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Progressive Learning Record
THE AIM OF THIS COURSE

The aim of this course is to provide you with knowledge and skills to:

- participate in rescue operations as a member of a rescue team;
- inspect, maintain and test a range of equipment according to SES procedures;
- apply general occupational health and safety requirements when working in the usual SES environment, excluding emergency incidents.

On completion of this course, you should be able to:

- prepare and respond to rescue;
- participate in assessing the rescue scene;
- perform rescue;
- conclude rescue operations;
- inspect response equipment;
- test response equipment;
- clean, maintain and restow equipment;
- follow workplace procedures for hazard identification and risk control;
- contribute to participative arrangements for the management of occupational health and safety (OHS).

This Learner Guide has been written to reflect units PUASAR001A Participate in a rescue operation, PUAEQU001A Prepare, maintain and test response equipment and PUAOHS001A Follow defined occupational health and safety policies and procedures from the Public Safety Training Package.

The elements and performance criteria specific to these units are contained under the heading What You Should Achieve. Elements of competency are the building blocks which make up a unit. Use the elements to:

- identify what you have to achieve;
- identify what you have already achieved;
- check your progress, i.e. how you are going.
# WHAT YOU SHOULD ACHIEVE

**For unit PUASAR001A Participate in a rescue operation**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Performance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On completion of this unit, you should be able to:</strong></td>
<td><strong>You will know you have achieved this when you can:</strong></td>
</tr>
</tbody>
</table>
| 1. Prepare and respond to rescue. | - Obtain operation and task information.  
- Identify and select appropriate rescue equipment based on incident information as directed by the supervisor.  
- Select personal protective equipment based on the nature of the rescue operation.  
- Receive any further details of the nature of the rescue en route.  
- Discuss anticipated hazards and associated risks with rescue team members whilst on approach. |
| 2. Participate in assessing the rescue scene. | - Conduct rescue scene reconnaissance and report identified hazards and results to the supervisor.  
- Maintain communication with other team members using appropriate techniques and terminology.  
- Minimise or control hazards and environmental conditions.  
- Follow health and safety and security procedures correctly in accordance with organisational policy and relevant legislation.  
- Recognise and refer personal capabilities and limitations to the supervisor.  
- Report need for additional personnel and/or specialist equipment to the supervisor. |
| 3. Perform rescue. | - Gain access to incident and/or casualties using techniques and equipment in accordance with organisational procedures.  
- Conduct rescue procedures in accordance with the supervisor's instructions and organisational procedures.  
- Prepare casualties for removal.  
- Extricate casualties safely using appropriate equipment rescue techniques and procedures.  
- Monitor incident constantly for hazards to prevent injury to self or others. |
### Elements
On completion of this unit, you should be able to:

<table>
<thead>
<tr>
<th>Element</th>
<th>Performance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Conclude rescue operations.</td>
<td>◆ Recover, clean and maintain equipment to organisational standards and manufacturers' procedures and restow to maintain operational readiness.</td>
</tr>
<tr>
<td></td>
<td>◆ Where identified, recognise signs and symptoms of operational stress in self and others and report to relevant personnel.</td>
</tr>
<tr>
<td></td>
<td>◆ Participate in operational debriefing and complete documentation to organisational standards.</td>
</tr>
<tr>
<td></td>
<td>◆ Implement hygiene precautions in accordance with the organisation's requirements.</td>
</tr>
</tbody>
</table>

### For unit PUAEQU001A Prepare, maintain and test response equipment

<table>
<thead>
<tr>
<th>Elements</th>
<th>Performance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>On completion of this unit, you should be able to:</td>
<td></td>
</tr>
<tr>
<td>1. Inspect response equipment.</td>
<td>◆ Inspect equipment in accordance with organisation’s procedures.</td>
</tr>
<tr>
<td></td>
<td>◆ Identify and report missing parts according to organisation’s procedures.</td>
</tr>
<tr>
<td></td>
<td>◆ Report and record faulty or damaged equipment in accordance with organisation's procedures.</td>
</tr>
<tr>
<td>2. Test response equipment.</td>
<td>◆ Test equipment according to approved procedures and fit for purpose according to organisation’s standards.</td>
</tr>
<tr>
<td></td>
<td>◆ Record test results according to regulatory and organisation's requirements.</td>
</tr>
<tr>
<td></td>
<td>◆ Report and record defective equipment and sub-standard performance according to organisation’s procedures.</td>
</tr>
<tr>
<td>3. Clean, maintain and restow equipment.</td>
<td>◆ Clean, maintain, assemble and stow equipment according to organisation's procedures.</td>
</tr>
<tr>
<td></td>
<td>◆ Update equipment records according to organisation’s procedures.</td>
</tr>
<tr>
<td></td>
<td>◆ Recover, restow and make ready equipment for future use.</td>
</tr>
</tbody>
</table>
## For unit PUAOHS001A Follow defined occupational health and safety policies and procedures

<table>
<thead>
<tr>
<th><strong>Elements</strong></th>
<th><strong>Performance Criteria</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On completion of this unit, you should be able to:</strong></td>
<td><strong>You will know you have achieved this when you can:</strong></td>
</tr>
<tr>
<td>1. Follow workplace procedures for hazard identification and risk control.</td>
<td>✦ Recognise hazards in the work area, rectify where possible and report to designated personnel according to workplace procedures.</td>
</tr>
<tr>
<td></td>
<td>✦ Follow workplace procedures and work instructions for controlling risks.</td>
</tr>
<tr>
<td></td>
<td>✦ Follow workplace procedures for dealing with workplace emergencies whenever necessary within scope of responsibilities and competencies.</td>
</tr>
<tr>
<td>2. Contribute to participative arrangements for the management of occupational health and safety (OHS).</td>
<td>✦ Raise occupational health and safety issues with designated personnel in accordance with workplace procedures and relevant occupational health and safety legislation.</td>
</tr>
<tr>
<td></td>
<td>✦ Make contributions to participative arrangements in the workplace within organisational procedures and scope of responsibilities and competencies.</td>
</tr>
</tbody>
</table>
WHAT YOU CAN DO ALREADY

You may already have some skills for this course. Perhaps you completed similar activities in previous work or learned them in another training course.

If you can demonstrate to your trainer that you are competent in a particular skill, you will not need to repeat the training for that skill. This is called ‘Recognition’. Your current competency is recognised when you can successfully demonstrate that you are competent in a particular skill.

Take a look at What You Should Achieve and see if you feel confident about doing some of these things already. A good way to check is to read through your Learner Guide and check yourself by completing the Quick Check questions.

If you feel that you have some of the skills, talk to your trainer about having them recognised. Your trainer will then check to make sure you can do all the required activities.

If you have a qualification from an accredited course, show it to your trainer as proof of your skills rather than having to do part or all of the course.

WHAT YOU NEED TO COMPLETE THIS COURSE

♦ Your own copy of this Learner Guide.
♦ Before starting this course, ensure you have completed SES Induction. If not, you may have difficulty with some of the prerequisite knowledge and skills.
HOW TO USE THIS LEARNER GUIDE

Read through the Learner Guide carefully. It is divided into topics which cover all the skills and knowledge you need to successfully complete this course.

Talk to your trainer and agree on how you will both organise the training for this course.

Work through all the information and complete the exercises and practical activities in each topic.

Exercises and activities are clearly marked.

Your trainer is there to support you and show you the correct way to do things. Ask for help when you need it. You will be given plenty of opportunity to ask questions and practise your skills.

Your trainer will tell you about the important things you need to consider when you are completing activities and it is important that you listen and take notes.

Talk to more experienced members and ask for their guidance.

Use the Quick Checks at the end of each topic to check your own progress.

As you work through the exercises and practical activities, ask for feedback on your progress.
SYMBOLS
Throughout the Learner Guide you will see a range of symbols. This is what they mean:

![Symbol]
Discuss this subject with your trainer

![Symbol]
Danger! You could get hurt

![Symbol]
Remember this, it is important

![Symbol]
Write or draw the answer

![Symbol]
Check your work

![Symbol]
Carry out this activity
SAMPLE ASSESSMENTS

Below are some ideas of how an Assessor might evaluate your competence in this course. As you progress through the course, use these sample assessments to help prepare yourself for final assessment. Remember to talk to your trainer about any difficulties you have and ask for help if you need it.

During final assessment you may be assessed by:

♦ demonstrating your practical skills in a real or simulated environment;
♦ answering oral or written questions;
♦ a combination of these methods.

SAMPLE ASSESSMENT 1

During final assessment, as a member of a team, you may be required to:

♦ stabilise a heavy object horizontally, and
♦ stabilise the object vertically, then
♦ lift the object from a trapped casualty.

SAMPLE ASSESSMENT 2

During final assessment, as a member of a team, you may be required to:

♦ secure a wall, and
♦ breach a wall, so that you can access/recover a trapped casualty.
During final assessment, as a member of a team, you may be required to:

- use a ladder to gain access to a casualty;
- load and lash the casualty into a stretcher;
- lower or raise the casualty to safety;
- transport the casualty across uneven ground.

### SAMPLE ASSESSMENT 3

During final assessment, as a member of a team, you may be required to:

- lower a rescuer or equipment to a trapped casualty, then
- construct a hauling/lowering system to rescue the casualty.
TOPIC 1: PREPARING FOR RESCUE AND KEEPING YOURSELF SAFE

LEARNING OUTCOMES

On completion of this topic, you should be able to:

◆ prepare yourself for rescue work;
◆ explain the stages of rescue;
◆ fit and use PPE;
◆ use fire extinguishers and hoses.
It takes a certain type of person to be an effective rescuer and it is important that you are well prepared for your role. All rescues are different, but if you have a plan the rescue can be completed quickly and effectively. During operations you must act to reduce risk to yourself, your team and the public. It is important to look after yourself first, because without the rescuer, there would be no rescue.

This General Rescue course has been designed to prepare you for the demanding role of rescuer, to show you a system for rescue and to teach you how to work safely. The course is built around a potentially real scenario – the collapse of an occupied building. Responding to building or structure collapse is an important part of SES work (for example when a car crashes into a building, or when a tree falls on a house in a storm) and the skills you learn here are relevant to all aspects of SES field activities.

The scene

It is about 1.30 pm Friday afternoon in the middle of summer. A violent earthquake has just struck your town. A large government building has partially collapsed. The number and location of people working in the building is unknown.

You and your team have been asked to respond to the scene to locate and extract casualties.

WHERE DO I START?

WHAT DO I DO?

HOW DO I LOOK AFTER MY HEALTH AND SAFETY?

WHAT IF THERE IS A FIRE?
1.2 WHAT IS GENERAL RESCUE?

The aim of general rescue is to save life and minimise further injury to people or damage to property. Your rescue training is designed to give you a range of basic skills that will keep you safe. These skills are also the foundation for advanced rescue skills, including storm damage response, flood response, road crash and vertical rescue. They also form an important link with the first aid skills you learn.

Rescue by stages (the plan)

As a member of a rescue team, you may be asked to:

- provide access to, support and remove trapped persons;
- help recover the dead; and
- provide support to other services, authorities or specialist teams on request.

There are no set rules for tackling every rescue task. However, a rescue is generally faster and more effective if it follows five stages:

<table>
<thead>
<tr>
<th>C</th>
<th>Clear surface casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Rescue those trapped / easily accessed</td>
</tr>
<tr>
<td>E</td>
<td>Explore likely survival points</td>
</tr>
<tr>
<td>S</td>
<td>Selected debris removal</td>
</tr>
<tr>
<td>T</td>
<td>Total debris clearance</td>
</tr>
</tbody>
</table>

Stages of rescue
Fire services in Australia use a slightly different set of words to describe their rescue plan, based on the acronym REPEAT: Reconnaissance and survey, Elimination of utilities, Primary surface search and rescue, Exploration of voids and spaces, Access by selected debris removal, Termination by general debris removal. As you can see, the stages are essentially the same.

**Stage 1: Clear surface casualties**
The first task is to clear surface casualties—those who are not trapped and are clean of any obstruction or hazard. Ambulance or first aid personnel normally care for casualties, but you may be asked to help.

**Stage 2: Rescue of lightly trapped/easily accessed**
The next task is to rescue those who are lightly trapped and search lightly damaged buildings.

**Stage 3: Explore likely survival points**
The third stage is to search likely survival points where people may have taken shelter or refuge and where they may be trapped, either injured or uninjured.

**Stage 4: Selected debris removal**
When casualties are found the rescue team will often have to remove debris to get to them. The amount of debris moved depends on:

- the location of the casualty;
- the nature of their injuries (if known);
- the layout of the building or structure;
- the way in which the building or structure has collapsed.

**Stage 5: Total debris clearance**
The final stage of a structure collapse rescue will be to methodically strip the site. This stage may be completed by demolition contractors, rather than emergency services.
A successful rescue operation depends upon the abilities of every member of the team.

- Rescue work isn’t easy.
- It’s not glamorous.
- It only suits some people.
- It can be physically and mentally demanding.

What are the characteristics of an effective rescuer?

Be proud of who you are, as well as what you do.
**Personal behaviour**

It is important to create a feeling that the situation is in competent hands and everything possible is being done to rescue and care for the victims. In a disaster it is essential to make sure your personal conduct supports the operation.

<table>
<thead>
<tr>
<th>POSITIVE PERSONAL BEHAVIOURS</th>
<th>WHY THEY ARE IMPORTANT FOR PUBLIC PERCEPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Psychological effects of rescue situations**

Think about a situation in which you, or someone close to you, have faced danger. How did you feel? What about afterwards? How do you feel about it now?

- Be aware of the psychological needs of **everyone involved**.
- Rescuers have needs as well as the victims.
- People tend to react differently to danger.
- As a rescuer, you are expected to be able to cope.
- It is normal to be anxious and feel fear in the face of danger.
- People's emotions may change during a rescue operation.
Rescuers

The trained rescue team is usually the last group to arrive at the scene. Untrained people who saw the event are usually milling about and trying to help. Witnesses often know the location of some casualties and may know the layout of the rescue scene.

The three groups at the scene of a rescue operation may include:

Group 1: Survivors Survivors are usually those physically capable of helping others in the incident. The potential for good is enormous, but so is the danger of untrained people doing rescue work.

Group 2: Untrained helpers Untrained helpers are people who either saw the event or were drawn to the site by curiosity or a desire to help the victims.

Group 3: Trained personnel Trained rescue personnel are usually from one of the emergency service organisations.

A well-trained rescue team knows:

- what to do;
- how to use resources efficiently;
- how to use untrained helpers without endangering anyone.
Before you go any further, discuss with your trainer what it means to be a rescue operator.

### Primary PPE

Your personal protective equipment (PPE) is issued to keep you safe. You need to wear it during operations and training. For your safety, make sure you wear and use your PPE properly.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>KEY POINTS TO REMEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protective clothing</td>
<td>Protects you from most hazardous elements.</td>
</tr>
<tr>
<td></td>
<td>Should be closely fitting, with no loose items hanging.</td>
</tr>
<tr>
<td></td>
<td>Must have sleeves rolled down to protect your arms.</td>
</tr>
<tr>
<td></td>
<td>Should be kept done up.</td>
</tr>
<tr>
<td>Footwear</td>
<td>Must have a good sole pattern with plenty of ‘grip’.</td>
</tr>
<tr>
<td></td>
<td>Must be properly maintained.</td>
</tr>
<tr>
<td></td>
<td>Laces should be secured to prevent entanglement.</td>
</tr>
<tr>
<td>Gloves</td>
<td>Should be close fitting, generally made of leather.</td>
</tr>
<tr>
<td></td>
<td>Used to prevent most friction burns and loss of control with rope.</td>
</tr>
<tr>
<td>Eye protection</td>
<td>Includes safety glasses or goggles (primary protection).</td>
</tr>
<tr>
<td></td>
<td>May include face shields (secondary protection).</td>
</tr>
<tr>
<td>Hearing protection</td>
<td>Either earplugs or muffs must be worn when operating in noisy environments.</td>
</tr>
<tr>
<td>Wet- and cold-weather clothing</td>
<td>Weather conditions can be unpredictable; so you should ensure appropriate clothing is available.</td>
</tr>
<tr>
<td>Dust mask or filter</td>
<td>Should be P1 or P2 type for debris or dust.</td>
</tr>
<tr>
<td>Helmet</td>
<td>Must be rated for rescue work.</td>
</tr>
<tr>
<td></td>
<td>Should be able to fit a helmet light.</td>
</tr>
<tr>
<td></td>
<td>Must be worn in accordance with manufacturer's specifications.</td>
</tr>
<tr>
<td></td>
<td>Must be worn when there is a risk of objects falling on your head, or when operating at heights.</td>
</tr>
</tbody>
</table>
Secondary PPE

Secondary PPE can be useful in certain circumstances. You will discuss these during the course.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>KEY POINTS TO REMEMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knife</td>
<td>Used to cut items in a rescue or to cut away items that may entangle you or a victim. Must not be attached by lanyard to your body, as it could catch and become a hazard. Must have a folding blade (no sheath knives).</td>
</tr>
<tr>
<td>Chalk or crayon</td>
<td>To mark areas that have been searched for casualties. Useful for marking general items.</td>
</tr>
<tr>
<td>Whistle</td>
<td>Used to signal commands when lifting or lowering. Used to signal others if lost or to make your location known.</td>
</tr>
<tr>
<td>Knee or elbow pads</td>
<td>Used for protection when moving around rubble.</td>
</tr>
<tr>
<td>Sunscreen and hat</td>
<td>To prevent sunburn.</td>
</tr>
<tr>
<td>Water</td>
<td>To prevent dehydration.</td>
</tr>
</tbody>
</table>

⚠️ Danger

Take care with long hair, rings, earrings and watches as well as lace hooks on boots. These can get caught on moving machinery or other snags and may cause serious injury.

Features of a helmet

- Close fitting
- Rigid shell
- Padded suspension system
- Clip for helmet light
- Ear uncovered to permit hearing
- Nape and chin straps
Activity 1.2

PPE

1. Discuss the uses of each item of PPE.

2. Put your PPE on and have it checked:
   ◆ Does it fit?
   ◆ Is it on correctly?
   ◆ Is it damaged and does it need replacing?

1.5 YOUR HEALTH AND HYGIENE

Some rescue operations may involve health and hygiene hazards such as sewage, spoiled food, body fluids or other hazardous materials. Remember that you are responsible for your own health and hygiene, as well as the health and hygiene of your fellow team members.

*Universal precautions* is an approach to infection control in which all human blood and other potentially infectious materials are treated as if known to be infectious with HIV, HBV and other blood borne pathogens (germs).

Rescuers must always take universal precautions to prevent contact with blood or other potentially infectious materials.

*Prevent infection by…*
◆ Wearing surgical gloves beneath your rigger’s gloves when handling casualties and/or bodies.

◆ Thoroughly wash your hands before eating.

◆ Wash and cover any cuts or abrasions you have with waterproof dressings to prevent the transfer of bacteria and viruses.

◆ Report all injuries immediately to your team leader.
Dehydration

Working hard, especially in hot conditions, can cause dehydration. Dehydration can be a serious condition. If you are thirsty, you are already dehydrated and damaging your body. Avoid dehydration by:

◆ drinking water every hour (at least 2 litres of water every day, more if it is hot);
◆ avoiding caffeine, alcohol and sweet drinks.

Check for dehydration

◆ If you are thirsty, have a headache or are light-headed, you are already dehydrated.
◆ If your urine is dark and has a strong odour, you are dehydrated.
◆ If you get dehydrated, rest and drink more water, and encourage other team members to do likewise.

Activity 1.3 Health and Hygiene

1. What can you do to prevent infections at a rescue?
2. Describe the effects of dehydration and how to prevent it.
3. List as many ways you can think of to carry 2 litres of water with you during operations.
You would not usually start on a rescue operation until the all-clear is given by the fire service. However, fires can re-ignite and some equipment you use may cause unintentional fires, or even catch fire itself. Consequently, you need to be able to apply firefighting procedures.

What is a fire?

A fire is a chemical reaction that produces heat, smoke and usually light.

Three elements are necessary for a fire to start:

1. Heat
2. Oxygen
3. Fuel

These three elements form the triangle of fire.

Remember

- As long as these three elements are present, fire will continue.
- Eliminating or removing one or more of these elements extinguishes the fire.

This is the basis of all firefighting operations.
Classes of fire

Fires are classified according to the nature of the fuel involved. The type of fuel determines the best way to put the fire out. There are six main classes of fire:

<table>
<thead>
<tr>
<th>Class A (solid combustibles)</th>
<th>Wood, paper, cloth, etc. Organic in nature and carbon based.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class B (flammable and combustible liquids)</td>
<td>Petrol, oil, grease, paint, fat, alcohol, thinners.</td>
</tr>
<tr>
<td>Class C (flammable gases)</td>
<td>Methane, propane, butane, etc. Gases in either vapour or liquified form.</td>
</tr>
<tr>
<td>Class D (combustible metals)</td>
<td>Magnesium, aluminium, sodium, potassium, etc. These fires require special extinguishers and expert advice.</td>
</tr>
<tr>
<td>Class E (electrical fires)</td>
<td>Electric wires, power points, fuse boxes, etc.</td>
</tr>
<tr>
<td>Class F (cooking oils and fats)</td>
<td>Olive oil, beef drippings, etc.</td>
</tr>
</tbody>
</table>

Firefighting appliances

Portable fire extinguishers can be divided into six categories that are grouped by the type of extinguishing agent they contain:

- water
- wet chemical
- foam
- powder
- carbon dioxide
- vaporising liquid.
1. **What to do when you discover a fire**

If you discover a fire:

1. **Assess** the situation.
2. Raise the **alarm**.
3. **Evacuate** the immediate area.
4. **Call** the fire service.
5. **Attack** the fire only if **safe to do so**.
6. Always work in pairs.

2. **Smoke**

Working in smoke and darkness is extremely dangerous. Most fires generate toxic smoke. If the fire is generating lots of smoke, stay low and get out. Never try to work in a smoky environment – wait for the fire service.
3. Putting out fires

To extinguish a fire you must remove one or more of the three elements of the triangle of fire. This can be done by:

You may have to use more than one method to put the fire out.

4. Using fire extinguishers

First you need to work out whether or not to fight the fire at all.

A fire that is larger than about 1 m high and about 1 m wide is generally too big to be put out with a single extinguisher.
Method
P  Pull the pin.

A  Aim the nozzle at the base of the fire.

S  Squeeze the operating handle and release the extinguishing agent.

S  Sweep the extinguisher from side to side across the base of the fire until it appears to be out.

Releasing the handle will stop the discharge. Most common extinguishers operate in the upright position.

5.  How to operate a hose reel

There are several types of hose reel, from the common garden hose to the firefighting hose found in industrial and commercial buildings. It is important to know how to operate these appliances as you may be called to help in fighting a fire.

Some small hose reels can be operated by one rescuer, larger hoses will need more operators.

Method
1.  Make sure the nozzle or jet is in the ‘closed’ position.

2.  Turn on the main valve (most reels have a device that holds the nozzle until the main valve is open).

3.  Pull the hose off the drum, towards the fire.

4.  Open the nozzle or valve and direct the stream of water at the source of the fire.
Activity 1.4
Fire Extinguishers and Hoses

1. Practise using the different types of extinguishers available in your Unit.
2. Practise operating a hose reel (if there is one in your Unit).
3. Locate, identify and restow the fire extinguishers that are fitted in your vehicle, boat and Unit.

Quick Check

Having completed this topic, are you able to:

- prepare yourself for rescue work?
- explain the stages of rescue?
- fit and use PPE?
- use fire extinguishers and hoses?

If you have answered NO to any of these questions, ask your trainer for help.
TOPIC 2: RESCUING SURFACE CASUALTIES

LEARNING OUTCOMES

On completion of this topic, you should be able to:

- identify hazards in and around a rescue scene;
- locate casualties in various environments;
- handle casualties without equipment;
- load and lash casualties into stretchers;
- transport casualties in various environments.
2.1 INTRODUCTION

If you are dealing with a structural collapse and missing people, you will be faced with decisions based on what you see, smell, touch and hear. Combine this with limited access and the possibility of foul weather or night operations and any rescue may look like an enormous task. Good planning and a systematic approach will break a seemingly impossible problem into manageable pieces.

When one or more rescue teams combine to work at one incident, there has to be a standardised way to:

- identify work site hazards;
- identify the different teams and what they have done; and
- map landmarks with common symbols.

Once mapping and marking has been established you can systematically remove casualties in a sensible order by locating, accessing, stabilising and transporting them to a designated area.

The scene

It is now about 1.45 pm. A violent earthquake has struck your town and a large government building has partially collapsed.

Before we enter the building we must identify as many hazards as we can, and do what we can to control them. We might need to think about lighting for when it gets dark in about five or six hours.

If we find injured people, how do we get to them? Do we stay with the first casualty we find or do we move on? How do we know where the first one was when we come back with assistance? How do we transport the injured for further medical attention?

What happens if it rains, gets hotter or we get even more after-shocks?
2.2 LOCATING AND ACCESSING CASUALTIES

Reconnaissance and risk assessment

Reconnaissance is primarily the team leader's responsibility. However, each member of a rescue team must be trained in rescue reconnaissance, as the team leader will always need your help.

During a reconnaissance you need to get an accurate assessment of:

- the number and location of casualties;
- hazards that might endanger rescuers or survivors;
- the extent and type of damage;
- ways to gain access to the casualties or tasks;
- available resources, both personnel and equipment; and
- how long the task would take with available resources.

2.3 HAZARDS AND RISK

A hazard is anything with the potential to harm the health or safety of a victim, the rescue team, other rescue or response personnel, the wider community or the environment.

Hazards are sources of risk. You need to consider hazards and work out what risk they represent by considering:

- the consequences of exposure to it; and
- the likelihood of it happening or affecting you.

Remember that rescuers must consider their own safety as more important than any single casualty. The loss of a single rescuer will reduce the capability of the team to do its job and possibly prevent other people from being saved.

Your actions could have an impact on others. Always consider the implications of any action you take. If a hazard or hazardous situation is detected, clearly advise others (team leader and other team members) of the situation.
Types of hazards

There are seven major hazards. Work with your trainer to complete the table below:

<table>
<thead>
<tr>
<th>HAZARD TYPE</th>
<th>EXAMPLES</th>
<th>CONTROLS</th>
</tr>
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<tbody>
<tr>
<td>Structural instability</td>
<td></td>
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</tr>
<tr>
<td>Surface hazards</td>
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<tr>
<td>Below surface hazards</td>
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<td>Above surface hazards</td>
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<td>Hazardous materials</td>
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<tr>
<td>Public utility hazards</td>
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<tr>
<td>Environmental hazards</td>
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</table>

**Danger**

Electrical hazards are especially common. Even when meter box switches are off and fuses are pulled, the building will still be ‘live’ from the meter box to the street supply. Always seek expert assistance when you are dealing with electricity.
Activity 2.1 Hazards

Do a hazard identification and risk analysis for the building that you are training in.

2.4 MAPPING AND MARKING

The International Search and Rescue Advisory Group (INSARAG) has developed an internationally agreed system for marking collapsed structures. The system normally uses building plans and street maps, but if these are not available it can be used with sketch maps of the building, which also identify and label landmarks.

To use the system, you need to establish the building’s orientation, and name the sides and internal sectors of the building. Internal plans (if available) make this task much easier.

The address side of the structure is defined as SIDE 1. Each other side of the structure is numbered clockwise from SIDE 1.

Preliminary identification
The interior of the structure is divided into sectors. Each sector is identified alphabetically, starting with ‘A’ at the intersection of SIDE 1 and SIDE 2. The central core, where all four sectors meet, is always Sector E.

Building sectors

Multi-story structures should have each floor clearly identified. If not clearly discernible, the floors should be numbered as seen from outside. The ground level floor is designated FLOOR LEVEL 1. Moving upward the next floor is FLOOR LEVEL 2, and so on. The first floor below ground level is called BASEMENT 1, the second BASEMENT 2, and so on.

Marking systems

Two systems of marking are used at rescue incidents. These marking systems are for:

* structure assessment, and
* victim location.

Structure assessment marking system

Structure assessment marking systems tell a brief story of who did what in a damaged structure. The markings of the first team are placed on the outside of the structure, close to the entry point.
If a second team enters the building they should put their own marks next to the original markings. No team should ever amend existing marks. If it is necessary to review the original marks, a separate set must be placed next to the original.

**Scenario 1 – Structure marking**

Your rescue team (SES RSC1) is tasked to check the integrity of the structure. A Safety Officer is appointed to remain outside the structure. The Safety Officer will ideally be in voice contact with the search team. The search team will cover as much of the building as possible. The Safety Officer may talk to local survivors to find out about the structure. When they finish, the search team should compare their findings with the Safety Officer’s and draw markings on the outside of the structure in close proximity to the safest entrance (see the example below).

The structural marking system shown below indicates the following:

<table>
<thead>
<tr>
<th>Top of square</th>
<th>The structure requires shoring and rats were found inside.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left side of square</td>
<td>1 person found alive and removed.</td>
</tr>
<tr>
<td>Right side of square</td>
<td>2 people found dead and removed.</td>
</tr>
<tr>
<td>Bottom of square</td>
<td>Unaccounted for victims and locations of other deceased victims.</td>
</tr>
<tr>
<td>Inside the square</td>
<td>G (go) indicates the structure is safe to enter and NG (no go) would indicate it is not safe for entry. Name of rescue team. Time and date rescue team entered the structure. Time and date the team exited the structure.</td>
</tr>
</tbody>
</table>

**Hazard information**

<table>
<thead>
<tr>
<th>#LIVE VICTIMS REMOVED</th>
<th>G or NG (Go or No Go)</th>
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</thead>
<tbody>
<tr>
<td>TEAM</td>
<td>TIME/DATE OF START</td>
</tr>
<tr>
<td>#DECEASED REMOVED</td>
<td>TIME/DATE OF END</td>
</tr>
<tr>
<td>NUMBER OF PERSONS UNACCOUNTED FOR AND LOCATION OF OTHER VICTIMS</td>
<td></td>
</tr>
</tbody>
</table>

**Structure marking box**
Note
The finished marking system is circled. This does not mean that all victims have been removed from the structure, it simply indicates that that team has finished its assigned task.

Completed structure marking box

Victim location marking system
A key part of the initial search is to locate any victims. Debris in the area may completely cover or obstruct the location of known or potential victims.

Search teams mark victim locations whenever a known or potential victim is located and not immediately removed.

Victim location markings should be made with fluorescent colour.

- Draw a large ‘V’ near the location of the known or potential victim/s.
- Draw an arrow in the direction of the known or potential victim/s.
- Draw the letter ‘L’ with a number to denote the number of live victims.
- Draw the letter ‘D’ with a number to denote the number of deceased.
Scenario 2 – Potential victim in area
Your team arrives at a collapsed structure. A woman standing outside the building tells the team leader that it is her apartment block. She says that her husband and daughter are still inside on the first floor in what the team would identify as Sector A.

Initially a V is placed in the area to identify a potential victim location due to the information received from the wife.

The rescue team then conducts a search to locate the victims. The team indicates the suspected location of any victims with an arrow.

When the team talks to the trapped man, it is obvious he is alive, but he states that his daughter and one other person in that area are dead. The victim marking is now changed to show one live and two dead victims.

After the rescue team extricates (removes) the trapped man, and only the deceased remain in the area, the marking is changed so that it is clear that the live victims have been extricated.

If the rescue team is only concerned with extricating live casualties, it is now finished with this task. A circle is drawn around the entire marking to denote that the team has finished and moved on.

Where the team is tasked with clearing all victims from the area, and has removed the deceased, the marking is completed by crossing out the number of dead. When the team leaves the site, a circle is again drawn around the entire marking. As an additional measure, the V is crossed out to clearly show that all victims have been removed.
General Rescue

- Facilities—circles
- Zones—irregular shapes
- Command function—box
- Reference point—triangle
- Command post
- Emergency operations centre
- SAR base of capital operations
- On site operations coordination centre
- Reception centre
- Work site
- Airport
- Landing zone
- Hospital
- Hazards (write hazard and specify zone)
- Fuel
- Medical care (Red Cross symbol)
- Reference point/landmark (triangle include descriptor)

INSARAG symbols
Note
Remember that rescue teams are concerned primarily with recovering the living. Teams may leave the deceased in place and move on to the next site where live victims may be located. The marking would then be circled when the team moves on.

Dealing with the deceased
In general, rescuers would not remove bodies from the position in which they are found until authorised by Police. Nevertheless, rescuers may be justified in moving a body:

◆ when rescuers would be put at risk if they had to re-enter the damaged building or structure where the body is located;
◆ where it is necessary to reach a person who is still alive;
◆ where the body itself might be affected by flooding, fire or imminent collapse of the building or structure.

You should keep written notes and sketch drawings of the scene and what you find. The exact position in which a body is found may be critical to its identification. In addition, rescue team members may be called as witnesses for the Coroner.
**Moving across debris**

Moving across loose rubble is hazardous to you and to anyone who may be trapped below the rubble. You have to minimise any disturbance to rubble piles. To do this you ‘rubble crawl’.

Observe the following safety points when moving over rubble:

**Method**

Maintain a 3-point contact with the rubble surface, i.e. a combination of three hand and foot surface contact with your body weight distributed over the 3 points:

1. Stay low to improve your balance.

2. Make sure your points of contact are firm and stable before transferring your body weight.

3. Be careful in windy conditions as gusts of wind can move rubble and blow you off balance.
Calling and listening

The calling and listening technique involves six steps:

**Method**

1. The team leader puts available team members at points around the area where people may be trapped.

2. The team leader calls out ‘SILENCE. SILENCE FOR RESCUE’.

3. One at a time each member, as directed by the team leader, calls ‘RESCUE TEAM HERE. CAN YOU HEAR ME?’ The other members listen carefully for any reply.

4. If no reply is heard, tap good conductors of sound, such as a wall, gas or water pipe or beam running into the debris. Again listen for an answer.

5. On hearing a reply, each listener points to the place where they think the sound came from.

6. When contact has been established with a trapped person, the team maintains contact until the rescue is completed.

If you use this technique at night, point a torch to the area the sound comes from. It is essential to point to where you think the sound comes from, even if others point in a different direction.
Activity 2.2
Marking, Crawling, Calling and Listening

Given information about a disaster scenario, your tasks are to:

1. Carry out structure marking.
2. Carry out potential victim in area marking.
3. Practise moving across rubble.
4. Take part in a calling and listening activity.

Generators

There are many different types of generator, but they all consist of a motor driving an alternator to generate electricity. Generators used by SES Units provide domestic voltage (240 V).

Vehicle-mounted generators

There may be generators mounted in your Unit’s vehicle/s. For your safety, check for the following.

- External generator outlets have weatherproof fittings.
- Standard fittings are located under cover in equipment bays or the interior of the vehicle.
- Protective covers are fitted on all electrical equipment and extension lead connections.
- A double pole switch controls vehicle-mounted outlets.
- Extension leads and portable equipment have been tagged as safe.
Generator safety
Any combination of heat, petrol and electricity creates a potentially dangerous situation. The electrical output of generators is potentially lethal. For your safety:

◆ Keep the generator dry. Be especially careful in rainy conditions.

◆ Never connect a generator to a household wiring system.

◆ Keep a close eye on all electrical equipment, particularly leads.

Using a generator
Always read the manufacturer's manual first! It will tell you about:

◆ pre-start checks
◆ starting the generator
◆ operating the generator
◆ basic maintenance
◆ refuelling, and
◆ long-term storage.
Work with your trainer to complete the checklist below.

### Checklist for the Unit generator

<table>
<thead>
<tr>
<th>STEP</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td></td>
</tr>
<tr>
<td>Inspect equipment</td>
<td></td>
</tr>
<tr>
<td>Test equipment</td>
<td></td>
</tr>
<tr>
<td>Maintain and clean equipment</td>
<td></td>
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<tr>
<td>Restow equipment</td>
<td></td>
</tr>
</tbody>
</table>
Calculating the amount of power
Generators have a limited capacity to power tools or lighting. You need to know how to calculate the amount of power a particular appliance will draw, so you do not overload your generator. Lights and heating appliances are normally rated in watts. Many tools, however, are rated in amps. It is easier to make the load calculations if the appliances you want to plug in are rated in watts.

The power of the alternator is measured in watts (W) or kilowatts (one thousand watts [kW]).

\[
\text{watts} = \text{kilowatts} \times 1000
\]

You calculate the power still available by:

- adding the wattage of lights being used; and
- subtracting the figure from the generator capacity.

**Example**
If your generator is rated at 2500 watts (2.5 kW), and you want to plug in three banks of lights, each drawing 500 watts, what is the remaining capacity of the generator?

\[
2500 \text{ watts (generator 2.5 kW)} - (500 + 500 + 500) \text{ watts (lighting)} = 1000 \text{ watts}
\]

So there is still 1000 watts capacity in the generator.

Converting amperes to watts
Equipment using electric motors (such as drills) often indicates the amount of current drawn from the generator, not the power. This information is usually found on a compliance plate on the equipment and is expressed as or rated in amperes (amps [A]). The relationship between current (amps), power (watts) and voltage (volts) is \( P=IV \) (where \( P \) stands for power, \( I \) stands for current and \( V \) stands for volts).
Example
The electric saw you are using is rated at 5 amps.

To work out its power in watts, you need to multiply the 5 amps by 240 volts:

\[5 \text{ amps} \times 240 \text{ volts} = 1200 \text{ watts}\]

So this electric saw can be run from a 2500 watt (2.5 kW) generator but not from a 1000 watt (1 kW) generator. To save time and possible overload problems during an emergency, teams need to:

- calculate the power rating of each appliance likely to be used; and
- clearly mark this figure in watts on the appliance.

Caution
The current required starting an electric motor is up to five times its rated full load current. Your generator needs to be able to cope with the extra load of an electric motor starting up.

Electrical leads
- Unwind coiled leads before use.
- Use heavy duty flex for all extension leads.
- Always use approved waterproof connectors.
- Keep leads out of water.
- Keep leads visible by marking with witch's hats or with high-visibility tape.

Lighting
Working at night creates special hazards caused by:

- shadows
- glare, and
- poor vision associated with artificial lighting systems.
Positioning lighting
Each rescue scene will be different, but you should always:

◆ Position lights as high as possible to illuminate the area required and try to bounce light beams off light coloured walls or roofs, which may be enough to illuminate the area from above and below.

◆ Avoid looking into lights. If you do, you will lose your night vision. If this happens, stop work, close your eyes for a minute then look at a dark place until your night vision recovers. This could take several minutes.

Rescue scenes are best lit with a soft, medium density light for movement within the area. However, some work scenes must be lit with high-intensity lights, such as spotlights. In all cases, position lights to minimise large shadows.

Activity 2.3
Power and Lighting

Set up scene lighting, using multiple lights and lighting arrangements, and make sure all lights are the right size for your generator.

1. Gather all your Unit electrical equipment and calculate what can and cannot be used with your generators.

2. Use the generator—connect various power appliances to it and (for example) make a cup of tea.

Casualty handling
Now that the initial reconnaissance has been completed, you will have to start managing casualties. Casualty management includes providing first aid, moving people to a safe place for further medical aid or to have their details recorded.

How you move a casualty will depend on where they are and how they are injured.
Before moving any casualty, you need to carefully assess their injuries, condition and possible entrapment, ensuring they are not entrapped or tangled in some unseen object.

You may need to carry casualties across piles of debris and uneven ground to safety.

Some casualties may be seriously injured or unconscious. Although it is important to get people out quickly, you must remember that safety and proper handling will help prevent further injury.

**Casualty classification**
Standard international practice is that the casualties are tagged with a triage card identifying them as:

- **Top priority (red tag)** Life threatening situation
  - Airway obstruction
  - Breathing difficulties
  - Chest pain (possible cardiac history)
- **2nd priority (orange tag)** Serious but not yet life threatening
  - Uncontrolled bleeding
  - Major fractures
- **Walking wounded (green tag)** Needs to see a doctor but is not urgent
  - Minor fractures
  - Cuts that require stitches
- **Deceased (white tag with a black border)** No breathing and no pulse

**Note**
Not all serious injuries have highly visible signs and/or symptoms.
You may be required to treat and rescue casualties who are not seriously injured in order to reach more seriously injured persons.

Where hazards present a risk to casualties being treated, follow the principle of ‘remove the casualty from the risk or remove the risk from the casualty’.

Once you understand the basic principles of how to handle a casualty and what degree of injuries to expect, you can then look at the type of stretcher to use (if needed).

Where possible, you should place seriously injured casualties on a stretcher. However, sometimes you may need to remove the casualty quickly or no stretchers are available. All single-rescuer techniques involve the risk of injury to the rescuer, so two-rescuer techniques are preferred.

### Single-rescuer techniques

**Single-rescuer human crutch**

For a single rescuer to function effectively as a human crutch, the casualty must be:

- conscious; and
- able to help the rescuer.

With one hand, you should hold the casualty’s wrist over your shoulder and with the other hand, firmly grip the clothes at the waist or hip on the far side of the body. Keep the injured side of the casualty closest to you.
Pick-a-back carry (for a small person)
The pick-a-back carry is an effective method for smaller casualties.

- The casualty must be conscious.
- When they have been loaded, make sure they are supported well up on your hips with the body literally draped across your back.

If the casualty is incorrectly positioned:

- it will throw you off balance;
- the casualty is likely to fall;
- you are likely to hurt yourself or the casualty.

If you use this method:

- always consider the weight of the casualty;
- take appropriate safety precautions to make sure you don’t injure your back.

Only use this technique if you are confident you can carry the weight of the casualty.

Firefighter’s crawl
The firefighter’s crawl is a very useful method where a casualty has to be removed from a burning or smoke-filled building.
Two-rescuer techniques

Two-rescuer human crutch
The two-rescuer human crutch is similar to the one-rescuer human crutch, except that the casualty is supported on both sides.

Method
Cross the arms of the rescuers over the casualty's back and grasp the clothing on the opposite sides of the body.

Two-handed seat
Use the two-handed seat to deal with a casualty who has to be carried.

Method
1. Two rescuers kneel on either side of the casualty and get them into a sitting position.
2. Both rescuers place an arm under the casualty's knee and link up with the hand to wrist grip.
3. The rescuers cross their free arms over the casualty's back, where they get a firm grip on the clothing.
4. The team leader gives the normal orders for lifting and lowering.
**Three-handed seat**
Use the three-handed seat to give the casualty good support while being reasonably comfortable for the rescuers. This method has the added advantage that one rescuer has a spare hand.

The casualty must be conscious as neither rescuer can support their back.

**Method**
1. One rescuer grasps their left wrist with their right hand.
2. The second rescuer places their hand and wrist to form a seat.
3. If the casualty is capable of standing for a short period, place the seat under the buttocks.
4. If not, the rescuers must first place their hands under the casualty's knees, then join up.

In either case, the results should be as shown below.
Four-handed seat
This method provides a comfortable seat for the casualty and places a minimum strain on the rescuers. However, as shown in the figure below, the casualty must be conscious and able to hold on.

Method
In the four-handed seat method, each rescuer grasps their own left wrist and the hands are joined up.

Fore and aft method
In the fore and aft method, the casualty's wrists are tied together.

Method
1. The first rescuer stoops at the rear of the casualty.
2. The first rescuer then reaches under the casualty's arms and grips the casualty's wrists.
3. The second rescuer stoops between the casualty's legs, grasping them underneath the knees.
4. The standard lift orders are given and the casualty is lifted to the carrying position.

The advantage of this method is that the rescuer supporting the casualty's feet can have a free hand, which can be used to open doors, clear debris, etc.
Folding or pole stretchers

Some rescue agencies use folding stretchers where canvas forms the bed of the stretcher, two wooden poles make the structure rigid, metal Ds keep it off the ground and metal hinges keep it folded out. There are many other types of stretcher available and you will learn how to use all the different types in your Unit.

Preparing a folding or pole stretcher

Method

Before a casualty can be placed on a folding stretcher:

1. Unfasten the straps that hold the stretcher closed (if fitted).

2. Spread open the stretcher and lock the spreaders in place by pushing on each bar with your foot until it locks into place. Do not use your hands as the hinges may pinch them.

3. Prevent the hinge of the bar from collapsing by using:
   - duct or cloth tape to lock the hinge together; or
   - a securing rope;
   - a short length of cordage tied from each stretcher handle in a V pattern.

4. If the spreader bar is snagged, the hinge may unlock and collapse the stretcher.
Blanketing a folding or pole stretcher

You should always cover the stretcher with a blanket so the casualty does not come in contact with the canvas bed. Blanketing the stretcher:

- makes the casualty more comfortable;
- keeps the casualty warm; and
- helps to immobilise any fractures that may have been sustained.

You may need to use one or two blankets, depending on the weather and available blankets. You can use cotton bed sheets in very warm weather.

**Single-blanket method**

1. Lay one blanket diagonally across the stretcher with the corner of the blanket in the centre of the top of the stretcher. Leave about 150 mm overlapping.

2. Place the casualty on the blanket so that their head is level with the top of the canvas.

3. Fold over and tuck in the lower half of the blanket around the casualty’s feet and between their ankles to prevent chafing.

4. Fold over the upper half of the blanket and tuck it in over the casualty.
**Double-blanket method**

1. Lay a blanket lengthways across the stretcher, level with the head end. Have one quarter of the blanket extending over one side of the stretcher and one half on the other, as shown in the diagram below.

2. Place the second blanket with its centre in the middle of the stretcher and its end about 400mm from the top. Fold the sides into the centre and out at the foot as shown below.

3. Place the casualty on the stretcher so their head is level with the top of the canvas as below.

4. Place the centre of the second blanket between the ankles of the casualty (to prevent chafing), then cross the end points of the blanket over their legs and tuck the points in. If possible, tuck these points between the knees and ankles to prevent chafing.

5. Take the short side of the first blanket over the body of the casualty and if possible, tuck it in.

6. Tuck the long side of the first blanket on the opposite side of the stretcher, and fold the blanket for head support (unless there is a spinal injury).

In Steps 5 and 6, fold in the tips of the blanket so the casualty’s face is not covered. If you are operating in a wet or contaminated area, it is advisable to concertina the ends of the first blanket down the sides of the stretcher before the second blanket is placed in position.
Side position blanketing
The blanket is used:

◆ to provide warmth, comfort and immobilisation; and
◆ as padding to keep the casualty in the side position.

Method
1. Roll the blanket end to end and position it on the stretcher as shown below. The rolled portion is used to pad the casualty’s back.

2. Place a second blanket on the stretcher in a similar manner with the rolled portion on the opposite side. Fold the blanket over the casualty and tuck it under the first roll.

Basket stretchers
Most rescue agencies use basket stretchers. These stretchers, except for the very old wire designs, can accommodate a scoop style stretcher or spinal board. This makes the transfer of a spinal casualty easier.

The parts of a basic basket stretcher are:

◆ tubular frame;
◆ wire or moulded plastic body support;
◆ multiple points of attachment or carry points.
Blanketing a basket stretcher
Basket stretchers are blanketed in the same way as folding stretchers.

Alternatively, to maintain body heat, you may:

◆ transfer the casualty into a sleeping bag in the stretcher, as long as you are still able to attend to injuries; or
◆ lay two folded blankets under the casualty for insulation.

2.9 LOADING A STRETCHER
Loading a stretcher is an important part of handling casualties. It is essential to use correct methods to:

◆ ensure the wellbeing of the casualty; and
◆ prevent aggravation of injuries.

The four-rescuer method
When four rescuers are loading a stretcher and where spinal injuries are not suspected, you can use the following method:

[Diagram of the four-rescuer lift]
**Method**

1. Make up the stretcher and place it near the casualty’s head or feet.

2. The team leader details three others to kneel on one side of the casualty, with the casualty lying flat on their back. Each rescuer kneels on the knee nearest the casualty’s feet, with the knee up that is closest to the casualty’s head.

3. The team leader kneels near the casualty’s hip on the opposite side to the three others and gently rolls the casualty towards themself.

4. The other three place their hands and arms under the casualty and the team leader lowers the casualty back onto their arms. **Make sure the casualty’s head is supported.**

5. The team leader gives the order: ‘**Prepare to lift**’.

6. If no one shouts ‘**Stop**’, the team leader gives the order to ‘**Lift**’ and all four rescuers lift the casualty up.

7. If necessary, the rescuers briefly support the casualty on their knees.

8. The team leader then places the stretcher under the casualty.

9. Final orders are ‘**Prepare to lower**’, followed by ‘**Lower**’.

10. The three rescuers, helped by the team leader, lower the casualty on to the stretcher.

**Blanket-lift method (four or six rescuers)**

The blanket lift is an effective way to load a casualty onto a stretcher or move a casualty in a confined space.

**Method**

1. Prepare a stretcher using one blanket only.

2. Roll a blanket lengthwise to the centre line and lay the rolled section along the side of the casualty (casualty flat on back).
3. The team leader is at the casualty’s head or left shoulder.

4. The team leader directs two (or three) rescuers to kneel on each side of the casualty. The rescuers on one side ease the casualty away from them and push the rolled section of the blanket well under the casualty.

5. With the rolled-up section of the blanket now under the centre of the casualty, ease the casualty over in the opposite direction and unroll the blanket. The casualty should now be lying flat on two layers of blanket.

6. Roll up the sides of the blanket close to the casualty’s body to provide handgrips for the bearers.

7. On the order from the team leader, lift the casualty waist high and carry them to the stretcher.

8. On the order from the team leader, lower the casualty onto the stretcher.

9. Then complete the blanketing using one blanket and leaving the lifting blanket in position.

10. You can also use this blanket carry as an improvised stretcher for carrying over moderate distances.

**Note**

You can safely transport casualties with suspected spinal injuries by this method, as long as you use correct spine immobilisation and pay particular attention to the head and neck.
Clothing lift (three rescuers)
When the casualty's injuries are not too severe but time is critical, or only three rescuers are available, you can use a clothing lift.

Method
1. Blanket a stretcher and place it close to the casualty.
2. If the casualty is unconscious, tie their hands together with triangular bandage or similar materials.
3. Roll the casualty's clothes together along the centre of the body. Make sure you support the head and neck of the casualty at all times.
4. Three rescuers are positioned on the opposite side of the casualty to the stretcher, with their hands placed as illustrated below.

Normal commands are given and the casualty is gently placed on the stretcher.

Webbing bands/tape lift (five rescuers)
In some cases you may need to transport a casualty some distance to a place where a stretcher can be loaded. Webbing bands can greatly help this operation. Many configurations can be used, one of which is illustrated on the next page.

Method
1. Place the bands/tape in position by pushing the long steel handle under the natural body hollows.
2. Seesaw the bands/tape into the required position, under the buttocks and shoulders.
3. When the bands/tape are correctly positioned, centre the handles of each band above the middle of the casualty.

4. Five rescuers then take up their positions.

Securing casualties with rope and tape

When you load a casualty onto a stretcher, you will normally need to tie them in. To do this you need to be able to use natural or synthetic fibre rope, or synthetic tape. Rope (sometimes called cordage) is generally classified as rescue rope (which conforms to AS4142.3) or general purpose rope. Rescue ropes are made of continuous filament polyamide (nylon or perlon), while general purpose ropes can be made from a range of different materials, including natural and synthetic fibres.

History
The condition of a rope or tape depends on its history, age, what it has been used for and how it has been looked after.

A rescue rope’s history is recorded in a Rope History Log/Card.
Rope should be labelled on a heat-shrink sleeve and the number recorded in the Rope History Log/Card. Ask your trainer to show you how this is done.

Labelling rope

UNIT CODE
KERNMANTEL
SIZE in mm
LENGTH in m
YEAR of acquisition
ROPE no.

Caring for rope

- Avoid cutting any rope unless it is essential.
- Ensure the cut end is heat sealed, whipped (K and T) or knotted with a thumb knot (NF) as soon as possible to prevent fraying.
- Knots left in a rope can damage its structure and reduce its strength.
- Use approved knots and lashings for all rope.
- Sharp bends or knots can overload elements of the rope.
- Avoid stepping or walking on rope as this will force damaging grit and dirt into the fibres.
Thumb knot

A thumb knot (or overhand knot) is used as a stopper knot. It can also be used to stop a rope passing through a pulley and (temporarily) to prevent fraying of a rope end.

Method

1. Make a loop in the rope (bight).
2. Pass the running end around the standing part and then through the loop.
3. Dress and pull tight.

Inspecting rope or tape

All stretcher rope and tape should be inspected before, during and after use by visually examining and thoroughly feeling it. Look for bulging, stiffness, fraying, discoloration and soft spots, all of which indicate damage.

- If you notice that rope or tape has been damaged or is defective, label it and remove it from service immediately.
- Enter the details on the Rope History Log/Card.

Contamination

Avoid letting rope or tape come in contact with oils, solvents, acid or corrosive materials as these will damage it. Rope should be considered as contaminated unless the material the rope or tape has come into contact with is known to be harmless.

Remove damaged rope from service and use it for practice only.

Remember

WHEN IN DOUBT – THROW IT OUT.
**Synthetic fibre rope**

*Construction*

Synthetic fibre rescue ropes are of **kernmantel** construction. General purpose synthetic fibre ropes may also be of **laid** construction, which is explained in the section on natural fibre rope.

Kernmantel construction consists of a *kern* (or core) of filaments designed to carry the greater part of the load, protected by a *mantel* (or sheath).

Kernmantel rope of diameter less than 9 mm is commonly referred to as *cord*. Cord is normally ‘static’, which means it has very limited stretch. Some ropes are ‘dynamic’, which means they are designed to stretch.

**Rated strength**

Rope is commonly rated for strength. You can incorporate a safety factor of eight by dividing the rated strength by the safety factor to determine a safe working load:

\[
\text{Breaking force (BF) in kg} = \frac{\text{SWL in kg}}{8}
\]
The rated strength of cord will vary between manufacturers:

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>RATED STRENGTH (BREAKING FORCE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 mm</td>
<td>700–750 kg</td>
</tr>
<tr>
<td>7 mm</td>
<td>1000–1200 kg</td>
</tr>
<tr>
<td>8 mm</td>
<td>1200–1500 kg</td>
</tr>
<tr>
<td>9 mm</td>
<td>1600–1800 kg</td>
</tr>
</tbody>
</table>

Minimum rated strength (from Standards Australia)

**Rescue rope**

Rope is the primary tool of a rescuer, so you must have a thorough understanding of the types and properties of rope and of rope management techniques. In almost all cases, rescue rope is synthetic fibre static kernmantel.

The criteria for synthetic fibre rescue ropes are:

- Minimum diameter 11 mm.
- Static kernmantel construction.
- Minimum rated strength 3000 kg.

**Danger**

Ensure the equipment you are using with the rope is suitable for the task.
<table>
<thead>
<tr>
<th>ROPE DIAMETER (mm)</th>
<th>MIN RATED STRENGTH (kg)</th>
<th>SAFE WORKING LOAD (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>3000</td>
<td>375</td>
</tr>
<tr>
<td>12</td>
<td>3300</td>
<td>412</td>
</tr>
<tr>
<td>13</td>
<td>3600</td>
<td>450</td>
</tr>
<tr>
<td>14</td>
<td>3900</td>
<td>487</td>
</tr>
<tr>
<td>15</td>
<td>4200</td>
<td>525</td>
</tr>
<tr>
<td>16</td>
<td>4500</td>
<td>562</td>
</tr>
</tbody>
</table>

Minimum rated strength and safe working load [from Standards Australia]

**Natural fibre rope**

Natural fibre ropes are general purpose ropes, often used to lash casualties into stretchers. Manila and sisal are the two most common natural fibres used for making rope. New sisal fibres are white while manila is light brown. Manila is more common than sisal because it is softer, absorbs less moisture and lasts longer.

**Construction**

Most natural fibre ropes are made by twisting a number of fibres into yarns.

The yarns are then twisted to make strands (generally three) which are laid together to make the finished rope. This rope is called plain or hawser laid rope. Most laid ropes are twisted into a right hand lay.

The number of fibres in the yarns determines the size of the rope. The more fibres, the thicker the rope.

Synthetic fibres can be used to make a laid rope in the same way as natural fibres.

While these ropes do not comply with Australian Standard for rescue rope, they can be used for general-purpose lashings or tie-downs.
All non-rescue ropes should be treated as if they were natural fibre and arbitrarily given safe working loads appropriate to natural fibre ropes of the same diameter.

**Working out safe working loads (SWL) for natural fibre rope (NFR)**

If the breaking strain for a natural fibre rope cannot be determined, there is a way to work out the SWL.

For new NFR the formula is:

\[
\text{Diameter squared (mm}^2\text{)} = \text{SWL (kg)}
\]

For rope that has been used the formula is:

\[
\frac{\text{Diameter squared (mm}^2\text{)} \times 2}{3} = \text{SWL (kg)}
\]

If there are knots in the rope or it is being taken around a circular object reduce the safety factor by a further one-third of the SWL, the formula is:

\[
\frac{\text{SWL} \times 2}{3} = \text{SWL (kg)}
\]
### Examples based on 16 mm rope

<table>
<thead>
<tr>
<th>Description</th>
<th>Calculation</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>New rope</td>
<td>16 mm X 16</td>
<td>256 kg</td>
</tr>
<tr>
<td>Used rope</td>
<td>( \frac{256 \times 2}{3} )</td>
<td>170 kg</td>
</tr>
<tr>
<td>Knots or bends in rope (used rope)</td>
<td>( \frac{170 \times 2}{3} )</td>
<td>113 kg</td>
</tr>
</tbody>
</table>

### Tape

**Construction**

Tape is most commonly made from polyamide. There are two types of tape:

- flat, and
- tubular.

Standard tubular tape is the stronger and more flexible of the two.

Tubular tape, or webbing, is an ideal alternative for lashing stretchers.

Tape is sized by flat width. The most common sizes are 25 mm and 50 mm.

Tape has a rated breaking strain between 1250 and 3000 kg. For rescue operations, you should only use tape with a minimum rated strength of 2000 kg.

Tape has no sheath for protection, so you must be careful to protect it from sharp edges or friction. If you are unsure that a tape is safe, destroy it.
Caring for tapes
Tape should be treated in exactly the same manner as synthetic rescue rope, subject to all normal inspections and safety procedures and recorded in the Rope Record Log/Card.

Stretcher lashing
The idea of lashing a casualty into a stretcher is to keep them in it. No rescuer wants their casualty to fall or slip out; neither does the casualty!

The method you use to lash a casualty to a stretcher will depend on the type of stretcher used. You can use synthetic fibre rope, natural fibre rope or tape. You will need to know how to tie a half hitch, clove hitch, round turn, round turn and two half hitches and a tape knot.

Clove hitch
A clove hitch is the basis of many securing knots. It may be used to start a rope lashing. The clove hitch is better-suited to laid fibre rope.

Method
1. Facing the standing part, pass the running end around the pole.
2. Continue around the pole, crossing over the standing part.
3. Continue around the pole again, passing the running end up underneath the already crossed ropes.
4. Dress the hitch by pulling both the running end and the standing part to tighten the knot.
**Half hitch**

A half hitch is always used in conjunction with other knots. In this case it forms part of the stretcher lashing.

**Method**

Pass the short end or running end of a rope around a spar or another rope and under the standing part, so that when pulled one part of the rope binds the other.

---

**Round turn**

A round turn is used to make up other knots. It can also be used as a very basic friction device.

A round turn will not secure a rope.

**Method**

Pass the short end or running end of the rope around an object twice. In this case the round turn is taken around the casualty's feet.

---

**Round turn and two half hitches**

**Method**

1. Pass the running end around the pole to form a round turn.
2. Make two half hitches around the standing part in the same direction (clove hitch).
3. Dress and pull tight.
4. Monitor at all times.
Prior to loading a casualty into a stretcher, make sure any personal belongings are removed from their pockets and given to your team leader. Always make sure the casualty is told what you are doing, even if they are unconscious. Make sure items are placed in a marked bag and passed on with the casualty. Keep notes of anything removed from a casualty.

Always talk to your casualty and reassure them.
Securing a pole stretcher

You can lash the casualty securely with 12 m lengths of general purpose rope, 25 mm or 50 mm synthetic tape or 11 mm or smaller synthetic rope.

Method

1. Before lashing, you can place bricks or timber under stretcher Ds so the rope can be passed under the stretcher more easily.

2. Start by tying a clove hitch around the top stretcher handle.

3. Then take three half hitches around the casualty and the stretcher:
   a. in the region of the chest (for a female casualty, place the top securing hitch just above the breast line, to suit the build or the injury, or in line with the arm pit);
   b. in the vicinity of the wrists;
   c. just above the knees.

4. Form a round turn around the feet. (If the lashings are not firm, the casualty will slide down the stretcher when stood up.)

5. Apply three half hitches to the rope in Steps 3a–c on the opposite side of the casualty.

6. Finish lashing with a clove hitch or a round turn and two half hitches on the remaining top stretcher handle. You may vary the position of the three securing half hitches according to the location of any injuries.
Securing a basket stretcher

Securing straps
Some basket stretchers have seatbelt buckles or ‘fastex’ clips to secure a casualty. If the straps are fitted with automobile seat belt buckles, you can reduce the risk of accidental release of the buckles by turning them upside down after fastening and tightening them.

If you are handling a small casualty you can reduce the risk of them sliding out of the stretcher by filling gaps between the casualty and the stretcher sides with blankets, pillows and clothing, before the straps are snapped into place.

Lashing
You can lash a basket stretcher in much the same way as a folding stretcher.

Always secure the casualty’s feet.
If you are shifting the casualty in a vertical position, you must secure their head as follows:

1. Pack soft material around the casualty’s head.
2. Tie a length of bandage to one lower rail (horizontal).
3. Lay the bandage over the casualty’s head (not covering the eyes).
4. Tie the other end to the opposite rail.

**Side position lashing**

When you are lashing the stretcher for the side position, pass the rope through the Ds of pole stretchers on the foot end of the stretcher as shown below.

![Stable side position lashing](image-url)
If there are insufficient stretchers for the number of casualties involved, you may need to use an improvised stretcher. There are many ways to improvise, such as:

**Platform stretchers**

You can make improvised stretchers from:

- doors
- sheets of galvanised iron, or
- bed frames.

**Method**

If you use doors as improvised stretchers, you can blanket them in exactly the same way as for a folding stretcher. The lashing, however, requires a significant modification.

1. Bore two holes at one end of the door adjacent to the position for the casualty’s head.
2. Tie a rope through one hole, and then lash in the normal manner.
3. Complete the lashing by tying the rope through the remaining hole.
Stretchers improvised from poles and blankets, coats or bags

Blankets make excellent improvised stretchers. You can make the stretcher more secure by using nails to pin the two top folds together.

Method
Pole stretchers are simple to make. You need two poles about 2 m long. Stout broom handles, water pipes or 50 mm x 25 mm timber are suitable.

1. Place the blanket flat on the ground and lay the two parallel poles on the blanket about 600 mm apart.
2. Fold each side of the blanket across each pole to make a stretcher.
3. Form the bed of the stretcher with a blanket, sacks, overalls or coats as shown below.

You can also make a stretcher with two bags and two poles. Cut the stitching in the bottom of the two bags just enough to permit the poles to pass through. Slide the end of the second bag a short distance over the foot of the first bag.
**Improvised ‘blanketing’**

If no blankets are available, you can use a small tarpaulin as alternative wraparound protection.

**Method**

1. Lay the tarpaulin on the stretcher with about 1 m overlapping the head end of the stretcher.

2. Fold the head end in 200 mm folds to form a headrest.

3. Fold the bottom of the covering over the casualty’s feet.

4. Fold one side of the tarpaulin over the casualty, then fold and tuck in the excess.

5. Repeat the above procedure with the other side.

**Bush stretchers**

Make a bush stretcher from two timbers about 3–4 m long, strutted and lashed together as shown below.

In the bush, this may be the only suitable means of carrying an injured casualty over long distances.
To build a bush stretcher you will need to know some new knots and lashings:

**Timber hitch**

**Method**
1. Make a half hitch around the object, leaving a long tail (running end). The longer the tail, the greater the strength.
2. Continue with the running end around the standing part.
3. Marry the running end with the lay of the rope.
4. Dress and pull the standing part tight.

**Diagonal lashing**

**Method**
1. Start with a timber hitch around both poles horizontally.
2. Take four vertical turns and pull it tightly.
3. Take four horizontal turns and pull tightly.
4. Finally, put four turns over the lashing, between the poles, pull tight and finish with a clove hitch.
**Square lashing**

A square lashing is used to lash together two poles that touch and cross at right angles.

**Method**

1. Start with a clove hitch round the standard, below the ledger, marrying the ends. Take the married ends up and around both standard and ledger.

2. Repeat this circuit three or four times, working inwards on the standard until the gap is filled, keeping the rope as tight as possible.

3. Take three or four frapping turns around the whole lashing between the poles, draw tight and finish with a clove hitch of the ledger.

**Ladders**

Sometimes, you may need a very narrow stretcher to pass through a small opening, such as a window. In this case, you can use a small ladder or half an extension ladder.

**Method**

1. Place a decking of boards on the ladder (if available).

2. Blanket it in the normal way.

The figure shows a variation to the standard stretcher lashing.

1. Start lashing with a clove hitch on the stile above the rung nearest the casualty’s feet.

2. Take two loose round turns around the ladder and half hitch the lashing to the centre of the turns.

3. Three half hitches around the body in the usual positions.

4. Tie off the lashing with a clove hitch to a rung above the casualty’s head.
Chairs

You can use strong kitchen-style chairs to carry casualties who have no serious injuries as shown below:

Chair stretcher

Activity 2.4
Prepare, Load and Lash Stretchers

Prepare, load and lash a selection of stretcher types that you have available in your Unit, including improvised stretchers.

2.12 MOVING STRETCHERS

Always keep stretchers as close to horizontal as possible, with the casualty’s head slightly elevated.

If you are going uphill, the casualty’s head must be above their feet.

Wherever possible, carry the casualty feet first.

Stretcher passing over uneven ground

To move a heavy casualty over difficult debris conditions for more than 10 to 15 m, you will probably need six rescuers.
Method
1. The team leader positions three rescuers on each side of the stretcher where they have firm footing.

2. On the order ‘Prepare to lift’, the rescuers kneel down and grasp the stretcher. The team leader checks that everyone is ready.

3. The team leader gives the order ‘Lift’ and the stretcher is raised to waist height.

4. The next order will be ‘Prepare to pass’. If any member of the team is not ready, they should inform the team leader by saying ‘Stop’.

5. On the command ‘Pass’, the stretcher is passed until four rescuers are holding it, leaving two spares at one end to support it. Nobody should move their feet during the pass. The two spares then climb carefully around the stretcher and take up position at the other end of it.

6. The process is repeated until the stretcher arrives on clear, solid ground.
When four rescuers are used, the operation is carried out in a similar manner:

**Method**

1. Two rescuers support the stretcher while the other two rescuers move into position.

2. The two rescuers left supporting the stretcher should brace their thighs under the stretcher, for added support. This relieves the weight on their arms and helps to stabilise the operation.

**Moving stretchers in tight spaces**

In tight spaces you can stand the stretcher on end to move it around sharp corners. Where the height is insufficient, you can strike a balance between the vertical and horizontal position.

**Method**

1. Carry the casualty feet first as far as the middle of the right-angle bend.

2. Place the foot of the stretcher on the ground and lift the head as high as the situation will permit.

3. Work the stretcher around the bend, one rescuer easing the foot end and the other the head.

Avoid tipping the stretcher on its side.

Wraparound style stretchers are specifically designed for tight spaces.

**Moving stretchers over a gap**

A large gap can be overcome by laying an extension ladder across it and, if possible, placing a decking of boards over the rungs. Shorter gaps, such as in floors, can be patched using timber from the site or a short ladder. Smaller gaps can be traversed in a similar way to that described for moving over debris.
Activity 2.5
Moving
Stretcher

Lift and move stretchers or casualties over flat and uneven ground and in tight spaces, using:

- Your Unit’s stretchers, and
- improvised stretchers.

Quick Check

Having completed this topic, are you able to:

- identify hazards in and around a rescue scene?
- locate casualties in various environments?
- handle casualties without equipment?
- load and lash casualties into stretchers?
- transport casualties in various environments?

If you have answered NO to any of these questions, ask your trainer for help.
TOPIC 3: RESCUING LIGHTLY TRAPPED

LEARNING OUTCOMES

On completion of this topic, you should be able to:

- inspect, use and maintain ladders;
- use hand tools to breach obstacles;
- move loads vertically and make them safe using basic cribbing;
- move loads horizontally.
3.1 INTRODUCTION

This topic is about the techniques and equipment you would use to rescue people who are lightly trapped and easily accessible at a rescue scene. This includes using ladders to gain access to people who may be down an embankment or hole, on a ledge or in an area where the surface is unstable.

This topic also covers basic hand tools which can be used to move objects and/or to gain access. If these tools don’t do the job, you may find something else at the scene to use as a lever and fulcrum, which you can use to lift, push and/or pry with. Mechanical jacks and winches can be used to drag and lift larger items.

The scene

It is now about 2.30 pm.

After your reconnaissance, you have had a number of thoughts:

‘To gain access to the casualties we may have to climb over a wall with a set of ladders and then lay them across the debris to share the load and gain access to the injured.

‘I can see a trapped person behind a wooden wall or door – can’t make it out properly, so I will need some tools to remove the door or section of wall.

‘I do not think that I can move that slab of concrete on my own, so I will need some basic levering devices and cribbing to hold the weight of the slab, but if that fails I need a backup.

‘There is a work site next door, so I can use some of their industrial slings and winching devices to help move some loads. This will save damaging my rescue gear and committing it now in case I need it later.’
3.2 LADDERS

A ladder is used for gaining access to areas above or below the ground, or other levels not provided with permanent access. There are limits to the safe use of a ladder. Most accidents involving ladders occur because these limits are exceeded.

- All ladders should be adequately supported at the base.
- The top of the ladder should extend at least 1 m above the level being accessed.
- As a general rule, a ladder should be used as a means of access and not a place of work.

Parts of a ladder

Remember

Danger

Take special care if you are using ladders near electrical wires. All ladders have the potential to conduct electricity from wires, ‘live’ roofs or structures. Always make sure you have plenty of overhead clearance when putting up a ladder.
Inspecting ladders

You must inspect and test ladders regularly and carefully to identify damage or defects. Look for:

- cracks in the timber, fibreglass and aluminium;
- loose rungs or rivets;
- reinforcing wire which is not secure;
- loose pulleys, latching devices and extension guides;
- pulleys and latching devices in need of lubrication;
- frayed or damaged hauling ropes (replace immediately).

Pay particular attention to ladders which are stored on vehicle roof racks. They are frequently exposed to the weather.

Stepladders

Stepladders should:

- only be used in the fully open position;
- be positioned on a stable surface, with no tendency to wobble.

Positioning ladders

A ladder is safest and easiest to climb at an angle of about 75°. To obtain this angle, the foot of the ladder should be one quarter its height from the wall. This is often referred to as the quarter height rule or (1 in 4).
If the ladder is too straight up and down, you run the risk that it may fall backwards or sideways. If the angle is too great:

- your foot may slip;
- the ladder may break;
- the strength of the ladder may be reduced.

**Overlaps**

Two-part extension ladders must be extended with sufficient overlap for safety.

- Small ladders should have an overlap of three rungs.
- Large ladders should have an overlap of five rungs.

Where possible, the head of the ladder overlaps the landing point by at least 1 m.

**Putting up a ladder**

Ideally, three rescuers should work in a team to put up a ladder. However, it is possible for two, or even one rescuer, to put it up. To put up a rope and pulley ladder, place the unextended ladder into position and then extend it a few rungs at a time, using the rope. Always ensure the latching hooks are properly engaged after each extension. Long ladders and heavy ladders (greater than 20 kg) should be handled by at least two people.
Single rescuer

Method
As a single rescuer, to raise a short ladder:

1. Place the foot of the ladder against the base of a wall or stationary object.
2. ‘Under-run' the ladder by walking in and pushing forward and upwards on alternate rungs as shown in the figure.
3. Draw the foot of the ladder outwards to the correct distance from the wall.

Two rescuers

Method
If a third person is unavailable to foot the ladder:

1. Place the foot of the ladder against a wall, kerb or some other fixed object.
2. Two rescuers then under-run the ladder in the usual manner, extending it to the required height.
3. Draw the foot of the ladder outwards to the correct distance from the wall.
Three rescuers

Method
In a three-person ladder team:

1. Place the foot of the ladder as near as possible to its required position.

2. Anchor it by footing.

3. With rescuers on either side of the ladder, raise the ladder to the vertical position.

4. With the foot of the ladder firmly in place by footing:
   - pull on the hauling ropes to extend the ladder to the required height;
   - make sure the latching device is properly engaged on the rung.

5. Draw the foot of the ladder outwards to the correct distance from the wall.

Erecting and extending a ladder with 3 rescuers
Securing a ladder

Securing the head
To secure the head of a ladder, apply lashing to any secure point. For example, spread a length of timber across the width of a window on the inside and lash the head of the ladder to the timber.

Securing the foot
You can secure the foot of the ladder by:

- fastening it to a picket; or
- tying it to any secure object behind the ladder such as railings or a fence post.

Secure or stabilise ladders by ‘footing’ or lashing whenever anyone is on them.

How to climb a ladder safely

- Keep your body erect; don’t bend or lean.
- Hold your head upright.
- Keep your arms relaxed and straight.
- Avoid ‘hugging’ the ladder.
- Grasp the rungs (not the stiles) at a level between your waist and shoulders.
- Climb using the arch of your foot (not the ball of your foot).
- Use the ‘three-point contact’ rule with only one hand or foot off the ladder at a time.
- Climb steadily.
Working from a ladder

Ladders are designed for climbing, not as work platforms. However, if you have to work from the ladder, secure yourself using a lashing, a sling or a harness.

Helping a casualty down a ladder

Always take care when you are helping a person down a ladder, even if the person is conscious or uninjured.

Many people are unused to heights and may freeze up or lose their hold.

Method

1. Approach the casualty on the ladder. Reassure and calm them before attempting the rescue. Keep talking to the casualty throughout the operation.

2. Take your position, one rung below the casualty, with arms around the casualty’s body and grasping the rungs.

3. Keep in step with the casualty, letting them set the pace.

4. Keep your knees close together. In this way you ensure support if the casualty loses hold or becomes unconscious.

5. If the casualty becomes unconscious, let them slip down until their crutch rests on your knee.

6. Repeat this procedure for each step down the ladder. Then you can lower the casualty to the ground.

Do not overload the ladder. Check the safe working load before attempting this technique.

Place your ladder up against a wall at Unit HQ, erect it to the correct height, then practise helping people down.
Simple hand tools cause accidents every weekend in Australia. This is mostly because people take shortcuts and fail to use them properly. Simple hand tools are used for many rescue tasks and it is critical you know how to use them safely.

Some hazards linked to tools include:

- body parts becoming jammed in or crushed by moving parts;
- being cut, stabbed or punctured by sharp edges or flying objects; and
- being hit by parts of a tool which have fallen off or broken.

The table on the following page lists the uses of a number of tools and describes safety factors to observe when you use them. In addition, you should always:

- Make sure you understand the manufacturer’s specifications and standard operating procedures for the tools and equipment you are using.
- Use suitable personal protective equipment.
- Avoid cutting through concealed services, such as electric wires or gas or water pipes.
- Keep your body parts well clear of the tool.
- Make sure your body is clear of the backward or forward arc created when you use a swinging tool.
- Make sure other people keep clear of the tool and your working area.
- Pay attention to your posture and how you hold a tool to prevent back injury.
- Protect yourself and those around you from splinters (metal and wooden), remembering that the impact of a tool on the surface you are cutting may cause the tool, the cutting surface or both to splinter.
- Watch out for foreign objects in the cutting surface.
- Be careful of nails or bits of timber that could fly off and injure you or others.
- Pay attention to what you are doing.
- Use tools as they were intended to be used, e.g. do not use a screwdriver as a chisel.
### Using hand tools safely

<table>
<thead>
<tr>
<th>TOOL</th>
<th>SAFETY FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axe/hatchet</td>
<td>If you need to cut through material to get to a casualty, make sure the axe/hatchet doesn’t contact the person underneath. Check that you have a clear swing area. The axe/hatchet should always be in sight.</td>
</tr>
<tr>
<td>Hammers</td>
<td>Beware of splinters caused by the impact of the hammer with the object.</td>
</tr>
<tr>
<td>Cold chisel</td>
<td>Beware of splinters caused by the impact of the hammer onto the chisel or the chisel into the material.</td>
</tr>
<tr>
<td>Crow bar</td>
<td>Use a suitable bar and fulcrum for the load.</td>
</tr>
<tr>
<td>Insulated pliers</td>
<td>Make sure you don’t catch parts of your body in the tool. Verify that the wire you are cutting is safe and there is no current flowing through it.</td>
</tr>
<tr>
<td>Pipe wrench</td>
<td>Beware of splinters.</td>
</tr>
<tr>
<td>Screw driver</td>
<td>Do not use a screwdriver for a task for which it isn’t designed, e.g. as a chisel or a lever.</td>
</tr>
<tr>
<td>Shovels</td>
<td>Be particularly careful about your stance and grip to minimise the risk of back injury.</td>
</tr>
<tr>
<td>Spanners – adjustable and set</td>
<td>Always use a correctly fitting spanner.</td>
</tr>
<tr>
<td>Tin snips</td>
<td>Make sure you don’t catch parts of your body in the tool. Be careful of sharp edges which may be left on the cut material.</td>
</tr>
<tr>
<td>Hand held saws</td>
<td>Be alert for concealed electrical wiring. Make sure the object you are cutting is well secured. Ensure body parts are kept well away from saw blades.</td>
</tr>
<tr>
<td>Wrecking bar</td>
<td>Use a suitable bar for the load.</td>
</tr>
</tbody>
</table>

### Activity 3.2

**Hand Tools**

You must create an opening in a wall to reach a casualty trapped behind it. Breach the wall using the hand tools you have learned about in this topic.
3.4 MOVING LOADS VERTICALLY

Levers

The simplest way to lift or hold a load is to use a lever. You will have greater mechanical advantage by using a fulcrum with a lever.

You can move a load by pushing up (upward force) or down (downward force) on a lever.

The mechanical advantage gained depends on the distances from the fulcrum (B) to:

- the centre of the load (A); and
- the point where the force is applied (C) as shown below.

(a) Lever (downward force)

(b) Lever (upward force)

Remember

- Make sure the lever is strong enough to support the load you want to lift.
- Hard wood gives little advance warning of material failure. It will split suddenly.
- Mild steel bars will bend without warning.
- Push as near to the end of the lever as practical.
- If you use more than one lever, try to lift the load evenly.
Fulcrum

A fulcrum should:

- be made of crushable material such as softwood;
- rest on a firm base, which is as large as possible to distribute the weight to be lifted;
- be placed as near as possible to the weight of the load, depending on the distance required to move or lift the load.

Never place a fulcrum where there may be a casualty buried immediately below.

Cribbing

Cribbing are used to support loads and are built with timbers of various sizes, depending on the weight to be supported and the available working space.

Commonly known as 'packing', cribbing will support a load if it moves or collapses during a lift.

Method

To make a 3-point cross-tie crib:

1. Space three timbers well apart and parallel.
2. Place a second level of timbers on top and at right angles to the first layer; place the second level one thickness in from the edge of the first layer.
3. Add each new layer at right angles to the previous layer.

Remember

- Make sure the ground is level at the point where the crib is to be set.
- It is better to level off high spots than to fill low ones.
Folding wedges

The crib must be gently secured into position. The best method of securing timber cribbing is to use ‘folding’ or ‘opposing’ wedges. The wedges can be formed from timber found on site.

Wedges should be made with an angle of 10°–15° at the front.

Wedges can be made of soft or hardwood. What are the advantages and disadvantages of both types?

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softwood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardwood</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When two wedges are placed in opposition, the grain of the timber should run along each of the contacting faces, rather than meeting as end grains (see below). This helps keep the wedge from slipping.
Mechanical jacks
If hydraulic equipment is not available, you may need to use a mechanical jack.

Safety with Jacks
Always follow the manufacturer's instructions.

If you are using more than one jack under a load, all jacks must be raised and lowered together to prevent the load slipping or overloading one jack.

If you are jacking metal objects, place a wooden plank between the jack and the object to prevent slipping.

To prevent the jack slipping or sinking into the ground under a load:

- stand the jack squarely on a heavy timber or other substantial footing;
- make sure the footing is dry and free from grease.

Always 'pack as you jack'. As the load is lifted, continually place solid material supports under the load to prevent movement should the jack collapse. Always set cribs under heavy loads to prevent settling after the lifting operation is complete.

Danger

- Never push a load off a jack.
- Never repair the jack while it is under load.
- Never work under a raised load unless additional supports are used.
**High lift jack**

A high lift jack:

- can be used to lift, pull, push, hoist, winch and cramp;
- has a lifting capacity of about 3.5 tonnes and a continuous lift of about 96 cm.

**Method**

1. Place the jack on a firm, level surface with the upright steel standard in the vertical position.
2. Lift the reversing latch until it locks in the up position and raise the lifting mechanism until the lifting nose is completely and securely under the load.
3. Grasp the handle firmly using both hands and slowly move it up and down.
4. The load will be lifted with each down stroke.
5. To lower a load:
   - hold the handle in an upright position;
   - move the reversing latch to the down position;
   - grasp the handle firmly with both hands and pump down and up.
6. The load will be lowered on each up stroke.

**Special safety considerations with high lift jacks**

As well as the standard jacking precautions, you need to follow some special procedures with a high lift jack.

Place the handle in full vertical, full upright position, parallel to the upright steel standard before tripping the reversing latch or when the jack is under load.

Make sure the entire lifting nose of the jack is placed under the object to be lifted.

Keep your head and body away from the area that the handle moves in.
If the capacity of the jack is exceeded, the shear pin is designed to break, to prevent the lifting nose of the jack from breaking. The load will not fall when the pin shears, but the handle will drop rapidly. Never replace a shear pin with a bolt of higher strength. Always replace with the manufacturer's safety shear pin only.

The jack must be loaded at least 45 kg or more to lower step by step. Otherwise the lifting mechanism will automatically drop to the base level.

**Ratchet jack**

A ratchet jack is a simple jack which:

- raises a load using a lever working against a ratchet, which supports the load between each lifting stroke;
- has a range of sizes and lifting capacities available, of which the most commonly used are 2.5 and 20 tonne capacity.

**Method**

1. Place the jack on a firm, level surface.
2. Grasp the handle firmly using both hands and turn handle.
3. The load will be lifted with each turn of the handle.
4. The load will be lowered with each turn of the handle in the opposite direction.
**Screw Jack**
A screw jack is a simple jack operated by means of a winder which rotates a screw.

**Method**
1. Place the jack on a firm, level surface.
2. Grasp the handle firmly using both hands and turn the handle.
3. The load will be lifted with each turn of the handle.
4. The load will be lowered with each turn of the handle in the opposite direction.

**Activity 3.3 Vertical Loads**
Practise moving (lifting and lowering) a load vertically.
Rescue teams may have to move concrete slabs, steel girders, equipment and heavy machinery.

To do this they will need anchors, pulleys and mechanical winches to push, pull or lift the items with.

**Anchors**

**Strength**
Always look for the strongest possible anchor. For example, a load-bearing structural column in a building will generally withstand greater forces than a handrail.

**Direction of pull on an anchor point**
Always try to select anchors that will be in line with the direction of pull. Consider what will happen if the direction of pull changes.

**Positioning anchors**
Under the ideal conditions, the anchor should be close to and directly in line with the object to be moved. However, there would be circumstances where it would be preferable to have the anchor off to one side. For example:

- conditions where rocks or other dangerous objects might fall on the casualty or on the rescuers;
- where there are conditions between the anchor point and the casualty that could endanger rescuers or damage equipment such as rope;
- where there are no suitable anchors directly in line with the load.
**Improvised anchors**
Improvised anchors are those found on site, e.g. reinforced concrete, metal framework of buildings and baulks of timber across door openings. Sometimes the simplest and quickest anchor system is to use a vehicle.

**Constructed anchors**
Where you do not have access to an improvised anchor, there are many ways to construct an anchor:

**Picket holdfasts**
You can use picket holdfasts in ordinary soil for loads up to two tonnes.

Single pickets may be used or, when formed into a holdfast, they may be arranged as ‘1 and 1’; ‘2 and 1’; and ‘3, 2 and 1’ systems, according to need:

(a) 1 and 1 Picket holdfast
(b) 2 and 1 Picket holdfast
(c) 3, 2 and 1 Picket holdfast

**Picket holdfast systems**
Building a picket holdfast

1. Drive the pickets into the ground at about 90° to the line of pull. If the pull is horizontal, the picket should stand upright with a slight backwards lean. The higher the attachment is to the load, the further the picket leans back; however, if it leans back too far, the picket may plough through the soil.

2. Make sure the pickets lean slightly away from the load, with two-thirds of their length in the ground. The strongest picket should be nearest the load.

3. The lashings connecting the pickets should be at 90° to the pickets, extending from the head of the front picket to ground level on the rear picket. This determines the distance between the pickets, which should be at least 750 mm apart.

4. Monitor anchor systems at all times.

Driving pickets

Pickets are driven into the ground using sledge hammers or impact drivers. Impact drivers are capped lengths of pipe with an internal diameter greater than the pickets and fitted with handles.

If you are using a sledge hammer to drive the picket, have two rescuers secure the picket with a piece of cord while the third hammers it in. Always wear eye protection when you use a sledge hammer or picket driver. All operators around the picket should also wear eye protection.

Picket lashings

Each lashing is formed using a 12 m x 12 mm rope or similar.

1. Start the lashing with a clove hitch about 180 mm from the head of the front picket.

2. Take four turns around the base of the back picket and the head of the front picket, placing these above the clove hitch and tighten the lashing.

3. Apply frapping turns around the lashing, finishing off with a clove hitch. Coil any spare rope and place it near the picket or tape the coil onto the picket.
**Picket removal**

You can remove round or hexagonal pickets with a large Stilson or pipe wrench. There are also products designed to remove star pickets as well as various types of home made pickets/removers.

1. Fit the wrench to the shaft of the picket.
2. Use the wrench to wind the picket out of the ground, by pulling upward on the wrench handle. It helps to tap the base of the picket with a hammer to loosen the soil.

**Ground-plate holdfasts**

The ground-plate holdfast (GPH) is a pierced heavy metal plate. You can secure the GPH by hammering a number of short pickets or spikes through it into the ground.

A shackle secured to one end provides an attachment point:

![Ground-plate holdfast](image)

An alternative to using the ground-plate is to use a piece of rated chain with links long enough to place the pickets through.
**Buried holdfast**
The buried holdfast is only satisfactory where the angle between ground level and the rope is small.

For buried holdfasts you will need:

- a stout piece of timber, or
- a length of steel girder, or
- a large diameter water pipe, or
- a spare wheel from a vehicle.

**Building a buried holdfast**
You will need to dig a trench to accommodate the material used and place a small outlet at right angles to the trench to allow the rope or wire to come to the surface.

The greater the load to be applied, the deeper you must make the trench. You need not fill in the trench, but a rescuer should be detailed to check the holdfast when the load is applied.
Log-and-picket holdfasts
The log-and-picket holdfast is illustrated below.

Building a log-and-picket holdfast
1. Drive in four pickets about 400–500 mm apart.
2. Drive in a second row of four pickets 1 m behind the first row.
3. Lay a large log behind the first row of pickets.
4. Lash each pair of pickets together.

This method is particularly useful in wet or soft earth. The log acts as a beam and bears weight evenly against the front row of pickets.

Attachment to anchors using slings
Slings or independent short ropes should be used for anchor attachment. The advantages of this method of attachment are:

- maximum use of available rope lengths;
- reduced risk of damage to the main rope;
- quick to attach;
- easy to replace.
Attaching to an anchor
Rescue anchors are most commonly set up with the load attached with climbing tape slings and karabiners.

You may tie off ropes directly to anchors providing that the anchor material is padded or will not damage the rope. Wherever possible, two independent anchor points should be used, with the load equally shared between the two points.

Heavy-duty anchor systems are set up using steel wire rope (SWR), webbing or chain slings taken around a padded anchor and connected to the load using appropriately rated shackles.

Karabiner and slings attachment to anchor point

Anchor karabiners should be placed so that their gates don’t touch any object.

Knots for attaching to anchors

The following knots can be used on all ropes, but are designed for synthetic fibre rescue ropes.
**Round turn and two half hitches**
Recall this knot from stretcher lashings. It is a useful anchor knot because it's easy to adjust under load and easy to untie after the load is off the rope.

**Tensionless hitch**
Used as an anchor hitch. The anchor point must be at least eight times the diameter of the rope used.

**Method**
1. Wrap a rope around an anchor point several times to create enough friction to keep the rope from slipping.
2. Finish off with a figure of eight on the bight and a karabiner attached to the rope. There should be no load on the figure of eight.

**Load sharing**
If anchor points are at all questionable, or inconveniently placed, then a load-sharing anchor may be the solution. The simplest way to create a multiple anchor system for load sharing is to use two anchor ropes or slings. Run them from different anchor points and clip them together into a single point using a shackle.

**Load angles**
The loading angle refers to the angle formed by an anchor system carrying a load between two fixed points.

You should remember that any angle in an anchor system will increase the loading on anchors and other elements of the system. Only when the angle between the legs of the anchor system is 0° will each leg carry half the load. This is also referred to as the IYT principle.

Operationally, 90° (Y) is a maximum safe relationship between the two legs of the system. The smaller the angle, the lower the load on each leg.
A major concern for rigging any type of anchor is to minimise the angle between the legs of the anchor system. Ideally this angle should not exceed 90° and must never exceed 120°.

**Ideal**  
Angle which is less than 90°

**Yes**  
Refers to 90°–120°

**Terrible**  
Refers to 120°–180°

**Redirection anchors**

A redirection is a technique for bringing a rope into a more favourable angle of the load and/or pull or to avoid abrasion.
1. Weigh a small house brick with a sliding scale and record the weight.

2. With a piece of string about 120 cm long, form the same size loop in both ends, halve it and tie a loop in the middle.

3. Attach the small house brick to the loop in the middle of the string.

4. Attach a sliding scale to each of the ends and hang the house brick.

5. Hang both scales together at 0° and read the weight of the object, they should both read 50% of the brick's weight.

6. Place the scales at 90° and the reading should be at 70% of the load.

7. Place the scales at 120° and the reading should be at 100% of the load.

8. Place the scales at 150° and the reading should be at 200% of the load.

**Slings**

Slings are commonly used for load sharing in anchor attachments. Tape, rope or chains may be used as slings. Some examples of sling attachments are:

- suspending a block from a derrick;
- forming the hinge in a ladder hinge;
- anchoring a mechanical descent device.

**Note**

Use a log to record usage and maintenance for all slings, just like rescue ropes.
Flat webbing and round synthetic slings
Flat webbing and round synthetic slings are used for lifting where you need to protect the load from damage or to protect yourself from electrical hazards. They are made from polyamide, polyester, or other synthetic materials. Each sling must be labelled with the safe working load (SWL).

When the sling is placed around an anchor point:

1. Use a D or bow shackle to attach it to the load by the eyelets (loop hook) of the sling.
2. Feed the sling ends through so they are seated into the curve of the bow shackle.

Wherever possible, tape slings should be taken completely around an anchor point and the D shackle clipped through both sling eyes.

Attachment to anchor points
All reputable brands of slings have an information tag which shows:

- SWL
- Safe usage
- Australian Standards compliance.

Always read this information before using any sling.

Immediately tag any sling to be retired or marked with a sign saying, ‘Danger. Do not use.’
Shackles
There are two main types of shackle:

- D
- Bow.

D shackles are most commonly used in general rescue.

Most shackles are made from plain round steel bar. These are **locating shackles** and must not be used for lifting loads.

Lifting shackles are stamped with a SWL and made from a stronger metal.

Both types of shackle are secured by a round section steel pin located through one eye of the shackle.

In any rescue operation, you must select shackles that:

- are large enough to accept the slings or other attachments; and
- are appropriately rated for the loading and task.

**Remember**

- Always use the shackle pin to secure the shackle.
- **Never** replace the pin with a nut and bolt. This is highly dangerous and may cause the shackle to fail.
- Bow shackles are better suited for use with slings.
Using shackles safely
Shackles or pins that are worn by more than 10% of the original diameter must be destroyed.

Shackles or pins that have been bent, strained, deformed or damaged must be destroyed.

Screw shackle pins must be properly tightened and either moused or monitored to ensure the pins do not unscrew under load.

Chain slings
Single-link chain slings are commonly used for rescue purposes. These slings have a hook at one end and ring or eye at the other.

All reputable brands have the safe working load stamped on a tag connected to the ring end of the chain. Always check this tag before using the sling.

Should the information on safe working loads not be available, the following is an approximate rule of thumb method:

\[
\text{Diameter (mm) squared} \times 100 \div 13
\]

For example, for 12 mm chain:

\[
12 \times 12 \times 100 \div 13 = 1107 \text{ kg SWL}
\]

Flexible steel wire rope slings
Flexible steel wire rope (FSWR) slings are designed with eyes or loops at each end with a metal plate inserted by the manufacturer to maintain the shape of each eyelet.
The breaking strength of an FSWR sling is approximately:

\[
d^{\frac{3}{2}} / 20 \text{ tonnes}
\]

where \(d\) is the diameter of the rope in mm.

You should always apply a safety factor of eight to calculate the safe working load.

**Using slings safely**

- Make sure the sling can carry the load.
- Protect the sling from sharp objects.
- Always apply the load gradually, as shock loads may damage the sling.
- Make sure there is no twist in the sling and the load is taken in the bowl of the hook.
- Never attempt to shorten slings by tying knots in them.

**Steel wire rope**

Steel wire rope is constructed of wires and strands laid around a central core.

**Note**

Use a rope log for steel wire rope.
Broken wires
It is important not to confuse wires and strands. If a strand is broken, the rope is unusable. A single broken wire in a sling is not as important unless broken immediately below a metal fitting or anchorage. Fatigue from use will cause the outer wires in a steel wire rope to break. If you find broken wires in the cable, you need to report it to an appropriate person (trainer or team leader), tag the steel wire rope and have it withdrawn from service.

Once you have set up an anchor system, you need to set up a load-shifting (hauling) rig. This can be a block and tackle system, based on rope and pulleys, or a machine, such as a Tirfor winch. Any hauling system creates a mechanical advantage, making it easier to move the load.

Pulleys
Snatch block and swing cheek pulleys are commonly used in general rescue.

Snatch block and swing cheek pulleys
Lightweight pulleys
In general rescue work you will usually use lightweight rescue systems. Lightweight rescue pulleys should be a swing-cheek design with these characteristics:

- The sheave should have a diameter at least four times the diameter of the rope.
- The cheek plates should be moveable so that the pulley can be placed on the rope at any point. They should also extend beyond the edge of the sheave to protect the rope from abrasion.
- The axle should have rounded ends so it does not snag on ropes, other gear or objects.
- The bushes or bearings should be constructed so the sheave turns freely when loaded.

The pulley should have a rated strength in excess of 1500 kg and preferably greater than 2500 kg.

Pulley systems can be either lifting or hauling systems.

A lifting system is one in which the load is attached to the running (lowest) pulley with the running end of the fall (or rope between the pulleys) coming off the standing (upper) pulleys. (You will learn more about lifting (and lowering) systems later in this course).

A hauling system is one in which the running end of the fall comes off the running pulley, (to which the load is attached) and the standing pulley is made fast to an anchor of appropriate capability.
**Mechanical advantage**

The reason you use a pulley is to gain a mechanical advantage (MA) when raising, lowering or hauling a load.

A system of pulleys is used to lift heavy loads by the mechanical advantage of increasing the length of travel of the pull and decreasing the load.
Reeving a Z-rig
1. Bring the load line to the anchored pulley.

2. Take the load line through the anchored pulley and forward to the moving pulley. The moving pulley should be attached to the main line by a Prusik knot.

3. Take the load line through the moving pulley and back to become the running end.

Reeving a Z-rig pulley

Knots to use in a Z-rig

Double fisherman’s knot
A double fisherman’s knot is used to join kernmantle ropes of equal diameters.

Method
1. Lay both ropes side by side in opposite directions.

2. Make two round turns to left with right hand running end.

3. Feed end under the two round turns.

4. Make two round turns to right with left hand running end.

5. Feed end through the two round turns.

6. Dress and pull tight.

Prusik knot
The Prusik knot is a means of attaching a cord loop (6-8 mm) to a rope.

Method
1. Form a loop in a cord by joining with a double fisherman’s knot.

2. Take one end of loop and pass second loop around rope at least three times, then feed through original loop.
# Working safely with pulley systems

<table>
<thead>
<tr>
<th><strong>KEY POINT</strong></th>
<th><strong>YOU MUST CONSIDER...</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use pulley sheave sizes that suit the rope and the rope diameter.</td>
<td>If the diameter of a sheave doesn’t suit the rope, the rope may turn too sharply and be damaged.</td>
</tr>
<tr>
<td>Check the rope between pulleys.</td>
<td>Is it free from kinks and twists? Does it run easily over the sheaves?</td>
</tr>
<tr>
<td>Fastenings</td>
<td>Are they secure?</td>
</tr>
<tr>
<td>Carry – don’t drag.</td>
<td>Always carry pulley systems. Never drag them over the ground.</td>
</tr>
<tr>
<td>Lower</td>
<td>Gently ease off suspended weight. Never lower it in jerks.</td>
</tr>
<tr>
<td>Haul or lower in unison with your team.</td>
<td>Position team members on alternate sides of the hauling system. To keep the pull in a straight line, haul the rope hand over hand.</td>
</tr>
<tr>
<td>Hands away</td>
<td>Keep your hands away from pulleys when they are moving. The rope could trap a hand and draw it into the pulley.</td>
</tr>
<tr>
<td>Tackle</td>
<td>Attach only one pulley to either the load or anchor sling.</td>
</tr>
<tr>
<td>Pulleys</td>
<td>Are they:</td>
</tr>
<tr>
<td></td>
<td>♦ Well maintained?</td>
</tr>
<tr>
<td></td>
<td>♦ Carefully handled?</td>
</tr>
<tr>
<td></td>
<td>♦ Free of dirt and grit?</td>
</tr>
<tr>
<td>Redirection</td>
<td>If possible, use snatch blocks or single sheave pulleys on the running end of the system as redirection pulleys. This enables direction of haul to be changed when necessary.</td>
</tr>
<tr>
<td>Safety pins</td>
<td>Make sure safety pins are secured when you are using snatch blocks.</td>
</tr>
<tr>
<td>Anchor points</td>
<td>Are all anchor points capable of supporting the total load?</td>
</tr>
</tbody>
</table>
Reeving a snatch block system
Reeving a snatch block system is best achieved by a two-person team, following these steps:

**Method**
1. Kneel back to back about 1200 mm apart.
2. Each place a pulley in front of you, between your feet with the hook pointed away from you.
3. When you reeve a lifting tackle, make sure the coil of system rope is to the left of the pulley. For a hauling system, the coil should be to the left of the load (or moving) block/s.
4. The first rescuer:
   - reeves the standing end of the rope through the lowest sheave of the top pulley; then
   - passes the rope to the second rescuer.
5. The second rescuer then reeves the rope through the lowest sheave of their pulley.
6. Both rescuers then pass the rope successively through the sheaves of both pulleys from left to right.
7. Finally, make the rope fast to the becket.
8. Secure the running end of the rope to prevent slipping.

Reeving a snatch block system
**Buntline hitch**

A buntline hitch is used to secure a natural fibre rope end to the becket of a block when reeving a tackle so as not to interfere with the sheeve of the block. (This is not to be used with kernmantel rope.)

**Method**

1. Pass the running end of the rope through the becket eye.

2. Continue with the running end around behind the standing part, following the lay of the rope, forming a bight around the standing part.

3. Continue passing the running end over the top of that rope, forming a figure of eight around the standing part.

4. Pass the running end under the bight, forming a clove hitch around the standing part.

5. Dress and pull tight.

**Winches**

A winch is an appliance for moving an object by using a rope or chain to lift, lower or haul.

**Tirfor-style winches**

The Tirfor-style winch can be:

- attached to any convenient holdfast;
- hung from overhead beams or girders;
- slung from or attached to derricks or ‘A’ frames; or
- attached by the winch body to the anchor with the cable anchored to the load to be moved.

The Tirfor-style winch consists of a properly anchored machine through which a long steel wire rope (SWR) passes. The SWR is attached to the load to be hauled or lifted.
The Tirfor winch kit
The Tirfor winch kit consists of:

- a pulling and lifting unit (metal casing) with a swivel hook;
- a detachable collapsible tubular steel handle;
- a length of flexible steel wire rope.

Using the Tirfor
1. Pull the clutch lever firmly towards the hook on the machine until it is seated in the notch.
2. Push steel wire rope into the machine until it protrudes through the hole in the hook.
3. Pull the steel wire rope through the machine until the desired length is reached.
4. Place the clutch lever in the operating position.
5. To achieve this:
   - lift the clutch lever out of the notch;
   - allow the spring inside the machine to carry it into its operating position.

At this stage, the rope should be firmly gripped in the jaws of the machine.

To winch with the Tirfor:

- make sure the handle is fully extended;
- place the collapsible handle on the pulling lever; and
- move it backwards and forwards along the direction of the rope.

The rope moves through the machine on the forward and backward strokes of the pulling lever.

To reverse the action, you need to transfer the operating handle to the reverse lever on top. This passes the cable through the machine in the opposite direction.
To remove the steel wire rope:

1. Pull the clutch lever towards the hook until it is seated in the notch.
2. Pull the rope through the machine.

**Cleaning and maintaining the winch**

To remove dirt and dust:

1. Immerse the winch in a kerosene bath.
2. Shake well.
3. Repeat until the dirt and dust is removed.

The winch must be well lubricated before use. If the motion jolts when you are easing the load you must oil the winch immediately.

After use, make sure the steel wire rope is coiled onto the rope reel.

**Safety with Tirfors**

Tirfor-style winches have these built-in safety features:

- The clutch lever cannot be engaged while the machine is under load.
- If the strain on the pulling lever becomes too much for one rescuer, the machine has reached its safe working limit.
- If you try to use a Tirfor-style winch beyond its safe working limit, the three shear pins in the shaft of the pulling lever will break before you can seriously damage the winch.
- Spare shear pins are carried in the hollow handle of the machine.
- If the pins fail, you need to:
  - insert the new pins;
  - ease the load off the machine;
  - add blocks for a greater mechanical advantage.

Always follow the manufacturer’s instructions.
Keep the following safety factors in mind.

- Always use slings and anchors which are strong enough to withstand the load.
- Never allow any kinks in the rope to enter the machine. This could damage the machine.
- Only use steel wire rope supplied with the machine.
- Never anchor the machine by the tip of the hook. Always use slings.
- Never apply tension to the running end of the steel wire rope.
- Never step or stand over a wire rope under tension.
- Always keep clear of likely whipback areas, in case the rope breaks.
- Always keep hands well clear of where the rope enters and exits the winch body.

**Ratchet winches**

The ratchet winch is low-cost and readily available. To use it, you move a handle which cranks a drum via a pawl and ratchet system. This winds wire on to the drum.

The pawl is spring-loaded, which allows you to move the winch forward or backward.

Before using a ratchet winch, check the capacity of the winch and the length of wire rope required, as this varies from model to model.

Some cheap ratchet winches are of very poor quality and capability. Check them carefully before using and follow the manufacturer's specifications closely.

**Hook mousing**

A hook mousing stops load slings from jumping off a hook before the load is applied. Most hooks are fitted with automatic mousing devices but there are some still without. You need to mouse the hook manually if there is no automatic mousing device. It is more common for a steel wire sling to jump out of a hook than for a chain or synthetic sling.
Method 1
1. One method is to use mousing twine on the bight. Hitch the twine to the hook above the bulge of the shank so it cannot be pulled downwards.

2. Then:
   - take the twine towards the bowl of the hook; and
   - fix it to the shank again, using one or more half hitches before you create the first figure of eight or diagonal turn.

3. Pass the twine around the hook on alternate sides of the sling eyes.

4. Pass at least two half hitches around the diagonal turns.

Method 2
Wrap cloth or gaffer tape around the hook between the point just above the bulge of the shank and the end of the hook.

Method 3
1. Hitch the twine to the hook above the bulge of the shank so that it cannot be pulled downwards.

2. Take a series of round turns around this point and the end of the hook.

3. Frap these turns and tie off.
Activity 3.5
Horizontal Loads

Move loads horizontally, by hand and with mechanical winches.

Quick Check

Having completed this topic, are you able to:

- inspect, use and maintain ladders?
- use hand tools to breach obstacles?
- move loads vertically and make them safe using basic cribbing?
- move loads horizontally?

If you have answered NO to any of these questions, ask your trainer for help.
TOPIC 4: EXPLORING LIKELY SURVIVAL PLACES

LEARNING OUTCOMES

On completion of this topic, you should be able to:

◆ describe building types and their features;
◆ describe and identify various collapse patterns found in damaged buildings;
◆ remove debris;
◆ lift and stabilise loads using heavy equipment;
◆ build shoring systems;
◆ build debris tunnels.
4.1 INTRODUCTION

When a building suffers a major structural collapse, there will always be voids and openings. How many there are and their nature depend on the type of collapse.

To enter these spaces you may have to separate or lift large obstructions. Gaining entry can be extremely dangerous, as most (if not all) building collapses can shift. Damaged structures such as foundations, piers, walls and floors must be stabilised before you can gain entry.

The scene

It is now about 4.30 pm.

Until now you have been able to remove most of the casualties, but now comes the more hazardous phases of the rescue.

You have been asked to enter the building to explore likely survival places, such as voids. Your understanding of building construction will help you visualise how the building could have collapsed and where these voids may be found.

The team needs to remove as much debris as possible so that it can gain entry and start to shore up parts of the building. To do this it needs increasingly specialised tools to cut and remove timber and other debris.

As you enter the building you also need to ensure it doesn’t collapse behind you, so you tunnel through small holes that you’ve cut by breaching into walls and ‘shore as you go’.
You can learn much about how a building is constructed from the Building Code of Australia. Further, the method of construction has a major impact on how a building might collapse, regardless of the cause of the collapse.

**Building Code of Australia**

The Building Code of Australia (BCA) classifies all Australian buildings into ten classes according to purpose.

Each class has a different type of risk, especially when a building becomes structurally unsound or collapses. Classifying buildings according to purpose can give rescue personnel an indication of how many victims they may have to locate.

**Common methods of construction**

In addition to the BCA classes, there are also seven common methods of building construction:

- timber construction
- light frame construction
- besser block
- reinforced masonry – older style office blocks and residential buildings
- unreinforced masonry
- concrete tilt-up
- reinforced concrete and steel construction.

**Activity 4.1 Building Types**

Identify different building types around the headquarters.
4.3 COLLAPSE PATTERNS

As a general rescuer you need to be able to identify the five most common patterns of structural collapse:

1. Curtain fall wall collapse
2. Inward or outward collapse
3. Lean over collapse
4. Lean to floor collapse
5. Angle wall collapse.

A further six collapse patterns can occur. These collapses usually involve accessing voids and confined spaces:

6. Pancake floor collapse (horizontal)
7. Secondary collapse or other building
8. Inverted ‘A’ or tent collapse
9. ‘V’ collapse
10. Cantilever collapse

Much of what is known about collapse patterns is based on research and experience following earthquakes.

4.4 SECONDARY COLLAPSE

A secondary collapse can occur after the initial collapse. Secondary collapses are a real hazard for rescuers. The three most common signs that a secondary collapse is likely are:

- structure movement
- visual clues, and
- audible clues.
**Structure movement**
- Movement in any floor, ceiling and roof.
- Movement of ornamental shop fronts.
- Movement of unsupported or non-load bearing walls.
- Movement of structural beams.
- Columns and walls out of plumb.
- Ceiling sagging.

**Visual clues**
- Uneven surface, heavy signs on section or whole of the roof.
- Cracks appearing in the exterior walls.
- Sagging or bulging wall or cantilever shaking or swaying.
- Large fire which has been unsuppressed for more than 20 minutes involving two or more floors.
- Smoke or water coming through walls.

**Audible clues**
- Creaking and groaning noises coming from the building or structural elements.
- Interior explosions, rumbling noises, hissing sounds, electrical arcing.
- Strong winds.
- Safety warning signals, e.g. the standard stop signal of one long hooter or whistle blast.
Two methods to extract people trapped under a pile of debris are:

- clearing the debris by removing the debris piece by piece until the people are uncovered and freed; or
- building tunnels and linking voids.

If a building has collapsed, a large pile of debris may actually protect people from the main impact and weight of the debris.

**Precautions in operations**

- Rescuers must wear gloves.
- Be careful using edged tools in debris clearance.
- Remove debris close to casualties by hand.
- Avoid climbing over debris unless absolutely necessary.
- Withdraw debris only when it is certain that no further collapse will be caused.
- Operate heavy equipment only at the direction of the person in charge of the rescue.
4.6 LIFTING AND STABILISING

Once you are working amongst debris and exploring likely survival places, you may have to stabilise heavy loads. The light jacks you used in Topic 3 Rescuing Lightly Trapped may not be powerful enough. SES Units are issued with heavy lifting equipment, including airbags and hydraulic rescue kits.

Airbags

Many Units are equipped with airbags. Airbags are used to lift, spread or move objects. They are simple, quiet to operate and a very useful tool:

- for starting a shore by stabilising a load;
- where space is too restricted to use hydraulic equipment;
- on soft, marshy or uneven ground;
- on a slope;
- where there are flammable liquids and vapours (airbags are less likely to produce sparks than other lifting equipment).
Airbags are available in many sizes and designs. The most common are mini bags which range from 9.6 tonnes to 67.7 tonnes lift capacity.

**Method**
1. Place the bag under the object to be lifted on flat solid ground, a solid packing block or a crib base which is at least the same size as the airbag.

2. Protect the top of the bag with a solid packing block or some other impenetrable material which is the same size as the airbag. This will prevent it from flying out and becoming a projectile.

**Activity 4.2 Airbags**

Set up and use airbags (if your Unit has them) to lift a load such as a vehicle.

**Danger**

Avoid placing airbags where extremely hot, sharp or long protrusions could puncture them.

**Hydraulic rescue tools**

Hydraulic rescue tools can be hand-operated or power-operated models. They may be either single-acting or double-acting.

- Single-acting hydraulic tools apply force in one direction only.
- Double-acting hydraulic tools apply force in two directions and can be used for pushing and pulling.

Hydraulic tools and their accessories are combined to form rescue kits.

The basic hydraulic rescue kit is a single-acting, hand-operated pump system.
Hydraulic rescue kit

Basic kit
2 hydraulic pumps
2 lengths of pressure hose
2 rams of 10 tonnes capacity plus serrated saddles
2 screwed adaptors for ram plunger
1 wedge spreader
1 alligator spreader
2 flat base plates
2 ram toes
2 plunger toes

Kit options (20 tonne lift, 5 tonne pull rams and ram extension tubes)
2 basic jacking units:
◆ 2 pumps
◆ 2 rams
◆ various fittings for each ram
1 wedge spreader
1 alligator spreader

Only one wedge spreader and one alligator spreader are included because there will be a number of occasions where two jacks will be used simultaneously, but few where two of the same type of spreader are required.

The entire kit is portable, although it may take two people to carry it. Each of the items in the kit can be connected or disconnected by finger-operated screw couplers. No tools are required. The kit is operated when oil from the pump flows through a hose from the ram to its accessories.

The pump controls lifting and lowering. The flexible hose allows the ram and spreaders to be operated remotely. It also allows the operator to keep well clear of the job. The ram and accessories will work in any position, even under water.

Power is applied to an attachment by closing the release valve that leads to the attachment and operating the hand lever on the pump.
1. Familiarise yourself with your Unit's hydraulic rescue equipment. Attach and operate all the accessories. Practise bleeding the system.

2. Lift and stabilise different objects using hydraulic rescue equipment.

**Complex cutting tools**

You may be asked to use specialised cutting tools to stabilise a structure, get through (breach) obstructions or build shoring systems. Different Units have different tools and you need to be familiar with those used by your Unit.

When cutting take care to avoid cutting through concealed services such as gas, water pipes or electrical wires.

### TOOL SAFETY NOTES

<table>
<thead>
<tr>
<th>TOOL</th>
<th>SAFETY NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary saws (Quickcut)</td>
<td>Never use in tight spaces or in areas where an explosion is likely. Wear eye, ear and hand protection.</td>
</tr>
<tr>
<td>Circular saws</td>
<td>Keep the electrical cord away from the blade.</td>
</tr>
<tr>
<td></td>
<td>Wear eye and ear protection.</td>
</tr>
<tr>
<td>Angle grinders</td>
<td>Keep the electrical away from the blade.</td>
</tr>
<tr>
<td></td>
<td>Wear eye, ear and hand protection.</td>
</tr>
<tr>
<td>Jig saws</td>
<td>Keep the electrical cord away from the blade.</td>
</tr>
<tr>
<td></td>
<td>Wear eye and ear protection.</td>
</tr>
<tr>
<td>Power drills</td>
<td>Keep the electrical cord away from the drill bit.</td>
</tr>
<tr>
<td></td>
<td>Wear eye and ear protection.</td>
</tr>
<tr>
<td>Hydraulic cutters</td>
<td>Wear eye and hand protection.</td>
</tr>
</tbody>
</table>

If your Unit uses other tools, read the manufacturer's specifications and familiarise yourself with the tools.
Activity 4.4 Using Equipment

Keeping these specifications in mind, practise the following:

1. Using each tool correctly and safely.
2. Where applicable, maintaining and/or fitting replacement parts.
3. Cleaning each tool.
4. Storing each tool.
5. Completing any relevant paperwork.

4.7 SHORING

Shoring is a method of stabilising a collapsed or damaged structure with timber, metal frames and trusses or acrow props.

Shoring by rescue teams is normally only to:

- enable emergency personnel to carry out their duties with safety;
- prevent further injury to casualties; and
- prevent danger to the public through the collapse of the building onto a roadway or other public place.

Temporary shoring

As you move through a collapsed structure you may have to build shoring systems to stabilise crawl ways, tunnels, voids, walls or ceilings. Various types of shoring are used for these tasks.

Prior to temporary shoring

- Make sure you have enough timber.
- Stockpile the timber in a staging area.
- Clear the area of debris.
- Stockpile debris so it can be sorted for evidence and personal articles.
- Monitor foundations at all times for movement.
Types of shoring

The four main types of shoring are:

- raking shore
- flying shore
- dead or vertical shore
- crib shore.

Raking shore

A raking shore is used to prevent a wall or vertical part of a building from bulging or falling away.

<table>
<thead>
<tr>
<th>MAX HEIGHT (m)</th>
<th>RAKER (mm)</th>
<th>WALL-PLATE (mm)</th>
<th>SOLE-PLATE (mm)</th>
<th>STRUT (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>100 x 100</td>
<td>240 x 50</td>
<td>240 x 75</td>
<td>100 x 50</td>
</tr>
<tr>
<td>6.0</td>
<td>125 x 125</td>
<td>240 x 75</td>
<td>240 x 75</td>
<td>100 x 50</td>
</tr>
<tr>
<td>7.5</td>
<td>150 x 150</td>
<td>240 x 75</td>
<td>240 x 75</td>
<td>150 x 100</td>
</tr>
</tbody>
</table>
**Note**
These can be either of solid timber, size as stated, or can be made up by laminating timbers, i.e. 100 mm x 50 mm joists, strapped and dogged together, would form a 100 x 100 raker. (Dogged means to hold or fasten with a mechanical device, e.g. with a clamp or something similar.)

**Building a raking shore**

**Wall-plate**
Where possible, the wall-plate should be continuous throughout its length.

1. Back the wall-plate with timber pieces to ensure it lies flat on a bulging wall.
2. Nail a cleat to the wall-plate where it meets the head of the raker.
3. Secure the wall-plate to prevent it sliding upward as the raker is tightened into place.
4. When the cleat is nailed in position, hold the wall-plate against the wall, while securing the raker.
1. Place the sole-plate so a right angle is formed when the raker is tightened up.

2. Never tighten with a hammer, rather:
   - cut a small rebate from the foot of the raker;
   - insert a lever for tightening up as shown below; or
   - insert opposing wedges between the foot of the raker and a cleat on the sole-plate.

3. To give the necessary angle:
   - soft ground can be excavated sloping toward the unsafe wall;
   - on hard ground, build up the sole-plate.

4. Alternatively, you can build a sole-plate by using a plank as wide as the wall-plate.

5. When the bottom of the wall-plate is touching the ground, allow it to rest on the end of the sole-plate nearest the wall.

6. Nail a cleat into position in the right angle between the raker and the sole-plate. The cleat should be nailed on to the sole-plate about 50 mm away from the foot of the raker (to allow for the wedges between the cleat and the raker).

7. Be careful when the wedges are placed in position and tightened that the wall-plate does not ride up the wall.

8. Secure the end of the sole-plate outside the raker using a stake or spike to prevent movement.
**Strut (or brace)**

1. Fix the strut next. This prevents any movement by the foot of the wall-plate and stops the wall-plate from riding up the wall under stress.

2. The strut should be spiked or if necessary, dogged to the raker and the wall-plate.

Take care during the setting out to make sure the centre line of the raker and the centre line of any load bearing joists meet at a common point.

You can prevent the wall-plate from riding up the wall by using:

- window sills;
- oversailing brick courses; or
- spikes placed in ventilator bricks.

The best angle to achieve when locating the raker is $30^\circ$ at the head and $60^\circ$ at the foot.

**Flying shore**

A flying shore is used to brace a damaged wall when a sound adjacent wall can be used as a means of support.
Suitable sizes for these are given below.

<table>
<thead>
<tr>
<th>MAX HEIGHT (m)</th>
<th>HORIZONTAL BEAM (mm)</th>
<th>WALL-PLATE (mm)</th>
<th>STRUT (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>150 x 100</td>
<td>175 x 50</td>
<td>100 x 100</td>
</tr>
<tr>
<td>4.5</td>
<td>150 x 150</td>
<td>175 x 50</td>
<td>100 x 100</td>
</tr>
<tr>
<td>6.0</td>
<td>150 x 150</td>
<td>240 x 50</td>
<td>100 x 100</td>
</tr>
</tbody>
</table>

**Building a flying shore**

You should always set the job out on the ground first to get the measurements and angles right.

1. Nail the cleats to their positions on the wall-plates; the first pair to support the horizontal shore and the other pairs to the support struts.

2. Make sure the cleats for the horizontal beam adjacent to the sound wall are thick enough to allow for the folding wedges and a good overlap by the beam.

3. Try to give the horizontal beam equal cleat-bearing surface at each end.

4. Set the struts at an angle greater than 45° to the horizontal beam, and keep them apart on the horizontal beam by straining pieces. The length of these straining pieces is determined by the length of the horizontal beam.

5. While the wall-plates are being held in position, place the horizontal beam with the straining pieces temporarily lashed to it on the centre cleats.

6. Tighten by folding the wedges inserted between the shore and the wall-plate.

7. The struts are then placed into position between the cleats and straining pieces, being tightened by wedges.
Place wedges (if necessary) between the tops of the lower cleats and the lower struts.

The centres of the horizontal beam and struts meet at a common point.

The wall-plates should be continuous, packed between the wall and the wall-plate if necessary.

A flying shore should only span distances up to 7.5 m. Flying shores should be placed along a wall at intervals of 2.5 to 3.5 m, depending upon the circumstances and the degree of damage.
Dead shore

A dead shore carries the vertical load of a wall or floor. It should be built when rescue personnel are working below a wall, ceiling or floor that is in danger of collapsing.

Dead shores are labour intensive to build. Crib shores may be a simpler option.

Acrow props are designed for use as dead shores (see later in this topic).

The capacity of a dead shore depends on the configuration, height and materials used.
**Building a dead shore**

1. Lay the sole-piece in position on a solid foundation.

2. Hold the head-piece in position.

3. Place the vertical shores upright between the head-piece and the sole-piece.

4. Securely wedge the vertical shores using pairs of opposing wedges, inserted between each shore and the sole-piece.

5. All wedges should be tightened simultaneously. Before you attempt to tighten folding wedges make sure the wedge tips overlap.

6. When braces are necessary, they should be:
   - long enough to extend diagonally from the headpiece across the vertical shore to the sole piece; and
   - nailed to each in turn.

Dead shores may carry the full weight of the structure above, whereas raking and flying shores mainly oppose a threat of collapse. It is therefore very important to have a solid bearing for the sole-piece. The sole-piece must be as broad and as long as possible to spread the load.

When you are selecting the vertical shore, remember the length of each is the distance between the ceiling and floor less the thickness of:

- the head-piece;
- the sole-piece; and
- about two-thirds of the thickness of wedges.

It is fairly difficult to estimate what load a vertical shore will carry, but the following rules may help:

1. The shorter the length, the greater the load capacity.

2. Stability is increased if the ends are cut square to fit on the head and the sole piece.

3. Take care not to drive wedges too tightly to avoid them having a lifting effect.
Acrow props

You may need to use an acrow prop to strengthen a building/structure or prevent it from further collapse.

Acrow props components:

- head and base-plate
- inner tube
- outer tube
- thread
- nut.

It is important not to grease the thread, as dirt will stick to it, making it hard to use. Use graphite powder to lubricate the prop.

Acrow props can be used vertically, horizontally and at different angles, provided you use the optional swivel tilt bases.
Method for vertical position
1. Secure wooden base-plates to the acrow prop (if required).

2. Set up the acrow prop in a vertical position, checking that it is level and safe.

3. Make sure the acrow prop is centrally located under the load.

4. Use the screw on the acrow prop to expand (lengthen) it and make the structure safe.

Method for horizontal position
1. Secure wooden base-plates to the acrow prop (if required).

2. Set up the acrow prop in a horizontal position, checking that it is level and safe.

3. Make sure the acrow prop is centrally located between the load and the support.

4. Use the screw on the acrow prop to expand it and make the structure safe.

Method for diagonal position
1. Secure wooden base-plates to the acrow prop (if required).

2. Set up the acrow prop in a diagonal position, checking that it is level and safe.

3. Make sure the acrow prop is centrally located between the load.

4. Use the screw on the acrow prop to expand it and make the structure safe.

Note
All three methods must have the load square to the base and head of the acrow prop to support the load.
**Safety with acrow props**

- Wear gloves, helmet, safety footwear and eye protection.
- Check that the ground underneath the acrow prop is level and firm.
- Check the acrow prop for bends and dents before use.
- Make sure the high tensile prop pin is with the acrow prop.
- Make sure the base plate-and top plate are secured and not damaged.
- Make sure the base-plate and top-plate cannot sink or rotate.
- Make sure the acrow prop is free of, grease, grit and grime.
- Never pull out a pin unless it is safe to do so.
- If possible, use a number of props to make the situation safe.
- Never use an acrow prop as a lever or as a club. This will damage the prop, particularly the threads and tubes.
- Never use an acrow prop to move anything.
- Acrow props are to be used to make safe buildings, walls, roofs, etc. They should only be tightened to the point of making safe, and not to return anything to its original position.

**Crib shores**

Crib shoring is the most common type of shore used.

- They have the highest capacity of all the shoring systems to carry weight.
- They are relatively simple and quick to build.

The bottom layer should be solid to spread the load, especially on soil or asphalt paving.
The basic size is 100 mm x 100 mm timber, cut to length depending on the load and the structure to be shored. Timbers can be from 0.3 m to 5 m in length.

Approximate weight bearing capacities for different stack-cribbing heights are:

<table>
<thead>
<tr>
<th>CRIB POINTS</th>
<th>TIMBER</th>
<th>HEIGHT</th>
<th>SUGGESTED SUPPORTING WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 2</td>
<td>100 mm x 100 mm</td>
<td>3 x footprint</td>
<td>12 tonnes</td>
</tr>
<tr>
<td>3 x 3</td>
<td>100 mm x 100 mm</td>
<td>3 x footprint</td>
<td>24 tonnes</td>
</tr>
<tr>
<td>2 x 2</td>
<td>150 mm x 150 mm</td>
<td>3 x footprint</td>
<td>30 tonnes</td>
</tr>
<tr>
<td>3 x 3</td>
<td>150 mm x 150 mm</td>
<td>3 x footprint</td>
<td>60 tonnes</td>
</tr>
</tbody>
</table>

**Material and capacity**
Always use good-quality, construction-grade timber. Oregon makes excellent cribbing material and is the recommended timber. Pine and cedar are softer material and have less load bearing capability. Softwood cribbing has a tendency to bite into the load and itself when weight is applied.

Hardwoods, although excellent for strength, are heavier and can crack under strain, thus reducing their effectiveness. Hardwood gives more advance warning of material failure, i.e. you will hear it cracking.

- **4-point crib (2 x 2)** The layout is with 4 points of contact. It can withstand an approximate capacity of 30 tonnes.
- **9-point crib (3 x 3)** The layout is with 9 points of contact. It can withstand an approximate capacity of 60 tonnes.
- **Solid crib (8 x 8)** The layout can withstand an approximate capacity of 576 tonnes. This type of crib has one large point of contact.
Stability
Box cribbing stability is excellent as long as the height of the crib is no more than three times its width. You need to overlap corners a minimum of 250 mm (or the width of the timber) to guard against splitting the corners of individual pieces.

Angle cribbing
Cribs can be erected in almost any shape. As long as the bearing points have full contact on the tier below, they will hold up properly.

The double angle crib is useful when working around structural members and for spaces with limited access. This is not a very stable crib, so build it to a height no greater than its width.

Activity 4.5 Shoring
Use a range of hand tools and complex tools to construct different types of shores for rescuing people trapped beneath unstable debris.
4.8 DEBRIS TUNNELLING

Tunnelling is primarily for connecting existing voids. It is slow and dangerous work and should only be done after all other methods of reaching casualties have been tried.

- Tunnelling should be carried out from the lowest possible level and should not be used for general search.
- Tunnelling may be used to reach a point such as a void under a floor where a further search is to be conducted.
- Rescue teams may also have to remove people from under collapsed basement walls or from basements still intact but with exits closed by debris.

Debris tunnelling
**Timbering and lining tunnels**

The recommended method for building a debris tunnel is to use frames and fore poling.

![Typical section](image)

*Note 1, 2 and 3 are permanent frames, 4 is a temporary frame.*

**Triangular tunnel**

Rescuers must not enter tunnels which are contaminated or thought to be contaminated with toxic gases or deficient in oxygen. In these cases, advise the Fire Service, who are equipped to enter such spaces.
Warning signals
All rescuers involved in tunnelling operations must wear lifelines for signalling.

Lifeline signals
The standard lifeline signals are:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>One pull</td>
<td>Stop (if travelling) OK (if at rest).</td>
</tr>
<tr>
<td>Two pulls</td>
<td>Advance.</td>
</tr>
<tr>
<td>Three pulls</td>
<td>Retreat, come out at once (from the outside).</td>
</tr>
<tr>
<td>Continuous</td>
<td>Distress, need help.</td>
</tr>
</tbody>
</table>

A signal system must be agreed to by all on site.

Audible signals

<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three short blasts</td>
<td>Evacuate.</td>
</tr>
<tr>
<td>One long blast</td>
<td>Cease operations, all quiet.</td>
</tr>
<tr>
<td>One long blast followed</td>
<td>Resume operations.</td>
</tr>
<tr>
<td>by one short blast</td>
<td></td>
</tr>
</tbody>
</table>

Trenching
Frequently an open trench can be completed more quickly than a tunnel, if debris is not piled too high. All trenches deeper than 1 m must be shored.
Breaching walls

- When cutting through walls, be sure that support beams and columns are not weakened.
- When cutting or hammering away wall sections, take care to prevent further collapse.
- With all walls and floors, except concrete, the best method is to cut a small hole and then enlarge it.
- With concrete, it is better to cut around the edge of the section to be removed.
- If the concrete is reinforced, the reinforcing bars can then be cut by hacksaw, torch or bolt cutters and the material removed in one piece.
- Keep a fire extinguisher nearby if you are using any type of power tool.

Activity 4.6 Tunnelling

Use a range of hand tools and complex tools to tunnel beneath a secure structure.

Quick Check

Having completed this topic, are you able to:

- describe building types and their features;
- describe and identify various collapse patterns found in damaged buildings;
- remove debris;
- lift and stabilise loads using heavy equipment;
- build shoring systems;
- build debris tunnels.

If you have answered NO to any of these questions, ask your trainer for help.
TOPIC 5: RESCUE FROM HEIGHTS AND DEPTHS

LEARNING OUTCOMES

On completion of this topic, you should be able to:

- use basic lowering techniques;
- use techniques to rescue from heights;
- use techniques to rescue from depths.
Heights and depths rescue may include rescue from the heights of a roof top, a window in a building, or from the depths of a mineshaft or lift well, using ropes for access and life support.

The scene

The people that are still trapped in the collapsed building have been located and a rescue team has been tasked to look for casualties over a ledge (below a balcony) that had collapsed with part of the building.

The first members of the team make contact with the casualty and lower a team member over using what resources they have.

Once the remainder of the team arrives with additional resources, they set up to retrieve or lower the casualty and the rescuer who went down to give first aid.

They find that the load on the main rope is too much for them to pull on with just the casualty, so they must build a mechanical advantage into their system.

While the team is concentrating on their task at hand, more teams arrive and find that many more casualties are located under floors and down lift wells. The edges of these structures are unsafe and could give way at any time.

To overcome this, they decide to construct a jib and a series of rescue frames to access the casualties and retrieve them from below the structures.

Casualties have been found on partially destroyed floors above the rescuers, so ladders are erected and a series of ladder slides and hinges are used to lower them safely to the ground.
If you are likely to be in the danger zone for any reason, you must set up a safety system, either using a barrier or safety lines. The simplest improvised safety line is a loop tied around your waist. If you use a natural fibre rope, tie a bowline. If you use a synthetic rope, tie a figure of eight loop.

**Bowline**

A bowline is a non-slip loop or bight at the end of a laid rope.

**Method 1**

1. Hold the standing part of the rope in the left hand.
2. Form a small loop over the top of the standing part (running in an anti-clockwise direction).
3. Hold in place with thumb of left hand.
4. Pass the running end up through the loop, around behind the standing part and back down through the loop.
5. Dress and pull tight.
**Method 2**

1. Place the standing part of the rope across the palm of the left hand, with the running end towards you.

2. Place the running end across the standing part at 90°, running from right to left.

3. Place right index finger on top of the running end and thumb under the standing part.

4. Twist your wrist away from you, forming a loop in the standing part running in an anti-clockwise direction to the right and on top of the standing part.

5. Pull the running end up through the loop, around behind the standing part and back down through the loop.

6. Dress and pull tight.

**Improvised single point lower**

Use this technique when you don’t have descent or lowering equipment but you have to evacuate a casualty immediately, e.g. in a fire.
Method
1. Take two turns around a sound anchor point as a belay.
2. Pay out the rope hand-over-hand (rescuers must wear gloves while lowering).

Where possible at least two rescuers should control the lowering rope.

Harnesses
If you are working at heights, over depths or anywhere in the danger zone, you must wear a properly fitted climbing or rescue harness.

Types of harnesses

Adjusting your harness
With many harnesses, the strap buckles must be secured by 'double threading'.
**Waist belt loops**
Most harnesses are equipped with cord loops around the waist belt and sometimes at the back of the harness.

![Diagram of waist belt loops]

Securing harness buckles

These loops are intended only for carrying spare karabiners and other equipment, and must never be used for any other purpose.

**Improvised harnesses**
There are a number of ways to improvise a harness out of tape slings.

![Diagram of improvised harness]

Parisian baudrier
Tape knot
A tape knot is the only safe knot for joining climbing tapes.

Method
1. Tie one thumb knot near one tape end.
2. Take the second tape end through the original knot in the opposite direction.
3. Dress the knot. A tail of at least 75 mm should be left hanging from each end of the knot.

Attachment knots
The figure of eight loop or figure of eight on the bight are non-slip knots especially useful for synthetic fibre rescue ropes. It can be used to attach to a harness or karabiner. The figure of eight knot is the first part of the figure of eight loop.

Figure of eight knot
Used as a stopper knot to:
- stop a rope passing through a pulley;
- temporarily prevent fraying of a rope end.

Method
1. Take the standing part in the left hand, palm upward and the running end in the right hand.
2. Pass the running end over the top of the standing part, making a loop.
3. Carry on with the running end around behind the standing part, over the top, then down through the loop.
4. Dress and pull tight.
**Figure of eight on the bight**

1. Double the rope and make a figure of eight.

2. Place the loop over the object or connect with a karabiner.

**Figure of eight loop**

1. Tie a single figure of eight knot.

2. Pass the running end around the object.

3. Take the running end and follow the path back that the running end took, but on the inside of the original figure of eight.

4. Dress and pull tight.

**Karabiners**

Known also as krabs or biners, these are the most commonly used piece of hardware in rescue from heights and depths.
Accidental gate opening
The main job of a karabiner is to maintain its link with the other elements of the rescue system. To do this, the karabiner gate must remain securely closed. There are several ways in which karabiner gates may open accidentally. The most common situations are where:

- the karabiner is pressed against an edge or surface, forcing the gate open (see below).

![Image of karabiner pressed against an edge]

- a rope or section of tape is pulled across the karabiner gate, forcing it open (see below).

![Image of rope pulling across karabiner gate]

- the karabiner is used upside down where gravity may force the screwgate to come undone.
Using karabiners safely
Karabiners are designed to be loaded along the major axis or spine:

The gate is the weakest point of a karabiner. Any side loading severely reduces its strength and may cause it to fail. Never cross-load a karabiner.

Danger
Always make sure the karabiner gate is closed and locked. You should tighten the screw sleeve then back it off a quarter turn to prevent it locking shut.
The most common form of rope damage is from abrasion, caused when a loaded rope is raised or lowered across a rough or sharp edge. This can happen very fast and pose a very serious safety risk. Ropes should always be protected from sharp or rough edges using special edge protection devices or improvised protection.

Improvised protection can be a sandbag or sacking, full-size tarpaulin or similar material.

Rope protectors
Unlined canvas fire hose can be used as a rope protector. You can slit the hose lengthwise and sew in a Velcro closure to make an easy-to-use protector. A reinforced eye or grommet at each end is useful for tying the protector to a fixture so it doesn’t slide down the rope.

A rope protector can also be manufactured from sections of any durable and abrasion-resistant material.
Two-point vertical suspension

A two-point vertical suspension is used to raise or lower a stretcher over relatively short distances, where the casualty’s injuries allow.

Method:
1. Make sure the rescuers at height are secured from falling.
2. Secure lowering lines to the head of stretcher.
3. Use the same procedure for the guide lines at the foot of the stretcher.
4. Two rescuers above pass out the guide lines to two rescuers on the ground.
5. The two rescuers above ease the stretcher over the edge of the wall, until they come to the lowering lines with which they lower away hand-over-hand.
6. The two rescuers on the ground guide the stretcher clear of any obstructions and walk the guide lines to support the stretcher on either side as it comes down.
This technique can be used inside a building using a hole found or cut in the floor. If possible, do not cut through floor joists as it takes longer and weakens the whole structure. Four rescuers form the ideal team for the job. Additional rescuers can help in hauling or lowering the casualty.

Using a basket stretcher
1. Tie the ropes for hauling or lowering to the stretcher with a figure of eight loop, formed over the top rail (horizontal) and behind the appropriate cross frame.

2. Take the rope several times in a spiral manner around the top rail (horizontal) as shown below to distribute the load laterally along the rail.

3. Guide lines are secured in the same way.

Using a folding stretcher
1. Using a folding (furled or Mark 2) stretcher for rescues from heights or depths is an improvised technique when no other rescue stretcher is available.

2. Tie the hauling ropes to the stretcher with a figure of eight loop through the D and handle, with a half hitch around the small of the handle.
3. Where the stretcher Ds are set in toward the centre of the folding stretcher, tie the figure of eight loop through the D and half hitches around the handles to bring the lowering ropes to the correct position at the stretcher head.

4. Guide lines are secured in the same way.

Securing lowering lines/guide lines

**Four-point horizontal suspension**

A four-point horizontal suspension is a simple way to lower a casualty horizontally through a hole or into a space. Rig the stretcher and attach lowering lines in exactly the same way as for the two-point suspension:

1. Find or cut a suitable hole in the floor.
2. Raise or lower the stretcher.
3. Further rescuers may be required to receive the stretcher.
Knots for improvised stretcher operations

You can use a bowline on the bight or a chair knot for improvised stretcher operations.

**Bowline on the bight**
The bowline on the bight is a useful and adaptable loop. It can be used as a non-slip loop, temporary anchor (safety line), improvised chair knot or a four legged sling.

**Method**
1. Halve the rope (centre of a rope).
2. Take the double rope in your left hand.
3. Form a small loop with both ropes over the top of the standing part (in an anti-clockwise direction).
4. Hold in place with thumb of left hand.
5. Pass the running end loop up through the small loop (anti-clockwise loop in the standing part).
6. Pass the running end loop back down over the bight, continue up around and on top of the first loops placed in the standing part.
7. Dress and pull tight.

**Chair knot**
The chair knot is a useful and adaptable knot that can be used as a four-legged sling.

**Method**
1. Grasp the rope near the centre, with the rope lying across both hands.
2. Form two loops (loops upward): one loop in the left-hand anti-clockwise direction (in front of the rope), one in the right-hand anti-clockwise direction (behind the rope).
3. Overlap the loops (without crossing the ropes) and pull each loop through the other.
4. Adjust each loop to suit.
5. Tie a half hitch around both adjustable loops.
6. Dress down and pull tight.

Activity 5.2
Two or Four-point Techniques

Prepare an edge, then lower casualties by hand using two or four-point techniques.

Use each of the improvised lowering knots to raise or lower the casualty.

5.4 RESCUE FROM DEPTHS

Knots for rescue from depths

Alpine butterfly
An alpine butterfly forms a loop or bight along the length of a rope and gives a three-way loading.

Method 1
1. Pick up a bight of rope.
2. Twist the bight of rope twice.
3. Hold both crossovers.
4. Pass the free end of the bight (formed loop) behind both the crossovers.
5. Continue it over and down through the opening formed between the two crossovers.
6. Hold the knot in one hand, dress and tighten.
Method 2
1. Place standing part across the palm of the left hand.
2. Take two turns around your hand.
3. Pick up the standing part (in palm of hand) and place in the centre of the loops (loops around hand).
4. Pick up the first loop, place over the top of both loops (towards fingers), pass under both loops and pull back towards wrist.
5. Placing left thumb through the loop, slide off hand pulling both ends forming a knot.
6. Pull both ends in opposite directions, dress down and tighten.

Fisherman’s bend
A fisherman’s bend can be used to anchor synthetic laid rope. This is not a suitable anchor knot to sustain a life load.

Method
1. Take a round turn around the anchor point, bringing the running end out under the standing part.
2. Feed the running end through the two round turns from the top.
3. Finish off with two or more half hitches around the standing part.
**Double sheet bend**
A double sheet bend is used to join two laid ropes of unequal size. This is not a suitable knot for joining ropes that sustain a life load.

**Method**
1. Form a loop (tail inward) in the thicker rope.
2. Hold loop in one hand.
3. Pass the running end of the other (smaller) rope up through the loop around behind both thicknesses of the thicker rope (in an anti-clockwise direction), around and back under itself.
4. Continue around the two thicknesses of rope again, equal tails (200 mm) coming out on opposite sides.
5. Dress and pull tight.

**Casualty full body harness**
Rescue harnesses have dynamic fall arrest capability. Most industrial safety harnesses are NOT suitable for rescue; however, they may be used for low-risk static load situations.
Descenders and ascenders – raising and lowering techniques

You can use a range of mechanical tools to control a load you are raising or lowering. These tools are called in-line descenders (rescue Goldtail or Whaletail) or ascenders (a range of proprietary products).

Safety

◆ Keep all lowering operations slow, smooth and controlled to prevent excessive heat buildup in the descender (which could damage the rope).

◆ Hard braking or jerking during a lower can put undue shock loads on the rope.

◆ Ensure safety gates are properly located and secured on all descenders.

Descenders

Descenders are friction devices which are used in conjunction with ropes to enable controlled lowering of a load.

The descenders most commonly used in rescue are the:

◆ rescue Goldtail, and

◆ rescue Whaletail.

The rescue Goldtail and rescue Whaletail have rated strengths in excess of 2500 kg.
**Ascenders**
You can use an ascender as a personal safety attachment and as a safety brake. This device has good grip, even on wet or muddy ropes, and has little rope drag as it moves along the rope.

![Ascenders](image)

The connecting point between the ascender and the rope is the weakest point of the system. Under static loads, most ascenders will cut into the rope sheath and slide before they fail. The sliding motion is normally stopped by the sheath bunching up below the cut.

**Danger**
Avoid any form of shock loading.

**Hauling and lowering stretchers**

**Whistle signals**
Standard whistle signals should be used at all times:

<table>
<thead>
<tr>
<th>SIGNAL</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>One sharp blast</td>
<td>Stop</td>
</tr>
<tr>
<td>Two sharp blasts</td>
<td>Haul in</td>
</tr>
<tr>
<td>One long blast, fading away the end</td>
<td>Lower</td>
</tr>
</tbody>
</table>
**Lift or lower**
Wherever possible casualties should be recovered in a horizontal position, with the stretcher supported by a four-point lifting bridle. The situation may dictate a vertical lift, subject to the casualty’s injuries.

Hauling is carried out by attaching a harness or sling to four points of the stretcher so that it is in a horizontal position (or slightly head up) when suspended.

**Direct attachment**
Rig the direct rope attachment by taking the rope in through the head of the stretcher and around the first frame and the top rail on one side. Then take it around the top rail and the inward leg of rope to the first frame on the other side, then back out the head of the stretcher. This results in a braided attachment that distributes the load.

The rope is tied off using a pre-rigged figure of eight loop so that the angle formed by the two legs of rope at the knot should be less than 60°.
**Wraparound stretchers**

Many Units are equipped with wraparound stretchers, such as the Paraguard and the Fallright evacuation splint. These stretchers are designed for rescue from depths, e.g. inside a mine shaft where there is little room to move.

**Paraguard stretcher and wraparound stretcher**

Wraparound stretchers fit very closely to the casualty's body, making them very useful in tight space operations.

**Rescue frames**

There are four types of improvised rescue frame used to lift and lower loads:

- standing derrick
- jib
- ‘A’ frame (or sheer legs)
- tripod.

These frames are built from timber poles. Vertical poles are called ‘standards’ and horizontal poles are called ‘ledgers’.
Standing derrick

A standing (or pole) derrick is a single heavy duty spar or pole with the butt on the ground or on a solepiece, and the pole held vertical by three or four guy ropes. A short crosstree (or cross head) about 500 mm long is lashed with a square lashing about 500 mm from the top of the derrick pole to support the lifting tackle. This derrick can lift a load and move it right, left, or forwards. The shorter the length of pole bearing the load, the greater the load it can carry.

The distance of the guy anchors from the foot of the derrick should be equal to twice the height of the derrick if possible, but never less than the height of the derrick.
Building a standing derrick
Rig the head of the derrick with a pulley secured with a 10 mm chain or sling. Pass the load rope through the pulley and through a redirection pulley lashed to the foot of the derrick pole if required. Make sure the pulleys and hooks in the system are moused.

1. First, position the foot of the derrick. Remember to allow space to luff (move forward or backwards) the derrick.

2. Ensure the derrick is on stable firm ground. You may need to make a shallow hole for the butt of the derrick pole. If the ground is too soft to withstand the pressure of the butt, you can build a footing of timber baulks to spread the load over a large area of ground.

3. Take care to prevent the butt from kicking back, particularly when luffing.

4. Position the guy pickets and drive them in. Rig the derrick head, overhaul the tackle to the required length and temporarily lash the lower block to the pole.

5. The initial raising is done by taking in the slack on the guys. The guy at each picket is controlled with a round turn on the anchor and finally made fast with a round turn and two half hitches.

Luffing
◆ One of the advantages of the standing derrick is its ability to move the load by luffing.

◆ The maximum luff must not exceed \( \frac{1}{3} \) the height of the derrick with a load.

◆ The maximum reach of the luff must not exceed \( \frac{1}{5} \) the height of the derrick with a load.

Activity 5.3
Standing Derrick
Build and use a standing derrick, practising the role of each team member.
Jibs

A jib for rescue consists of a pole projecting about 1 m horizontally out from a structure, with a snatch block or pulley attached to the end, through which is reeved a lowering rope. The material used for the jib must be strong enough to allow about 1 m projection to bear all the weight.

Options for rigging a jib
Setting up a jib

Before pushing the jib pole out, the pulley must be secured. To do this:

1. ‘Middle’ a short rope or climbing tape and tie the middle of the lashing to the hook (snatch block) or to a karabiner that attaches to the eye of a pulley using a clove hitch.

2. Cross the two running ends over the top of the pole about 300 mm back from the end.

3. Take two or three cross-over turns around the pole and through the hook or eye.

4. Frap the centre of the lashing, again using the cross-over turns and finish off.

5. Reeve the rescue rope through the pulley and tie a thumb knot 2 m back from the running end to prevent the rope running back through the pulley. Alternatively, the pulley can be safely and rapidly secured to the jib by means of tape slings and a karabiner.
6. Make sure the load line is reeved through the block so that the running end goes directly to the casualty by the same route by which the casualty will leave the structure.

7. Firmly lash the pole in position, making sure that the pulley is in the centre of the opening and not more than 1 m out from the wall in order to reduce leverage on the jib.

8. Lash the pole as near as possible to the point where it passes over the wall.

9. Secure the other end of the pole to prevent it lifting.

10. Blanket and secure the casualty in the stretcher.

11. Attach two guide lines to the stretcher and pass it down to the rescuers on the ground.

12. Secure a friction lowering device such as Whaletail or Goldtail to an appropriate anchor point.

**Using the Jib**

The lowering operation should be controlled by a rescuer letting rope out slowly and carefully through the friction device.

Where a friction device is not available, at least two (preferably three) rescuers will be required on the load line. When all is ready, the weight is taken on the load line and the two rescuers up top ease the casualty through the opening, feet first.

As soon as possible the rescuers swing the stretcher around parallel to the structure and the rescuer on the load line starts to lower the stretcher.

Where necessary, the guide line rescuers can pull the stretcher out to a clear landing space as it comes down. They should walk in their guide lines to be ready to take hold of the stretcher as it comes within reach.

**Note**

Jibs may also be used to raise casualties.
Activity 5.4 Jib

Build and use a jib, practising the role of each team member.

‘A’ frame

An ‘A’ frame (or sheerlegs) consists of two poles with their butts on the ground and their heads lashed together held in the air by ‘fore’ and ‘back’ guys.

They can be used where a derrick would be impractical and to move a load in a straight line by swinging it between the legs.

For a given load, the two spars which comprise the ‘A’ frame may be lighter than the one required for a standing derrick.
**Building an 'A' frame**

1. Select two poles of about the same length and lay them parallel on the ground with their butts flush together.

2. Prepare a sound footing for the pole butts as for the standing derrick.

3. Insert 50 mm thick spacing inserts between the poles and lash the heads of the poles with a round lashing (using 12 mm lashing).

4. Spread the butts of the poles until their distance apart is about $\frac{1}{3}$ of the length from butt to head lashing.

5. Secure the poles with tape, rope or placed pickets, or by lashing a cross timber (ledger) to prevent the poles from spreading.

6. Pass a sling over the fork of the ‘A’ frame so that it will rest across the poles and not on the lashing between them.

7. Prepare the pulley system and hook it into the sling. Protect the lashing with padding.

8. Place guy line anchors at a distance of not less than twice the height of the sheerlegs from its base. The guys are similar to those required for a pole derrick but consist of only two: a fore-guy and a back-guy, usually of 16 mm laid or 11 mm kernmantle rope.

9. Make the guy lines fast above the round lashing by clove hitches with the fore guy to the rear pole and rear guy to the front pole.

10. Prepare the pulley system to the required length and temporarily attach the lower pulley to one of the poles to prevent swinging. Reeve the hauling rope through a leading pulley secured to the butt of one pole.

**Hauling**

The guy at each picket is controlled by a rescuer using a round turn on the pickets. As the ‘A’ frame is hauled, the slack of the fore guy is taken in. The guys are locked off with a round turn and two half hitches.
**Luffing**

‘A’ frames are luffed by carefully luffing out on one guy and taking in on the other. The team must work in unison under the leader’s direction. The amount of luff permissible is the same as for a derrick (initial luff $\frac{1}{5}$ thereafter $\frac{1}{3}$ of vertical height of rig).

**Round lashing**

A round lashing is used to lash two parallel poles together.

**Method**

1. Insert 50 mm spacers between the poles to keep the poles apart. Do not remove the spacers until the lashing is completed.

2. Start with a clove hitch around one pole and continue with six to eight close turns around both poles, travelling upwards.

3. Make two or three turns around the lashing.

4. Secure with a clove hitch on the opposite pole to the beginning of the lashing.
Activity 5.5
‘A’ Frame

Build and use an ‘A’ frame, practising the role of each team member.

Tripod

A tripod consists of three poles lashed together near the heads with the butts forming an equilateral triangle on the ground. No guys are required and the space occupied is small. A lateral pull or loading will destabilise the tripod and may cause its collapse. The poles used should be of roughly equal length and strength.

Layout and preparation

1. Lay the three poles side by side, the butts flush on the ground. Mark them about 1 m down from the head of the shortest pole to show the position of the centre of the lashing.

2. Reverse the centre pole and place the head between the heads of the other two so that all three marks are in line.
3. Insert 50 mm thick spacing pieces between the poles, and, using 12 mm lashing, lash the poles together with a figure of eight lashing.

4. Remove the spacer blocks and cross the two outer poles until their butts are at a distance apart equal to about half the effective length of the poles. The top of the centre pole should rest in the fork of the other two.

5. Place a sling in the fork of the tripod in such a manner as to bind the poles together when the weight is taken. Make sure the lashing is suitably protected.

6. Secure the redirection device (pulley or karabiner) to the sling.

7. If a pulley system is to be used, over-haul to the required length. Temporarily attach the lower pulley to one of the legs to prevent swinging while the tripod is being erected.

8. Reeve the hauling rope through a redirection pulley secured to the butt of one pole.

**Hauling**

1. Lift the head of the tripod as far as possible by hand and bring in the centre pole to form an equilateral triangle between the butts of the poles.

2. Make sure the butts are evenly spaced at a distance apart equal to about half the height from the butt to the lashing. They must all be on the same level or the weight will be distributed unevenly.

3. Make sure the tripod is placed so that its head is as near as possible over the centre of gravity of the load.

**Securing**

Whether a load is suspended or not, the tripod should not be left standing unless the butts are secured against slipping by one of the methods used for the ‘A’ frame.

**Figure of eight lashing**

A figure of eight lashing is used to lash three poles together.
Method
1. Insert spacers about 50 mm wide between the poles.
2. Start with a clove hitch around one of the outside poles, with the ends married.
3. Working upwards all the time from the first clove hitch, continue lashing in figure of eight fashion with six to eight turns.
4. Make two or three frapping turns around the lashing, repeat in next space.
5. Finish with a clove hitch on the opposite pole to the beginning of the lashing.

![Figure of eight lashing](image)

**Activity 5.6 Tripod**

Build and use a tripod, practising the role of each team member.

**5.5 RESCUE FROM HEIGHTS**

**Ladder hinge**

The ladder hinge is a relatively simple method of rescuing a casualty from an upper floor, where:

- you want to keep the stretcher horizontal;
- the building is too unstable to be used in the operation.

**Method**
1. Blanket and lash the casualty to a stretcher in the normal way.
2. Place the ladder vertically against the wall in front of the opening.
3. One rescuer supports the head of the stretcher, while another lashes the foot of the stretcher to the ladder about 250 mm above the window opening, using a short length of rope.

4. Keep the reinforced side of the ladder away from the structure.

5. Tie a figure of eight loop to one stretcher top rail or handle in the same manner as for a 2-point suspension.

6. Take the rope around the stile of the ladder in a half hitch.

7. Raise the stretcher until it is about 250 mm clear of the window sill.

8. Take 6 to 8 round turns around the ladder rung leaving some slack to form the hinge effect.

9. Half hitch the rope to the stile on the opposite side of the ladder and secure to the other side of the stretcher using a round turn and two half hitches. This hitch is used so that the stretcher may be adjusted for lateral balance.

10. Attach lowering lines to the head of the stretcher, and when all is secure pass the word to the leader who gives the orders ‘Prepare to lower’ and then ‘Lower’.

11. Pass the stretcher out the window by hand until the head end can be supported by the lowering lines.
12. Two rescuers remain close to where the ladder has been footed, ensuring no side-sway develops.

13. One rescuer then walks backwards, hand-over-hand with each rung, controlling the speed of the whole operation.

14. The stretcher should finally come to rest on top of the ladder flat on the ground, from where it can be quickly disconnected and the casualty removed to safety.

This method can also be used to raise a casualty.

Using tape slings and karabiners
An alternative means of forming the 'hinge' of the ladder hinge is by using tape slings and karabiners.

Note
The lowering lines can be controlled by a friction lowering device such as a Whaletail or Goldtail attached to an appropriate anchor point.

Activity 5.7 Ladder Hinge

Practise rescue from heights using a ladder hinge.

Ladder slide
1. Blanket and lash casualty to a stretcher.
2. Secure two lowering lines to the head end.
3. Three rescuers place the ladder in position at as flat an angle as possible.
4. One rescuer foots the ladder and two act as human props.
5. The rescuer then climbs the ladder, taking two pick handles or equivalent sized pieces of wood, one of which is passed into the building.

6. Pass out the foot of the stretcher on to the ladder and place a pick handle through the two bottom stretcher Ds.

**Note**
A basket style stretcher is used without pick handles or timber. Check that the stretcher skids will slide smoothly along the ladder.

7. Move the stretcher down the ladder until the head end passes clear of the opening.

8. Place the second pick handle through the top stretcher Ds and secure it by taking a round turn around the pick handle and a half hitch around the handle of the stretcher on each side with the lowering rope.

9. Slide the stretcher down the ladder. Continue to guide the ladder.

This method can also be used to raise a casualty.
**Safety factors**

As the load on the centre of the span will be close to 150 kg, it is important that the span be shored or propped by two rescuers.

Only use wire or fibreglass reinforced timber ladders for ladder slide techniques.

The ladder must be set at as flat an angle as possible for safety.

Lash the overlap of an extended ladder with a short rope or cord to ensure the ladder doesn’t buckle.

Care must be taken with folding stretchers to keep the casualty's back clear of hauling line pulleys and latching devices on the ladder.

---

**Activity 5.8 Ladder Slide**

Practise rescue from heights using a ladder slide.

**Quick Check**

Having completed this topic, are you able to:

- use basic lowering techniques?
- use techniques to rescue from heights?
- use techniques to rescue from depths?

If you have answered NO to any of these questions, ask your trainer for help.
Evidence Summary Sheet – General Rescue

This sheet is to be used as the summary sheet for individuals. The sections are to be filled in and signed off by the assessor, trainer and candidate when they are completed. Please print everything, except where signatures are required.

Candidate Name: ____________________ Unit: ______________

ID Number: __________

---

Pre-assessment

Candidate has completed formative exercises and assessment activities (Trainer)
Assessment process explained to the candidate (Assessor)
Candidate ready to be assessed (Candidate)

---

Summative Assessment (Assessor use only)

Rescuing Lightly Trapped ☐ Exploring Likely Survival Places ☐
Rescue from Heights/Depths ☐ Hauling/Lowering Systems ☐

RESULT (CIRCLE) Competent Not Yet Competent

(Assessor to list/explain areas for future training to the candidate)

---

Candidate’s Comments
I have been properly briefed and debriefed about this assessment.

Assessor’s Comments
I have provided the candidate with feedback, indicating areas for future development where required.

Signature: ______________ Date: ______ Signature: ______________ Date: ______

---

Original: Coordinating Assessor to submit for processing.
Copy: Candidate

Division Processing Checklist: Entered on database (GRC) ☐ Date: ______
Award issued ☐ Date: ______
Award number ________________

© NSW State Emergency Service 2004 approved by MLD 31 August 2004 General Rescue
### Progressive Learning Record – General Rescue

This sheet is to be used as the summary of progressive learning activities for individuals. The sections below are to be completed and verified by the trainer or activity supervisor.

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Confirmed by: ______________________ (Trainer) Date: ____________

Printed name and signature

**Comments:**