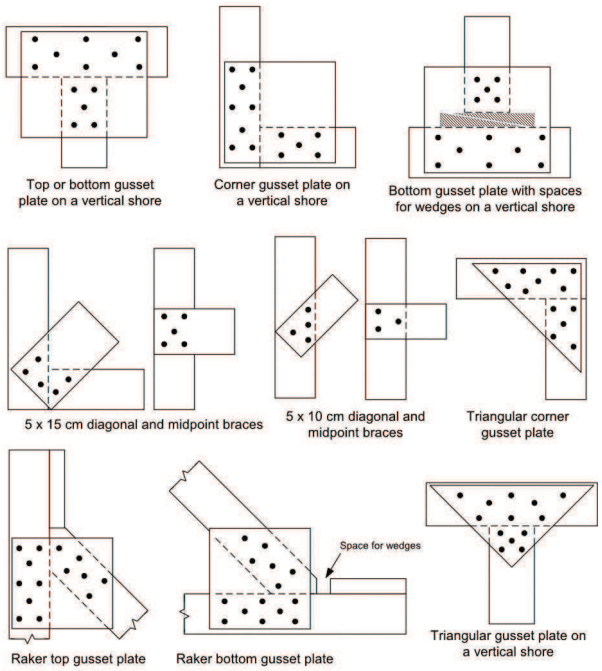
Figure 11 ▶

16d nail, approximately actual size (9 cm.)

The following diagrams show the correct nailing patterns that should be used when shoring:

Figure 12 ▼

Nail patterns for shoring



Instructor Activity

▶ Discuss the nail sizes used for the CSSR course, as well as the double-headed and common nails.

▶ *FC 9-1*

▶ Discuss nail patterns. Explain importance of following these patterns because they provide the greatest holding power while weakening the wood as little as possible.

Point out special positioning of gusset plate on raker shore to allow for viewing of the raker end. This ensures full contact with the top cleat before nailing, and provides sufficient space for wedges at the bottom cleat.

Emphasise proper measurement, especially with regard to cutting angles; improper angles can cause great loss of resistance.

Point out that though this lesson is completely hands-on in nature, it is essential for them to know proper shoring theory in order to build them correctly.

5

Building Shores (Two Types) Cont.

5.2 Vertical Shore

The two sizes of lumber most commonly used in vertical shoring are 10 x 10 cm and 15 x 15 cm. The estimated weight of the floor and its contents will help to determine the size of shoring materials and their spacing.

Businesses and commercial occupancies with heavier structural elements and greater floor height and/or loading may require 20 x 20 cm or even 30 x 30 cm lumber. The Structural Specialist should be used to help determine the correct size and placement of shoring materials.

Instructor Activity

▶ Discuss the nail sizes used Introduce the procedure for building a vertical shore and discuss lumber sizes.

▶ *FC 9-2 to 9-4*

STEP 1
Determine where to erect the vertical shore.

Review Steps 1-3 in detail.

- After installing initial temporary shoring as needed, clear the area of debris, down to the floor, removing thick carpeting if necessary. A clearance of approximately one metre wide is usually adequate.

- If the vertical shore is to bear directly on soil, examine the ground for stability. If the earth is soft, you should install additional supports under the sole plate to transfer the load over a wider area.

5

Building Shores (Two Types) Cont.

Instructor Activity

STEP 2
Measure and cut sole plate and header.

- Lay the sole plate on the floor or ground directly under and in line where the header will be installed.

- The sole plate should be as level as possible.

STEP 3
Measure and cut the posts to the proper height.

Review Steps 1-3 in detail.

- Place the header on top of the sole plate.

- With 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. Measure in at least three places deducting the width of the wedges to be used and use the shortest measurement.

5

Building Shores (Two Types) Cont.

STEP 4
Attach cleats or gusset plates to the header and posts, on opposite ends and opposing sides.

- The posts should be at least 30 cm, but less than 60 cm from each end of the header.

- This will allow the diagonal braces to be attached directly to the header, posts, and sole plate.

STEP 5
Install the posts and the header on top of the sole plate to support the damaged structural element.

- The first two posts are installed at opposite ends at least 30 cm, but less than 60 cm from each end of the sole plate.

- Keep the posts in line and plumb with header and sole plate.

- Shim the structural elements down to the header to keep it as level as possible.

Instructor Activity

Continue reviewing steps for building a vertical shore.

Make sure you allow participants to ask questions and get any clarification necessary.

5

Building Shores (Two Types) Cont.

STEP 6
Install a set of wedges under the bottom of each post.

- Tap them together simultaneously until the posts are under compression and tight.
- Nail behind the wedges to secure them in place.

_____

_____

Note: *You may want to use duplex nails to allow for adjustment of the wedges later on.*

STEP 7
Attach cleats or gusset plates on opposite ends and opposing sides of the sole plate and posts and nail in place.

_____

_____

Instructor Activity

Continue with Steps 6 - 8.

Answer any final questions on the procedure for building a vertical shore.

5

Building Shores (Two Types) Cont.

STEP 8
Attach the diagonal braces to each side of the vertical shore.

- Mid-point braces, when needed, should be installed prior to the diagonal braces (except when 5 cm material is used, and then the mid-point braces are placed over the diagonals)

- The diagonal 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 an X-pattern on opposite sides of the system.

- Vertical shoring systems that span a long area may require several sets of diagonal braces to connect multiple posts.

STEP 9
Secure the wedges with each other using a duplex nail. Never drive the nail completely.

Instructor Activity

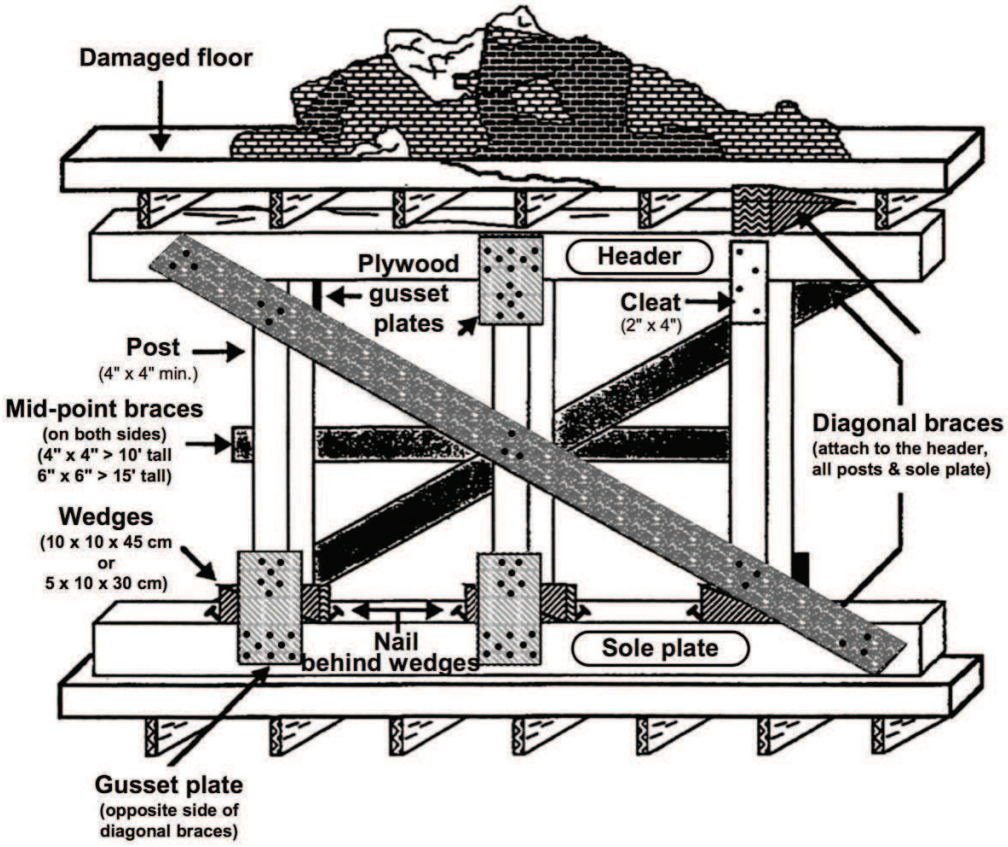
5

Building Shores (Two Types) Cont.

Instructor Activity

▶ *FC 9-6*

Figure 13 ▼
Details of a vertical shore



5

Building Shores (Two Types) Cont.

5.3 Window/Door Shore

The window and door shore is usually installed in entry points intended for use by rescue personnel to hold up or stabilise loose headers or lintels that have lost their integrity.

Additional load stress is usually exerted from above and therefore, constructed similar to the vertical shore. If additional load stress is exerted from the side, the window and door shore is constructed similar to the horizontal shore.

Instructor Activity

▶ *FC 9-5 to 9-9*
Review the basic purpose and structure of a window/door shore.

Remind them of when a window/door shore can and cannot be used.

STEP 1

Determine where to erect the window/door shore.

▶ Begin with Step 1.

After initial temporary shoring has been installed, clear the area of debris or remaining framing material.

STEP 2

Measure and cut the sole plate to the proper length deducting the width of the wedges to be used.

▶ Continue steps for Window/Door Shore.

Allow for questions and comments.

STEP 3

Measure and cut the header to the proper length deducting the width of the wedges to be used.

- Prefabricate a built-up header, if required (see end of procedure).

5

Building Shores (Two Types) Cont.

STEP 4

Measure and cut the posts to the proper height.

- Place the header on top of the sole plate.
- With 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 on both sides deducting the width of the wedges to be used.

- If you get two different measurements, use the shorter of the two.

STEP 5

Install the sole plate with a set of wedges at one end and tap them together simultaneously until the sole plate is under compression and tight.

- The sole plate should be as level as possible, using shims as necessary under the sole plate.

STEP 6

Install the header with a set of wedges at the opposite end of the sole plate and tap them together simultaneously until the header is under compression and tight.

- The header should be as level as possible, use shims as necessary above the header.

Instructor Activity

▶ Continue steps for Window/Door Shore.

Allow for questions and comments.

5

Building Shores (Two Types) Cont.

Instructor Activity

STEP 7

Install the posts between the header and sole plate and against the sides of the opening.

- Install the first post under the wedge-side of the header to prevent accidental movement if the header wedges loosen up.
- Keep the posts in-line and plumb with the header and sole plate.
- Install a set of wedges under each post, on top of the sole plate. Then tighten the wedges to lock the shore in place.

STEP 8

Attach cleats or gusset plates to at least one side of the header and posts and nail in place.

STEP 9

Confine the wedges by placing a cleat against the inside face of each post at the bottom and nail them in place with five 16d nails to each post and two 16d toe-nails to the sole plate.

- Future adjustment of the wedges may be required. Duplex nails can be used to allow for this.

▶ Cover remaining steps for Window/Door Shore.

5

Building Shores (Two Types) Cont.

STEP 10

Install diagonal braces on the window and door shore when the opening is not used for access or egress.

Built-up Header

A built-up header is used when additional support is needed or if the opening is more than 1.8 metres wide and only 10 x 10 cm material is available.

Prior to installation of the header, cut two 10 x 10 cm beams to proper length for header and set them one on top of the other. Place 15 cm-wide plywood strips (same length as the headers) on each side to join the two pieces, and hammer 8d nails at 8 cm on-centre from each strip of plywood to each 10 x 10 beam.

- Total nailing will be two rows of 8d nails spaced at 8 cm on-centre, per side.
- The header will be 20 cm thick, equivalent to a 10 x 20 cm beam.

Additional notes on building a window shore:

Instructor Activity

- Cover remaining steps for Window/Door Shore.
- Discuss a built-up header, its purpose and when it is needed.
- Discuss the graphic of a window/door shore.
- Allow for any final questions or comments on the window/door shore.

Instructor Activity

PRACTICAL EXERCISE

Review EG for Safety Briefing.

Ask participants to complete Lesson Evaluation Form. Allow several minutes.

REVIEW

Lesson objectives and other main points.

Ensure that lesson objectives have been met.

EVALUATION

Remind participants to study the RM in preparation for Post-Test.

CLOSING

Collect Lesson Evaluation Forms from everyone.

Thank class for their participation and announce the coming lesson.

— INSTRUCTOR'S COPY

POST-TEST | LESSON 9

Shoring Methods

1. **Shoring can be defined as the temporary support of only that part of a damaged, collapsed, or partially collapsed structure that is required for conducting search and/or rescue operations at reduced risk to the victims and rescue team.**

2. **List the components of a vertical shore.**
   1. **Sole plate**
   2. **Header**
   3. **Post**
   4. **Diagonal bracing**
   5. **Gusset plates**
   6. **Wedges/Shims**

3. **List two factors that determine the design and method of shoring.**
   1. **Weight of construction materials**
   2. **Weight of the structure to be supported**

4. **List the types of shores practised in this lesson.**
   1. **Vertical**
   2. **Window/Door**

5. Number the following steps (1–8) in the proper order for building a vertical shore.

5 Install the posts and header on top of the sole plate to support the damaged structural element.

7 Attach cleats or gusset plates on opposite ends and opposing sides of the sole plate and post and nail in place.

2 Measure and cut sole plate and header.

1 Determine where to erect the vertical shore.

4 Attach cleats or gusset plates to the header and posts on opposite ends and opposing sides.

8 Attach the diagonal braces to each side of the vertical shore.

6 Install a set of wedges under the bottom of each post.

3 Measure and cut the posts to the proper height.

6. Number the following steps (1 – 10) in the proper order for building a window/door shore.

4 Measure and cut the posts to the proper height.

8 Attach the cleats and/or gusset plates.

1 Determine where to erect the window/door shore.

3 Measure and cut the header.

10 Install diagonal braces (when applicable).

5 Install the sole plate with a set of wedges.

2 Measure and cut the sole plate.

7 Install the posts and wedges.

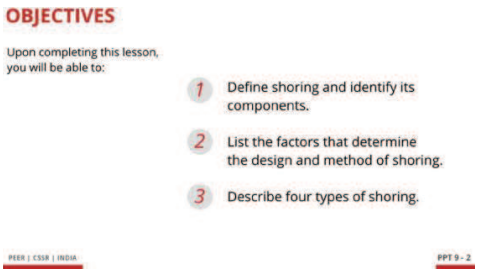
9 Confine the wedges.

6 Install the header with a set of wedges.

LESSON 9
— PPT's

9-1

9-2



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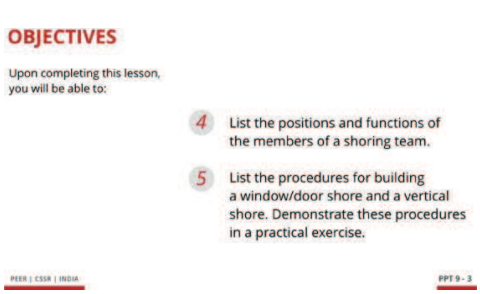

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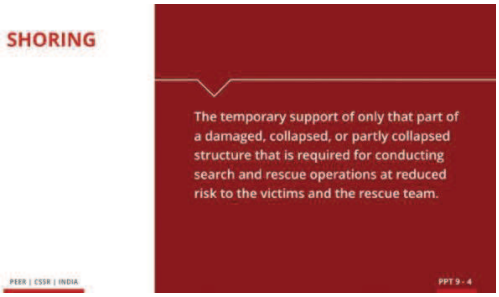

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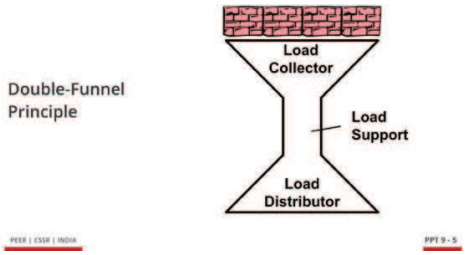
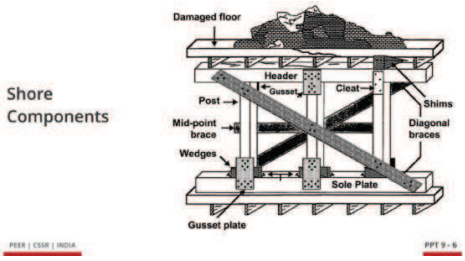


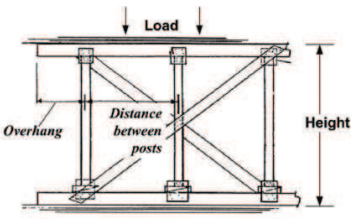
9-6



LESSON 9
— PPT's

9-7

Determining Factors



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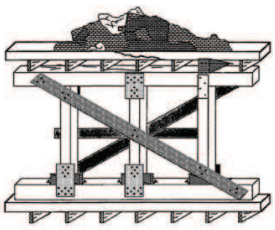
9-8

Vertical Shore



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9-9

Vertical Shore Specifications
with 10 x 10 cm POST, HEADER and SOLE PLATE

Maximum Height	Maximum Distance Between Posts	Maximum Overhang	Load-bearing Capacity per Post
2.5 m (8'0")	1.25 (4'0")	60 cm (2'0")	3,600 kg (8,000 lbs.)
3.0 m (10'0")	1.50 (5'0")	80 cm (2'6")	2,270 kg (5,000 lbs.)
3.7 m (12'0")	1.80 (6'0")	90 cm (3'0")	1,600 kg (3,500 lbs.)

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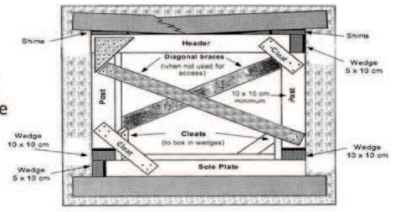
9-10

Window / Door Shore



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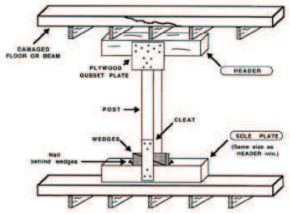
9-11

"T"-Spot Shore



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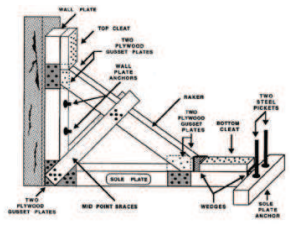
9-12

Raker Shore



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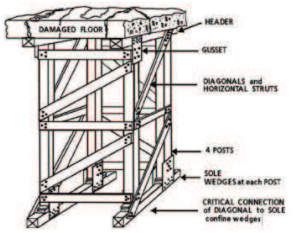
LESSON 9
— PPT's

9-13

Laced Post Shore



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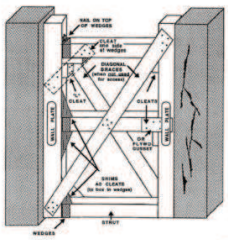
9-14

Horizontal Shore



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Bamboo Shore

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Air Shore

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9-17

SHORING TEAM COMPOSITION

Assembly Group

Cutting Group

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ASSEMBLY GROUP

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LESSON 9
— PPT's

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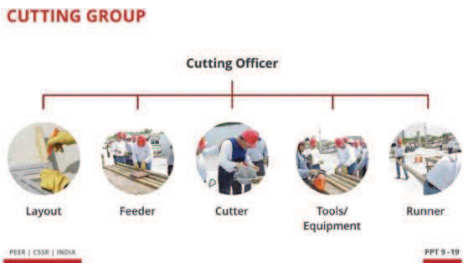
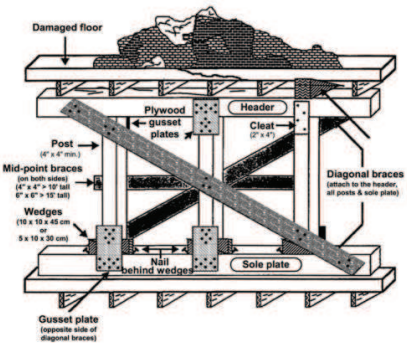


LESSON 9
— FLIP CHARTS

FC9-1

CSSR

VERTICAL SHORE



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FC9-2

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STEPS: VERTICAL SHORE

1. Determine where to erect the vertical shore.
2. Lay the sole plate on the floor or directly under and in line where the header will be installed.
3. Measure and cut the posts.

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FC9-3

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« continued

STEPS: VERTICAL SHORE

4. Attach cleats or gusset plates to the header and posts, on opposite ends and opposing sides.
5. Install the posts and the header on top of the sole plate.
6. Install a set of wedges under the bottom of each post.

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FC9-4

CSSR PEER India

« continued

STEPS: VERTICAL SHORE

7. Attach cleats or gusset plates on opposite ends and opposite sides of the sole plate and posts and nail in place.
8. Attach the diagonal braces to each side of the vertical shore.

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LESSON 9
— FLIP CHARTS

FC9-5

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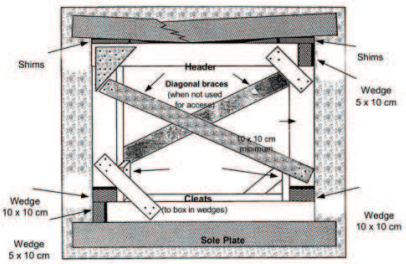
WINDOW/DOOR SHORE

The header requires width to thickness ratio of 10:1.
Example: an opening 1 m wide requires a header 10 cm thick.



The header, post and sole plate should all be the same width to maximise strength and connection with braces and cleats.

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FC9-6

CSSR

STEPS: WINDOW/DOOR SHORE

1. Determine where to erect the window/door shore.
2. Measure and cut the sole plate to the proper length.
3. Measure and cut the header to the proper length.
4. Measure and cut the posts to the proper height.

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FC9-7

CSSR

« continued

STEPS: WINDOW/DOOR SHORE

5. Install the sole plate with a set of wedges at one end and tap them together simultaneously until the sole plate is under compression and tight.
6. Install the header with a set of wedges at the opposite end of the sole plate and tap them together the same way as above.

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FC9-8

CSSR

« continued

STEPS: WINDOW/DOOR SHORE

7. Install the posts between the header and sole plate and against the sides of the opening.
8. Attach cleats or gusset plates to at least one side of the header and posts and nail them in place.

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LESSON 9
— FLIP CHARTS

FC9-9