

COLLAPSED STRUCTURE SEARCH AND RESCUE (CSSR)

LESSON 10 — OVERVIEW

Lifting and Stabilising Loads

Lecture: 02 Periods

Practical : 10 Periods **Total-** 12 Periods

Main Points	• Factors in lifting a load • Methods for lifting loads • Definition of lever • Components and classes of levers • Applications of the hoist • Types of cribbing • Steps to build cribbing • Steps to lift and stabilise a load • Steps to roll a load using pipes
Suggested Preparation	• Carefully review RM-10 • Based on lesson objectives, highlight all relevant areas in RM-10 • Review the Participant Workbook in detail and complete the blank spaces in order to become familiar with what information the participants will be filling in • Write in any relevant additional notes or comments in the lesson plan • Prepare the practical stations ahead of time • Material kits for the practical stations must be ready the day before • Meet with your assistant instructors and helpers and distribute tasks, answer questions • All assistants must be present for the lecture portion of the lesson in order to assist properly with the practical stations • Review and complete the lesson Post-Test as preparation to discuss the correct answers the next morning
Evaluation System	• Written test the next day • Demonstration of techniques used to lift and move a load; proper use of levers and equipment and the use of cribbing to stabilize a load will be conducted after lecture.
Materials and Resources Needed	• PowerPoint presentation (24) • Multi-media projector • Projection screen • Lesson Flipchart (2) • Post-Test (one for each participant) • Practical Evaluation Form (one for each participant) • Clipboard for each instructor • Two-way radios (6) • PPE for everyone

LESSON 10 — OVERVIEW (Cont.)

Lifting and Stabilising Loads

TEA	• 4 x 4 meter tarp (one per station) • Electric generator (one per station) • Portable lights (one per station) • Extension cords (2 per station) • Prying bars, 1.6-metre length minimum (8) • Sledgehammers (8) • Wedges 5 x 10 x 30 cm (16) • Wedges 10 x 10 x 45 cm (32) • Wood blocks 10 x 10 x 45 cm (120) • Wood blocks 5 x 10 x 45 cm (40) • Galvanized steel tubes, 10-cm diameter x 1.5 metres long (16)
Importance of This Lesson	• To familiarize the participant with the different methods of moving and lifting a load by using the simplest of resources that may be available at the cache.
Additional Materials	• Reinforced concrete slabs, 2.0 metres by 1.8 metres by 10 cm (4)
Practical Exercise Description	• Using four stations, set up the participants in four (4) groups, each one of them to work through all four stations. Each station will be monitored by one lead instructor and one assistant instructor, who will monitor time use. The instructors will explain and demonstrate the techniques for lifting, stabilising and moving loads, as described during lecture and based on the Lesson Plan. See the Exercise Guide. • The lead instructor must ensure that the materials kits for each station be ready the day before, using the kit configuration table included in this document.

LESSON

10

LIFTING AND STABILISING LOADS

Lecture: 02 Periods, Practical: 10 Periods Total: 12 Periods

LESSON OBJECTIVES

**Upon completion of this lesson,
you should be able to:**

1. List three factors that you must determine before lifting a load.
2. List and describe three methods for lifting a load.
3. Define a lever, its three components and the three classes of a lever.
4. List at least three applications of the hoist.
5. List two types of cribbing used to stabilise a load.
6. List the five steps to build cribbing for lifting and stabilising a load.
7. List the steps to roll a load using pipes.
8. Demonstrate in two practical stations the techniques for lifting, stabilising and rolling loads.

Instructor Activity

► **PPT 10-1 to 10-4**

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.

This lesson is very important because many times victims are trapped underneath a structural member or a heavy object. The victim can be freed using mechanical advantage techniques (manually-powered) which will be taught in this lesson.

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

Ensure that the objectives are clear to all participants.

Comment on why knowing how to lift and stabilise loads is essential in CSSR work. Relate it to freeing a victim trapped underneath a structural member or heavy object.

Ask participants to close their workbooks.

1

Before Lifting or Moving a Load

The following factors must be examined before lifting or moving a load:

- **Weight of the load**

- **Consequences when the load is moved (what will happen)**

- **Selection of the method for lifting or moving the load**

Instructor Activity

Ask participants what factors they think would have to be analysed before lifting or moving a load. Try to get them to list three factors.

▶ PPT 10-5

Participants may now open their workbooks.

Refer to RM 9-1 for weights of common building material and construction.

Discuss **weight, consequences and method.**

Participants should understand that they must study the possible consequences of moving a load before they attempt it.

2

Methods for Lifting Loads

21. The Lever

The lever is the **simplest** method for lifting a load. A lever is a rigid bar, either straight or bent, that is free to move on a fixed point called a **fulcrum**.

The fulcrum is the object or place that supports the load when a lever is used to move another object.

Applications of levers:

- To move a load that is too heavy to move by hand
- Pulling / hauling
- Raising

There are three components that make-up a lever:
fulcrum, load, and force.

Fulcrum: _____

Load: : _____

Force: : _____

Three Classes of Levers

Levers are divided into three classes based on where the fulcrum is located in relation to both the load and force.

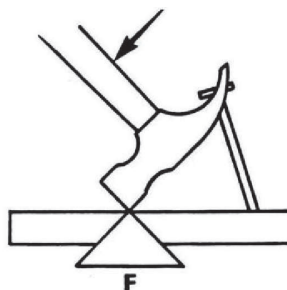
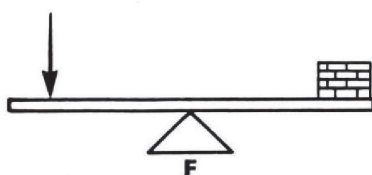
► Class One Lever

The fulcrum is placed between the force and the load, which provides the greatest mechanical advantage when lifting a load vertically. You can increase the mechanical advantage by using a longer lever.

Examples:

Figure 1 ▼

Class One lever examples
(F=fulcrum)



Instructor Activity

► PPT 10-6

Discuss the basics of levers, including the three components: load, fulcrum and force.

► PPT 10-7

Discuss three classes of levers, based on location of fulcrum in reference to load and force.

► PPT 10-8

► PPT 10-9

Discuss Class 1 levers.

2

Methods for Lifting Loads (Cont.)

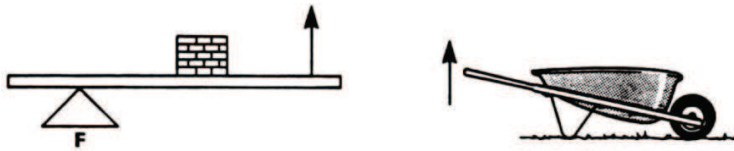
► Class Two Lever

The load is placed between the force and the fulcrum. This is the most useful and efficient lever for moving objects horizontally.

Examples:

Figure 2 ▼

Class two lever examples



► Class Three Lever

The force is placed between the load and the fulcrum. This type of lever is used when force may be sacrificed for distance, and reduces mechanical advantage.

Examples:

Figure 3 ▼

Class three lever examples



Instructor Activity

► PPT 10-10

Discuss Class 2 levers.

► FC 10-1

► PPT 10-11

Give a few examples of each type and discuss advantages/disadvantages.

Discuss Class 3 levers.

Give some examples and discuss advantages/disadvantages.

Methods for Lifting Loads (Cont.)

2.2 The Come-Along

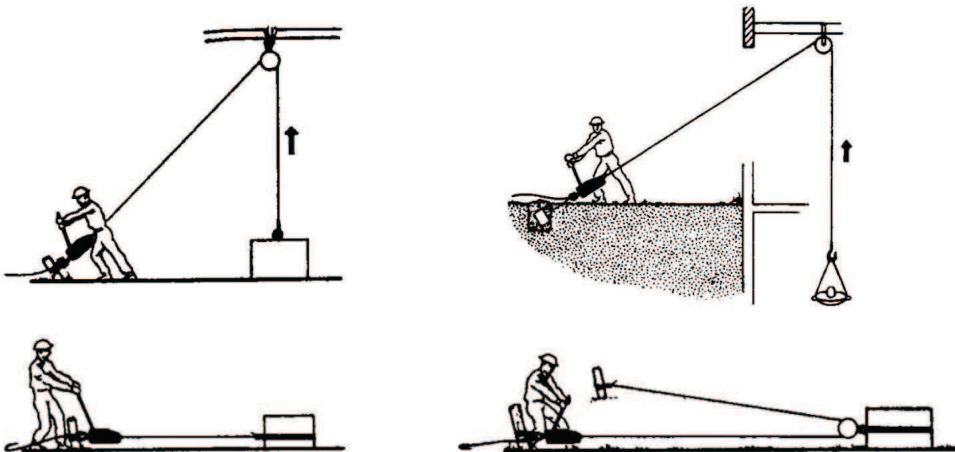
The **come-along** provides mechanical advantage for lifting and pulling using a lever and gear ratcheting system. It consists of an anchor hook on one end and another hook attached to a retractable chain or steel cable.

Figure 4 ►
The come-along



The following figure shows the many uses of the come-along.

Figure 5 ▼
Various uses of the come-along



Instructor Activity

- Discuss the basics of the hoist's functions and mechanisms.

Allow for questions and comments.

You must reference the three uses of a come-along during a CSSR operation:

- Lifting a load with pulleys
- Dragging or removing debris
- Securing a structural member

- Discuss the various uses of the Come-along.

Allow for questions and comments.

- FC 10-2

2

Methods for Lifting Loads (Cont.)

2.3 Hydraulic Jacks

These devices are operated with a lever to apply **hydraulic pressure** to a ram. Hydraulic jacks are used primarily for lifting heavy loads. Though they usually have only a short reach, they are extremely powerful – a hand-operated bottle jack can lift as much as 50 tons. It is important to keep the hydraulic jack **perpendicular** to the ground – the jack is not designed to handle lateral loads.

Figure 6 ▼
Various bottle jacks



3

Using Cribbing to Stabilise Loads

Cribbing:

The construction of a stable platform using wood pieces, which is used to stabilise and support loads.

Cribbing is constructed of **10 x 10 cm** - sized wood pieces arranged as a column to support the weight of an object.

Shims are used to fill in small spaces and secure the object in its position as it is being lifted. Shims are also used to change the angle of thrust in order to achieve optimum contact with uneven or sloping surfaces.

Instructor Activity

► PPT 10-12

Discuss mechanism and method of operation of hydraulic jacks.

Allow for questions and comments.

► Ask a participant to read the definition aloud.

Describe basic cribbing.
Finish description of cribbing.

3

Using Cribbing to Stabilise Loads (Cont.)

Failure of a wood cribbing system is **slow** and **noisy** as the wood fibres are crushed. This usually provides ample warning of impending failure for rescuers.

The requirements for improvised cribbing are:

- The material must be flat on both surfaces
- The material must be able to withstand the weight of the object being supported.

Examples include: Furniture, bricks, concrete blocks, tires, and rims

3.1 Types of Cribbing**BOX:**

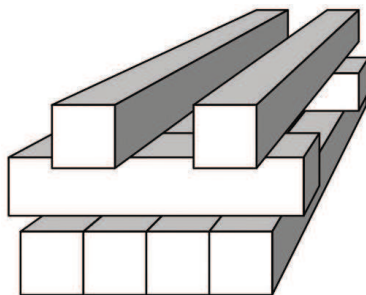
Built with wood blocks in a square configuration, using **two** parallel blocks per layer. Layers are set at 90 degrees to each other with the ends of the wood blocks overlapping each other by **10** cm. The box crib has an open centre.

Box Cribbing Capacity

10 cm x 10 cm beams: 11,000 kilos

15 cm x 15 cm beams: 27,000 kilos

Figure 7 ►
Box cribbing

**Instructor Activity**

► Discuss box cribbing.

► **PPT 10-13**

Review box cribbing capacities and the exponential effect on strength with increased thickness of wood.

3

Using Cribbing to Stabilise Loads (Cont.)

PLATFORM (cross-tie):

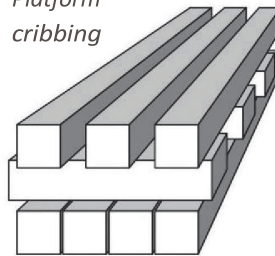
Built with wood blocks in solid layers of _____ or more wood pieces each. Layers are set 90 degrees to each other. Little or no space is left between the wood pieces. The ends of the wood pieces must also overlap each other by 10 cm.

Platform Cribbing Capacity

10 cm x 10 cm beams
= 48,000 kilos

15 cm x 15 cm beams
= 120,000 kilos

Figure 8 ▼
Platform
cribbing



3.2 General Guidelines for Cribbing

- 3.2.1 The first layer should be **solid** to fully distribute the load, especially on softer surfaces, such as soil and asphalt.

- 3.2.2 **Height limit:** The general rule is to limit cribbing to _____ times the width of the base layer of cribbing wood being used for cribbing (3:1 height-to-width ratio). For example, if the pieces of wood are one meter wide from one side of the first crib to the outer side of the last crib (across), the crib should not exceed three meters in height.

Note: - In cribbing, the **base width** refers to the **distance between the two outer edges of the bottom-most layer (or the first row) of timbers** in the cribbing stack.

- 3.3.3 Always overlap corners by approximately 10 cm. This prevents **splitting off** corners of individual pieces, which can affect overall stability.

Instructor Activity

Explain **platform cribbing**.

► PPT 10-14

► Point out that other materials can be substituted for wood. Give some examples and ask the participants for suggestions.

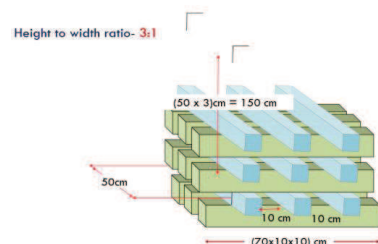
Discuss the capacities of platform cribbing.

Briefly explain under what conditions platform cribbing is recommended.

Solid first level

► PPT 10-15

Height limits
Refer to RM regarding height-to-width ratio.



Overlapping corners

Using Cribbing to Stabilise Loads (Cont.)

3.3 Procedure for Lifting and Stabilising a Load

This procedure consists of gradually lifting the target object or load and inserting one layer of cribbing after another until sufficient clearance and stability are obtained. Make sure to use full PPE before starting any work.

- 3.3.1 Make an initial opening using a shims or similar tool.

- 3.3.2 Set up a lever system with the pry bar.

- 3.3.3 Lift the load **gradually** to create an opening large enough to set up the first layer of cribbing under it. Use wedges to prop up the load gradually as you are lifting; if the pry bar slips or breaks, this will prevent the load from dropping any distance. It is not necessary to lift the full height of the next layer of cribbing all at once.

- 3.3.4 Raise the fulcrum, raise the load again, and set up the next level of cribbing with the wood pieces at 90 degrees to the previous layer.

- 3.3.5 Reposition and raise the fulcrum and continue to raise the load until enough clearance is obtained to extricate the victim safely.

Instructor Activity

Explain the basics briefly.

- Show **PPT 10-16** through **10-20** as you explain the steps, pointing out the details in the images.

Mention that wedges, essential in shoring, are also extremely useful in starting loads to be lifted. Wedges can be made of wood, heat-resistant plastic or metal.

Remind participants that they will be having a practical exercise on this procedure.

Allow time for questions or comments.

Complete steps and discussion of procedure for lifting and stabilising a load.

3

Using Cribbing to Stabilise Loads (Cont.)

Figure 9 ▼

Methods for safely lifting a load



3.4 Safety Measures for Cribbing

- “Lift an inch, crib an inch.”

- Never place hands beneath a load while cribbing!

- For maximum stability, the height cribbing should not exceed three times the width of the cribbing blocks (3:1 ratio).

Instructor Activity

- Review safety measures and make sure everyone has understood them clearly.

4

Rolling a Load

You can use metal tubes to roll heavy loads instead of lifting them. Follow the simple steps below using the picture as a guide.

- 4.1 Raise the load slightly using a Class One lever, just enough to slide three metal tubes underneath it (use the lifting technique for cribbing).



- 4.2 Using Class Two levers, push the load in the desired direction. The tubes may be fanned to turn the load as it rolls.

Instructor Activity

Explain that the use of this procedure is usually very limited because it requires a flat surface, and disaster areas rarely have them.

Review the steps.

- Show *PPT 10-21* through *10-24* and point out the details in the images.

[illegible]

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.

POST-TEST | LESSON 10

Lifting and Moving Loads

1. List the three factors that must be examined before moving or lifting a load.

- Weight of the load
- Consequences of the movement
- Proper method

2. Considering that a concrete floor 15 cm thick weighs 30 kg/m², if you need to lift a rectangular slab 4.2 metres by 2.5 metres, what would the approximate weight of the slab be?

- () 1,000 kilos
- () 3,150 kilos
- (**X**) 315 kilos
- () 12,300 kilos
- () None of the above

3. The type of lever that has the load between the fulcrum and the force is classified as what type?

- () First Class
- (**X**) Second Class
- () Third Class

4. List three uses for a Come-along during a CSSR operation.

- Lifting a load with pulleys
- Dragging or removing debris
- Securing a structural member

5. Describe the limitations of a hydraulic jack in a CSSR operation.

- Lifting capacity
- Lifting distance, as set by the length of the piston
- Can only be used vertically

6. Identify the following images:



Box Cribbing



Crosstie / Platform Cribbing

7. List the steps for rolling a load on metal tubes.

- Lift the load
- Insert metal tubes
- Use levers to push the load in the desired direction

LESSON 10 — PPT's

10-1



PPT 10-1

10-2

OBJECTIVES

Upon completing this lesson, you will be able to:

- 1 List three factors that you must determine before lifting a load.
- 2 List and describe three methods for lifting a load.
- 3 Define a lever, its three components and the three classes of a lever.

PEER | CSSR | INDIA

PPT 10-2

10-3

OBJECTIVES

Upon completing this lesson, you will be able to:

- 4 List at least three applications of the hoist.
- 5 List two types of cribbing used to stabilise a load.
- 6 List the five steps to build cribbing for lifting and stabilising a load.

PEER | CSSR | INDIA

PPT 10-3

10-4

OBJECTIVES

Upon completing this lesson, you will be able to:

- 7 List the steps to roll a load using pipes.
- 8 Demonstrate in three practical stations the techniques for lifting, stabilising and rolling loads.

PEER | CSSR | INDIA

PPT 10-4

10-5

BEFORE LIFTING A LOAD CONSIDER:

► Weight

► Consequences

► Method

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PPT 10-5

10-6

METHODS FOR LIFTING LOADS

Levers



PEER | CSSR | INDIA

Come-along



Jacks



PPT 10-6

LESSON 10

— PPT's

10-7

Lever



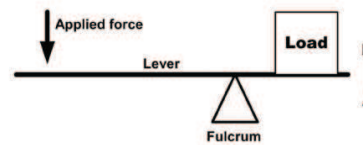
PEER | CSSR | INDIA

A lever is a rigid bar, either straight or bent, that is free to move on a fixed point called a fulcrum.

PPT 10-7

10-8

Components of a Lever

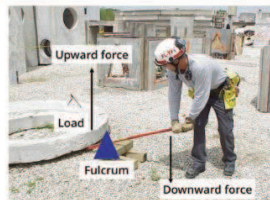


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PPT 10-8

10-9

Class 1 Lever



PEER | CSSR | INDIA

PPT 10-9

10-10

Class 2 Lever



PEER | CSSR | INDIA

PPT 10-10

10-11

Class 3 Lever



PEER | CSSR | INDIA

PPT 10-11

10-12

Hydraulic Jack



PEER | CSSR | INDIA

PPT 10-12

LESSON 10

— PPT's

10-13

Box Cribbing



PEER | CSSR | INDIA

PPT 10-13

10-14

Platform Cribbing



PEER | CSSR | INDIA

PPT 10-14

10-15

Cribbing Solid Base



PEER | CSSR | INDIA

PPT 10-15

10-16

Inserting a wedge to initiate cribbing



PEER | CSSR | INDIA

PPT 10-16

10-17



PEER | CSSR | INDIA

PPT 10-17

10-18



PEER | CSSR | INDIA

PPT 10-18

LESSON 10

— PPT's

10-19



PEER | CSSR | INDIA

PPT 10-19

10-20



PEER | CSSR | INDIA

PPT 10-20

10-21

Lifting to insert
tubes for rolling



PEER | CSSR | INDIA

PPT 10-21

10-22



PEER | CSSR | INDIA

PPT 10-22

10-23



PEER | CSSR | INDIA

PPT 10-23

10-24

Tubes fanned
for turning load



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PPT 10-24

LESSON 10 — FLIP CHARTS

FC10-1

FC10-2

