CHAPTER THREE

SAFETY

HAZARD ASSESSMENT

3.01 Storm damage operations can involve personnel operating in potentially hazardous situations. There have been instances recorded of severe injuries and even death directly caused by people working in hazardous conditions during or following storms.

3.02 Hazard assessment is the identification of **all** potentially dangerous conditions that are present on site. The identification of hazards will often take place during a reconnaissance. Reconnaissance is more fully discussed in Chapter Five.

3.03 Storm damage operations require as much care and assessment as any other potentially dangerous rescue operation Although the types of hazards may differ from operation to operation, the assessment method remains the same.

3.04 The potential hazards are not usually confined to one particular area. They are normally spread out over the damage site and its surrounds. Therefore, to ensure that all hazards are identified, it is recommended that a logical progressive survey be carried out starting at one point and working around the site until the whole area has been covered.

3.05 This assessment is the responsibility of the team leader who should carry out the survey personally and make any arrangements to eliminate the hazard or reduce the danger by use of appropriate safety precautions.

3.06 MAKING THE ASSESSMENT

Some hazards may not be readily recognised by simply looking around, so full use of all senses should be made and proper questioning techniques employed:

a **Sight** - Look at the entire site and its surrounds for visual signs of danger.

b. **Sound** - Listen for any signs of danger. (Gas leaking, electric wires shorting out, etc).

c. **Smell** - Be aware of any odours that may indicate a source of danger (Smoke, gas, fuel, etc).

d. **Touch** - Feel surfaces for signs of danger. (Heat, unstable structure, slippery surface, etc).

3.07 TAKING APPROPRIATE ACTION

Once the hazard survey has been done it will probably be necessary to take action to ensure that the hazards present do not endanger emergency workers or members of the public. This action will normally fit into one of these categories:

a. **Elimination** - Action taken to remove the hazard from the area. This could involve clearing debris from the site, removal of fuel, arranging for disconnection of electricity supply, etc.

b **Containment** - Roping off, barricading or sign posting unsafe areas. This action would normally only be necessary if the hazard could not be safely eliminated (eg a building that could possibly collapse, downed power lines, etc).

c. **Reduction** - Reducing the danger by the use of appropriate safety equipment and/or techniques. Safety equipment could include ropes, ladders, gloves, helmets, etc. Techniques may involve the use of methods that lessen the danger. (eg shoring of unstable structures)

d. **Alternative Assistance** - In some situations it may be unsafe or beyond the capabilities of the team to eliminate or reduce the hazard and therefore be able to provide normal assistance In these cases it may be possible to provide other forms of assistance such as the provision of covers for household furnishings when it would be unsafe to effect temporary roof repairs, assisting the householder to arrange for alternative accommodation through other organisations, or arranging for alternative resources to complete the task.

3.08 COMMON HAZARDS

The following hazards are commonly associated with storm damage

a. **Weather Conditions:**

(1) Wind, rain, hail and lightning are obvious weather conditions that pose a hazard to personnel when effecting roof repairs. Temporary repairs should not be attempted while these conditions are severe.

(2) Other weather conditions not commonly thought of as hazards are hot, sunny conditions and cold, wet conditions. These can have a direct bearing on personnel safety.

(3) The enforcement of safety precautions and dress standards along with the provision of adequate rest breaks, food and drinks normally overcomes these problems.

b. **Structural Style and Damage:**

(1) The structural style of the damaged building can be a hazard. Buildings with steeply pitched roofs, multi-storey buildings and the type and age of roofing materials can pose risks to personnel.

(2) The extent and type of damage caused to the building can also be a hazard. Buildings that have suffered structural damage may be unstable because of movement on their foundations. They may have serious damage to roof frame supports causing it to be unsafe to work on the roof area. Buildings that have been struck by lightning can have serious damage to the roof frame without obvious external signs. The framework of these buildings should be checked for damage by carrying out an inspection from the underside of the roof before commencing any repairs.

(3) Debris from a damaged roof can build up on the internal ceiling of the building, putting excessive strain on the ceiling material which also may have been weakened by water penetration. The volume of water built up within the roof also can cause similar problems. Unless the strain on the ceiling can be released, the ceiling could collapse and injure the occupants of the house. If possible remove the debris or release the water and advise the occupants to keep well clear of the area until it has been made safe.

c. **Electrical Power Supply:**

(1) One of the most common hazards associated with storm damage results from the downing of electrical power lines. When these lines contact the ground or a structure (eg fences, roofs, trees, etc) they transmit electrical energy into and through the structure or ground. This could mean that an area around or connected to this electrical energy could cause severe injury or death to anyone who enters the area or comes in contact with the object or structure. This effect can be magnified by the presence of water or in wet/damp conditions.

(2) Just because the power line is not dancing around sparking and arcing does not mean that it is not energised. The presence of any downed power line should be brought to the attention of the electricity authorities and confirmation of the disconnection of the power supply should be obtained before proceeding with any work in that area.

(3) Undamaged overhead power lines can also be a potential hazard, especially where the lines are close to or over the damaged building. Care should be taken with the movement and positioning of ladders, equipment and vehicles when operating under or around these lines.

(4) The internal power supply of a building could also become a hazard if the wiring has been damaged or the circuit has suffered water penetration or been damaged by lightning strike. If in doubt, disconnect the power supply at the main switchboard, or if this is not possible advise the electricity authority

WARNING: The electrical supply authority must be contacted in all cases where there is significant risk from electrical hazards. The building will still be 'live' to the street source even when internal fuses are removed.

d. **Fibrous Products** - When working with fibrous products during storm damage operations personnel may be at risk due to the existence of dangerous airborne particles. A large number of products made from asbestos cement may be found in damaged buildings, houses and structures. These products include flat, corrugated or compressed fibro sheeting, pipes, roofing shingles and guttering. The state/territory workplace health and safety organisations will have codes of practice which deal specifically with working with fibrous products. The following are general guidelines to follow when coming into contact with fibrous products:

(1) Use approved respiratory protection.

(2) Do not use abrasive cutters or dust producing machinery.

(3) Wet down material prior to contact to reduce the production of airborne particles and dust. Work in well-ventilated areas or use breathing apparatus

(4) Minimise disturbance to the workplace in order to avoid the creation of dust.

(5) **Follow all relevant State/Territory workplace standards.**

e. **Surface Conditions** - Varying conditions of the surface of roofing material can pose a hazard such as:

(1) wet, painted, glazed, moss or algae-covered surfaces causing the roofing material to become slippery;

(2) old fibro or tiled roofs that may disintegrate under a person's weight;

(3) metal roofs with loose or protruding sheets that may cause serious lacerations; or

(4) roofs that have been weakened by corrosion or previous damage

f. **Ignition Sources and Fuel** - This type of hazard is rarely encountered, but can be present in the form of:

(1) arcing electricity circuits,

(2) low power supply causing electrical appliances to overheat;

(3) leaking mains or bottled gas; or

(4) leaking or exposed containers of liquid fuel (eg petrol, cleaning liquids, solvents, etc).

g **Trees and Branches:**

(1) Trees, especially shallow rooted trees, can be a hazard. Occasionally trees or branches are weakened by storms and require only minor further disturbance to fall.

(2) Fallen trees also can pose a problem especially if they are precariously supported against a building or other structure Removal of these trees should be attempted only by experienced personnel after they have carefully assessed the situation to eliminate the possibility of causing injuries to persons in the area or further damage to the building.

h **Debris** - The presence of storm-scattered debris can become a potential hazard. Simply trying to work amongst this debris can pose safety problems. If possible remove the debris from your immediate work area

3.09 SUMMARY OF HAZARD ASSESSMENT

a. Hazard assessment is more than just looking around for obvious dangers It involves using all the senses and questioning techniques to identify all potential hazards.

b A properly conducted hazard assessment can prevent serious injury or even death and should be carried out at each individual site regardless of location or urgency.

c The safety of team members and the public is far more important than the protection of property. Personnel should not allow property owners to pressure them into attempting to effect repairs if the hazards present warrant other action.

d. The hazard assessment is for the safety of the team members and public on site, but any delay in the completion of a task or inability to provide assistance because of unsafe conditions should be notified to the tasking headquarters.

FALL PREVENTION SYSTEMS

3.10 GENERAL

Personnel operating on roofs must be protected with some form of safety line system which prevents the rescuer from falling from the roof. It must be stressed that such systems are not 'fall arrest' but rather 'fall prevention' systems designed to maintain the safety of the rescuer at all times.

3.11 A recommended system consists of two main lines (Australian Standard static life rescue line, minimum 11 mm) joined by a large steel 'delta' Maillon Rapide or similar heavy duty link capable of sustaining a three way loading. One or more rope tethers of suitable length static life rescue line are attached to the maillon or link by karabiners, and the main lines are placed across the ridge of the roof as shown in Figure 3:1 (overleaf) so that the maillon sits on the ridge line.

3.12 The main lines must be secured to suitable natural or constucted anchors which are appropriate for the potential load, and tensioned by hand by one person. The main lines must be protected from abrasion and other damage and must meet the ridge line at right angles. The rope tether or tethers must be put in place during the deployment of the main lines.

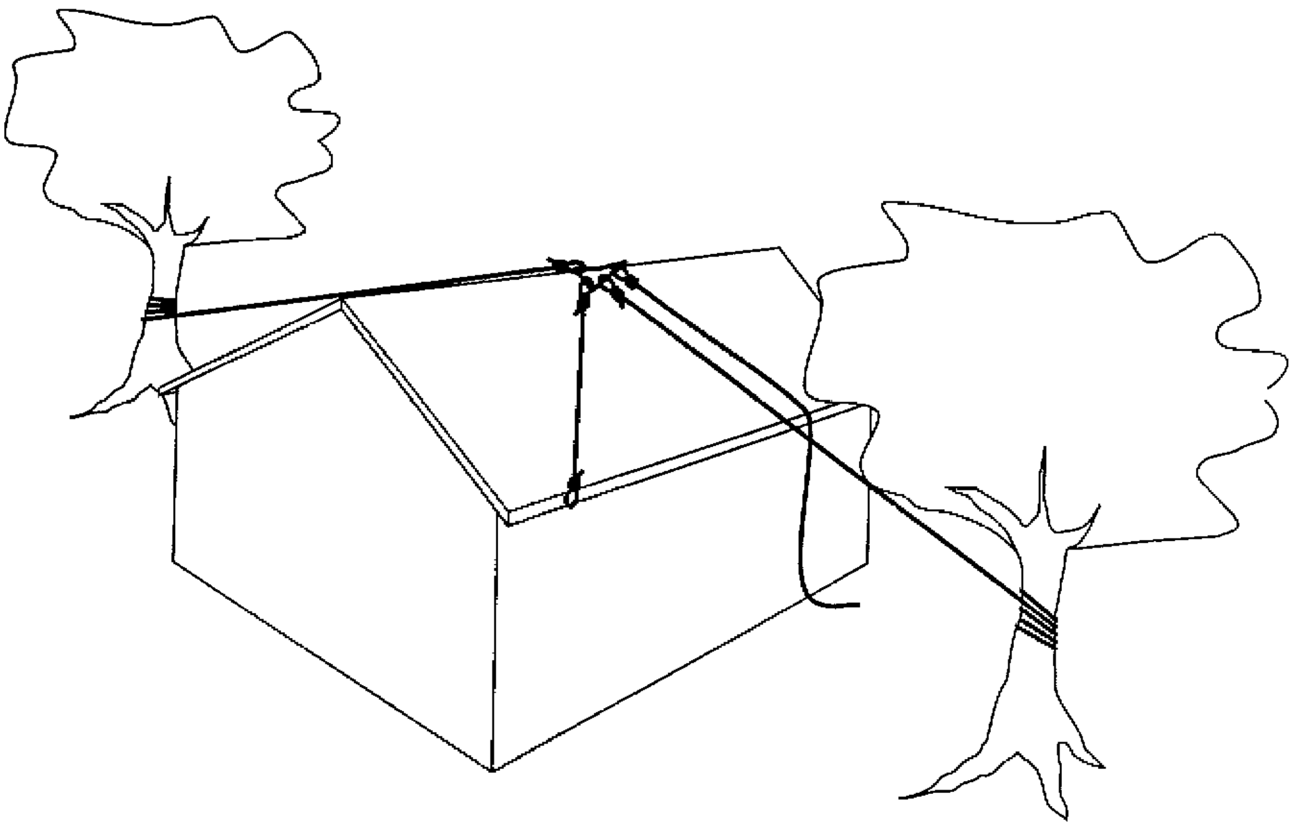


Figure 3:1
Fall Prevention System

3.13 USING THE SYSTEM

The system is used in the following manner:

a. The rescuer is fitted out with an approved vertical rescue harness complete with a mechanical rope ascender and attachment sling to harness or a Prusik loop.

b Ladders are placed to provide access to the roof.

c The rescuer connects to the rope tether by means of the mechanical ascender or Prusik loop and ascends the ladder, advancing the safety attachment on the rope tether to provide safety.

d. On reaching a safe stance on the roof, the rescuer ties an Alpine Butterfly on the rope tether below their attachment point and at such a point on the tether so as to prevent a fall past the roof edge

e. The rescuer may now safely work on the roof by moving the attachment to the rope tether to a suitable position, ensuring that the ascender or Prusik is correctly locked without slack in the tether.

f. The rope tether will allow for safe operation in a wide arc of movement but the rescuer must be aware of the pendulum effect in the event of a fall from a point near the ridge line.

SAFETY RESPONSIBILITIES

3.14 GENERAL

This section deals with the safety points that should be considered in relation to storm damage operations. Most of these points are common safety principles and are related to other types of operations that emergency service members could be involved in. Safety is the responsibility of all members at all levels. Each member has a duty to draw attention to any matter relating to any aspect of safety.

REMEMBER! SAFETY IS EVERYONE'S RESPONSIBILITY.

3.15 The subject of safety responsibilities can be broken into three parts:

a. Unit responsibilities.

b. Team leader responsibilities.

c. Members' responsibilities.

3.16 UNIT RESPONSIBILITIES

a. Unit management has a number of responsibilities that have direct and indirect relationships with safety. These responsibilities include:

   (1) ensuring that members receive adequate training in storm related operational techniques including the use of safety equipment;

   (2) provision of safety equipment;

   (3) formulation of standard operating procedures (SOPs); and

   (4) formulation of standing orders (SOs);

b. The unit responsibility for safety lies mainly in the formulation of safety rules. Some of these rules are based on the policies laid down by emergency services

c. SOPs on safety for storm damage operations should include the following:

   (1) **Dress** - A dress standard should be laid down for storm operations to provide protection for field team members. This standard should take into account the comfort of members working in various weather conditions.

   (2) **Safety Equipment** - Procedures governing the issue and use of safety equipment. This may include the type of equipment and conditions under which this equipment will be used.

   (3) **Safety Procedures** - Standard procedures that cover common situations such as downed power lines or unstable buildings encountered in storm damage operations.

   (4) **Welfare** - Standard procedures for:

      (a) maximum duration teams are to be in the field;

      (b) provision of rest breaks; and

      (c) provision of meals, drinks etc.

d. Another responsibility of the unit management is to ensure that attention is given to specific safety aspects during the briefing of team leaders before commencing operations.

3.17 TEAM LEADER RESPONSIBILITIES

a. Team leaders are responsible for the safety of team members. They also have an obligation towards the safety of members of the public who are on site.

b It is the team leader's job to conduct the hazard assessment and take any action necessary to ensure that the work area is as safe as possible.

c. Specific examples of the safety responsibilities of the any team leader are as follows:

(1) **Training:**

(a) The team leader has a responsibility to provide on-the-job training for team members and should be aware of the experience, level of knowledge and standard of all team members and should provide extra training to increase and/or maintain this level.

(b) Through training, the members will become more confident in their abilities. Being able to use equipment correctly and employ techniques proficiently has a direct bearing on the standard of safety.

(2) **Standard Operating Procedures** - It is the team leader's responsibility to ensure that the standing orders and standard operating procedures of the organisation are followed. Apart from acting as safety officer, the team leader should encourage safe working practice by example.

(3) **Welfare** - The Team Leader is responsible for ensuring that the team's welfare requirements are met. This may involve checking that arrangements have been made for sufficient supplies of food and water, adequate rest breaks, etc.

d. Although the leader has the responsibility for all safety matters within the team, it is impossible to be in all places at all times and therefore team members must be relied upon to exercise safety precautions.

3.18 TEAM MEMBERS' RESPONSIBILITIES

Generally team members have a responsibility to ensure that safety precautions are taken to prevent any injury to themselves or any of the other team members. This is achieved by:

a members realising their own level of competence and ensuring that the Team Leader is informed of any problems that may exist;

b obeying all standing orders and procedures relating to workplace safety;

c. understanding and using safe work practices; and

d. being physically and mentally prepared for the tasks.

REMEMBER! SAFETY IS EVERYONE'S RESPONSIBILITY.

3.19 STANDARD SAFETY POINTS

The following standard safety points should be considered when involved in storm damage tasks.

a. **Weather Conditions** - Personnel should not attempt to effect temporary roof repairs during severe storms, strong winds or heavy rain. Remember, personal safety is more important than property

b. **Structural Conditions** - Extreme care should be taken when working on steeply pitched, high or slippery roofs. Use appropriate safety equipment and techniques. (eg ladders laid up the pitch of the roof and secured at the top and bottom, **safety lines attached to all personnel, etc).**Any building with structural damage should be approached with caution. If in doubt of the security and safety of the structure, don't attempt to effect repairs, but provide alternate assistance if possible

c **Electricity** - Always report any fallen power lines to the appropriate authorities and wait for confirmation of power disconnection before attempting any repairs. **Teams must not attempt to remove downed power lines until it is confirmed that they have been de-energised.** Take care when working with ladders or other long items when operating around overhead power lines.

d. **Equipment** - All techniques and procedures for the safe use of equipment should be observed at all times. Some examples are:

(1) the use of the correct formulas for the determination of safe working loads for rope, steel wire rope and chain;

(2) the use of the correct method to raise, climb and lower ladders; and

(3) the use of the correct methods and techniques for the maintenance and operation of chain saws.

e. **Working at Night** - Care should be taken with the use of lights at night, especially when working at height. The incorrect positioning or use of lights, even a torch, could destroy people's night vision and cause them to step off the edge of a roof or walk into an unsafe area. Care should also be taken when moving from a lighted area into a darker, unlighted area Allow time for the eyes to adjust to the darker conditions before continuing with the task.

f. **Use of Vehicles:**

(1) All road rules should be observed when driving a vehicle in response to a storm damage incident. Excessive speed or failing to observe traffic regulations are not warranted in these situations. The road conditions are normally poor following storms, so caution should be used when operating vehicles in these situations.

(2) Care should be taken when parking the vehicle on site. Allow a sufficient safe working area around the vehicle for the unloading and loading of stores and equipment, especially when there is other traffic in the area. If possible, position the vehicle off the road even if this means that it is some distance from the task site. At night and in poor visibility, ensure hazard warning lights are displayed as appropriate

(3) Ensure that all items of equipment are secured to the vehicle before moving off. This also includes securing equipment carried inside the vehicle to prevent injuries due to unexpected movement.

SUMMARY

3.20 By now it should be apparent that safety is mostly applied common sense. By stopping and thinking before acting, most safety considerations will become apparent. Through training and practice, all safety points that relate to the maintenance, use and operation of the different pieces of equipment should become second nature.

REMEMBER! SAFETY IS EVERYONE'S RESPONSIBILITY.

CHAPTER FOUR

TEMPORARY REPAIR METHODS

INTRODUCTION

4.01 This chapter covers methods for the temporary repair of storm damaged buildings. The information is based on techniques that have been tried and proven during actual operations over many years.

4.02 The determination of which method is the most appropriate to any particular situation should be based on practical application of the techniques during training sessions. Only by this can a complete appreciation of the advantages and disadvantages of each method be gained.

4.03 DAMAGE TYPES

The three main types of damage sustained during storms are

a. roof damage;

b. window damage; and

c. structural damage.

4.04 TEMPORARY REPAIRS TO STRUCTURAL DAMAGE

Temporary repair methods for structural damage are not covered in this manual. Most simply require the application of a common sense approach combined with standard rescue and storm damage techniques. Further relevant information is covered in the Australian Emergency Manual - Disaster Rescue, but specialist on-site advice may also be required.

ROOF DAMAGE

4.05 TEMPORARY REPAIRS

The main methods of effecting temporary repairs to storm damaged roofs are:

a. replacing roofing materials;

b. tarpaulins;

c. plastic sheeting;

d. tape; and

e. sealing compounds.

4.06 REPLACING ROOFING MATERIAL

a. In some cases roofing sheets or tiles that have been dislodged are able to be replaced. If this is possible it is probably the best way of effecting repairs. Metal sheets may require straightening before they can be repositioned and then all that is required is a hammer and a bag of roofing nails or a spanner and a quantity of roofing screws. Displaced tiles on small areas of tiled roofs can also be replaced, but large areas normally take too much time.

b. Roofs that have several damaged tiles on the main part of the roof can sometimes be replaced with tiles from the edge of the roof over the eaves or from the roof over a less important part of the building (garage, carport, verandah, etc). The removal of these tiles often does not result in water leakage into the living area of the building.

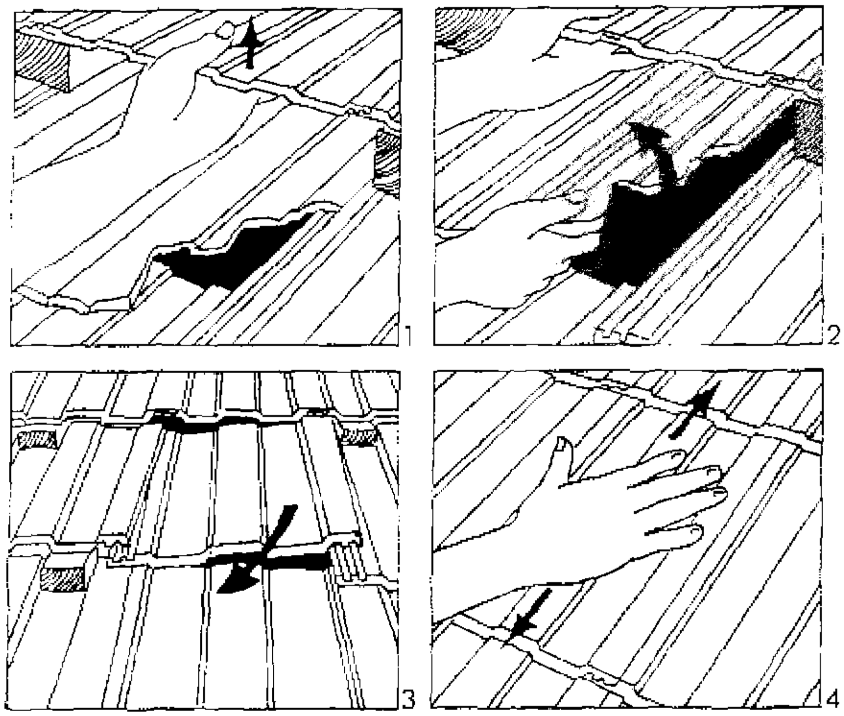


Figure 4:1
Replacing a Tile

4.07 TARPAULINS

a Even when tarping of a house is done efficiently and correctly, it may not make the house totally waterproof. If the tarping job was done poorly, the roof may appear to leak more than it did before.

b. Tarping should be undertaken only when all other options have been considered and rejected. Tarping is resource-expensive, time-consuming and labour-intensive and presents the added difficulty of recovery and/or replacement of, damaged tarps. All things considered, the use of tarpaulins is an expensive exercise.

c Tarpaulins come in many sizes and are made of various materials. Tarps in most common use for storm damage operations are made of polymer compounds and come in the common sizes of 3.5m x 3.5m, 6m x 4m, and 9m x 6m. The most suitable tarp will largely depend on the area to be covered and the style of roof. As a general rule, if a building needs tarping, then the larger the tarp the better

d No matter what size tarp is being used, extreme caution should be taken during windy conditions. Even moderate winds can cause a tarp to flap so violently that it could cause someone to be flung off a roof resulting in serious injury. **The general rule here is don't attempt to tarp roofs in strong wind conditions.** Tarping operations should be approached in the three steps of:

(1) preparation;

(2) positioning; and

(3) tying-off.

e. **Preparation:**

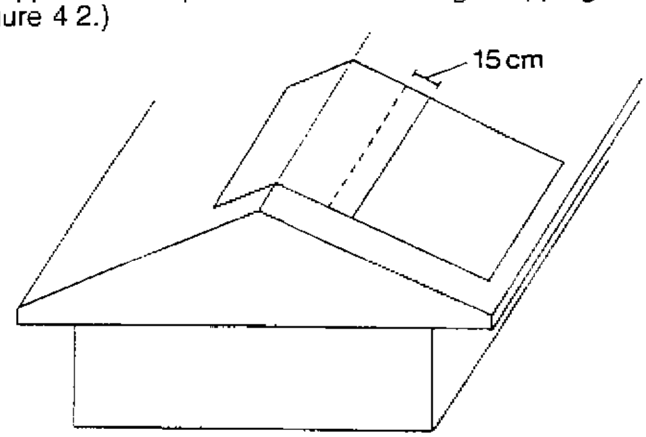
(1) Prior to tarping it is important to remove anything from the roof that may cause damage to the tarp. This might involve straightening or removing bent or torn metal sheets or removing protruding nails.

(2) To make the positioning of the tarp easier, it is recommended that the tarpaulin be folded and rolled before taking it onto the roof. This can prove to be of great advantage when it comes time to position and unfold the tarp. There may be some instances where having ropes already attached to the tarp would be an advantage. This can be done by laying out the tarp on the ground and determining how it will be positioned on the roof. You can then estimate the lengths of rope required and tie them to each eyelet. When the tarp has been positioned on the roof the ropes can then be simply thrown over the side and tied off.

f. **Positioning:**

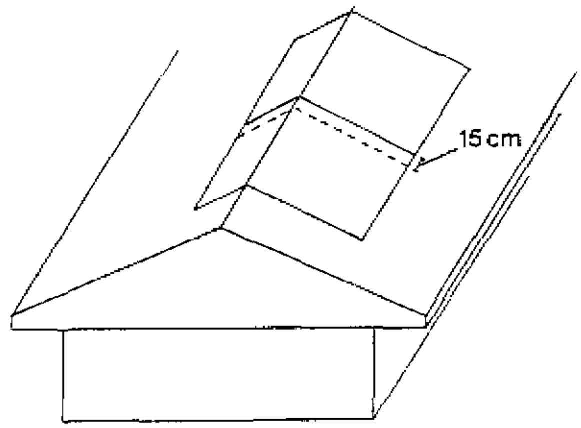
(1) When covering a roof with tarpaulins care must be taken to overlap the tarps correctly. The first tarp must be laid on the lower part of the roof. The tarp on the higher part must then overlap the lower tarp by at least 150mm to allow for water run off. The uppermost tarp must cover the ridge capping of the roof. (Figure 4 2.)

Figure 4:2



(2) Tarps laid side by side also should be overlapped by at least 150mm to reduce water penetration. If possible the overlap should take into account the current wind direction. (Figure 4·3) Joints can be taped with 50mm ducting tape for greater protection.

Figure 4:3



(3) Buildings with hip roofs can pose a problem during tarping activities. When tarping over the hip portion of the roof it is necessary to position and fold the tarp to allow for the change in roof angle. This technique cannot be described effectively in writing or diagrams. The best way this method can be covered is by practical demonstration and exercise.

g. **Tying-Off:**

(1) A tarpaulin should be tied down at every eyelet to avoid placing undue strain on any one point. The Bowline or Double Figure of Eight are the only knots recommended for attaching the ropes to tarpaulins. Slip knots should not be used as they can cut into the eyelets and cause damage to the tarp For added security, ropes may be tensioned across the tarp in criss-cross pattern and tied down.

(2) The ropes should be tensioned and tied off to anchor points so as to allow for easy adjustment. Knots such as the 'truckie's hitch' should not be used as they can easily place excessive stress on the rope and tarp. The most suitable anchoring method is to use a round turn and two half-hitches as this allows for easy adjustment.

(3) Fences, house stumps, downpipes, pergolas, etc make ideal anchor points, but quite often there will be no readily available tie-off point. In these cases there are several alternatives. simply driving roofing nails into the fascia or barge boards can be effective. Some other methods are:

(a) edge and gutter hooks;

(b) suspended ties; and

(c) rope around.

h. **Edge and Gutter Hooks** - These can be made up locally from pieces of scrap metal, and are used as shown in Figure 4:4.

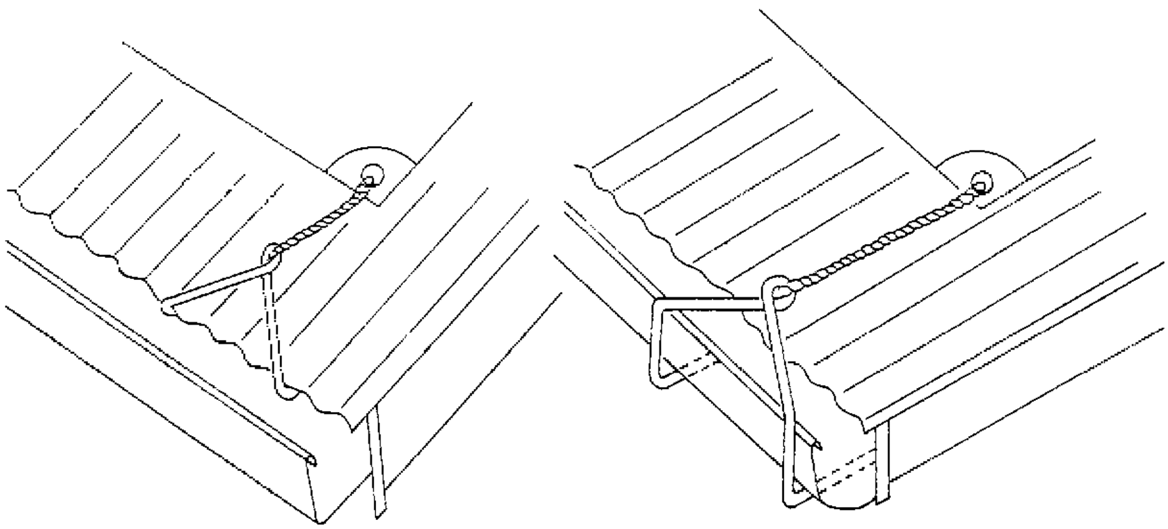


Figure 4:4
Edge and Gutter Hooks

i. **Suspended Ties** - Where no tie off points are available, weights can be suspended from the edge of the tarp to provide the required tension. Sandbags, garbage bags or similar weights can be used for this purpose. For safety reasons and to prevent any damage to the house, the weights should be just in contact with the ground. (Figure 4:5).

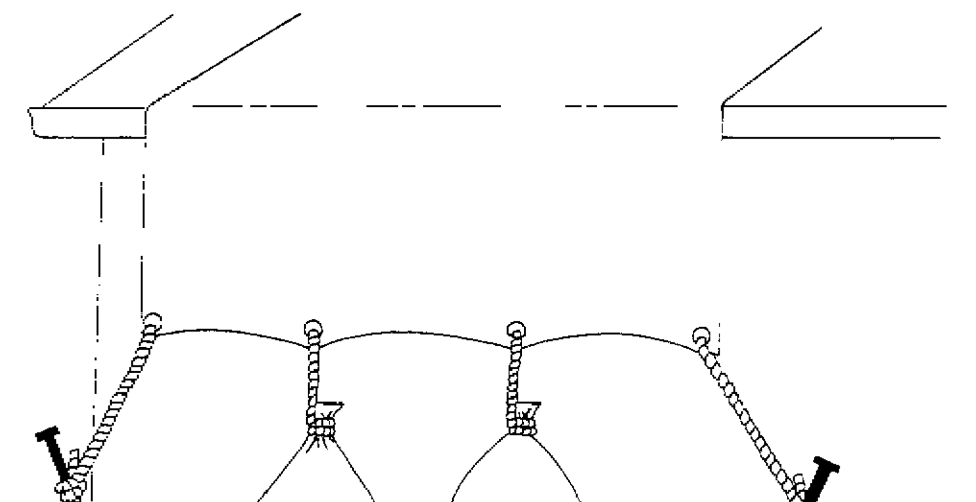


Figure 4:5
Suspended Ties

j. **Rope Around** - Another method, when no other tie off points can be used, is to run a large diameter rope completely around the building and tie it off securely. The tarpaulin tie down ropes can then be tied off to this rope Care should be taken in the placement of the larger rope to avoid obstructing doors and windows. (Figure 4:6)

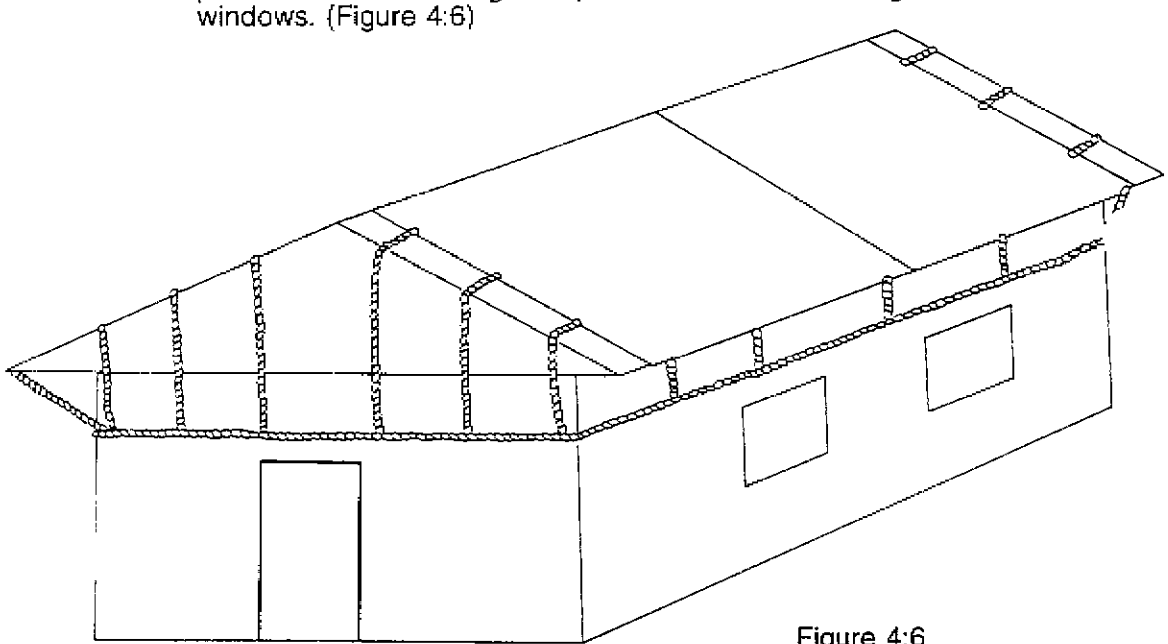


Figure 4:6
Rope Around

4.08 INTERNAL TARPING

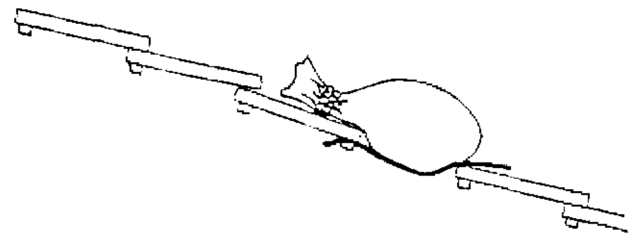
In some instances, it is not possible to tarp the roof of a damaged building effectively. An alternative method of providing assistance is to cover the furnishings in the building with tarpaulins. Depending on the extent of damage this could range from covering the entire contents of the house to covering the contents of one room. The items to be covered should be placed together to allow one tarp to cover them. This saves resources and is less time consuming. In some cases the occupants will be able to cover their own contents if supplied with tarps or waterproof covers.

4.09 PLASTIC SHEETING

a. Plastic in the form of sheeting or bags can be very useful to temporarily repair damaged roofs. Plastic bags, which are cheap and easily acquired (often from the householder), can be used to seal small holes by half filling them with soil and placing them over the hole (Figure 4:7). In some cases the bags may need to be held in position by tying a number of them together (Figure 4 8). Plastic bags can also be used to seal larger holes by placing a flattened out bag over the hole and sealing it with waterproof tape.

b. Broken or cracked tiles can sometimes be sealed in a plastic bag and replaced in position. This simple method often solves the problem efficiently.

Figure 4:7



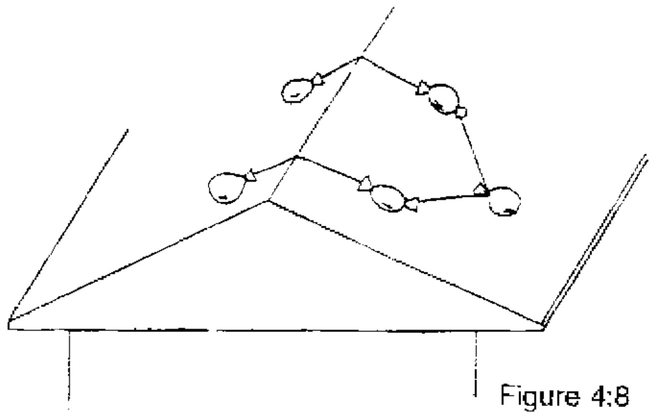


Figure 4:8

c. Plastic sheeting can be used to seal large areas by taping it over the hole or by laying it in the same manner as tarpaulins and securing it with timber battens (Figure 4:9). The edges of the plastic should be sealed with tape to prevent lifting and tearing in windy conditions.

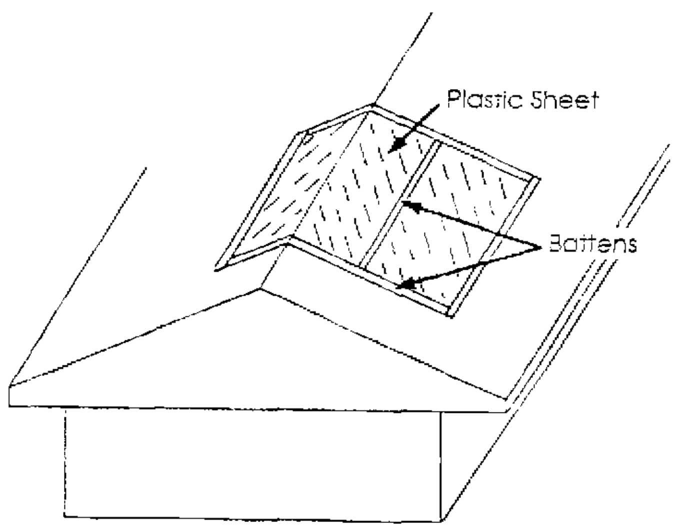


Figure 4:9

d. Some stronger types of plastic sheeting can be simply held in position by tying lengths of rope to the corners and edges of the sheet and anchoring as for tarpaulins. Pieces of timber or small rocks can be folded in the plastic to provide more grip for the rope. Puncturing or tearing the plastic to make eyelets should be avoided as this can cause the plastic to tear when under tension. (Figure 4 10).

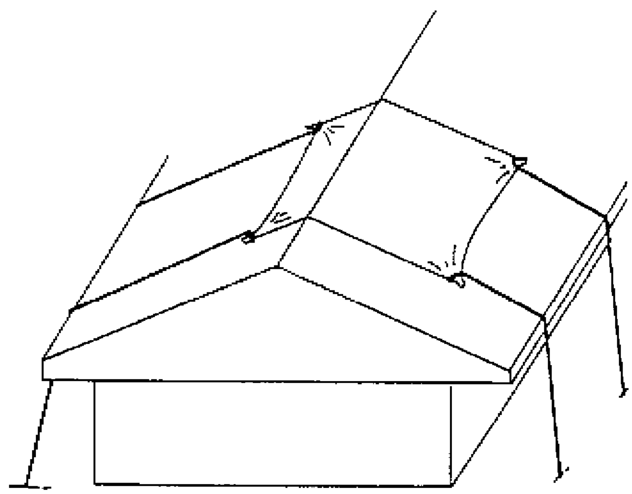


Figure 4:10

4.10 TAPE

a. Waterproof, self-adhesive tape has proved to be an effective way of sealing cracked tiles or covering small holes in roofing sheets. Even in cases where the roof has numerous holes, tape has proved to be more effective and a less resource/time consuming method.

b. The types of tape which have proved successful are as follows:

(1) **Flashband** - A metal or plastic-backed tape coated with a black sealing compound, manufactured in various widths. The most common is 72 mm and comes in 10m rolls. This tape is excellent for sealing small holes or cracks in almost any type of roofing material, and has been used as a permanent repair on many roofs. Although this material is probably the most effective tape, its cost makes it an expensive proposition for widespread use.

(2) **PVC Ducting Tape** - A plastic material impregnated with a fibre reinforcing and available in varying widths and lengths. This tape has been successfully used to temporarily seal cracked tiles and small holes in metal sheets. It can also be used to repair minor splits or tears in tarpaulins.

c. No matter which of the materials are used it is important that the roof surface be cleaned of any dirt, loose paint or scale before applying the tape The easiest way of doing this is to buff the surface around the damaged area with a wire brush and wipe clean with a rag.

4.11 SEALING COMPOUNDS

a. There are many different external, waterproof, sealing compounds available that can be successfully used to repair small holes or cracks in roofing material. Many of these are silicon-based sealants supplied in tubes of varying sizes, others are fibrous, mastic compounds either putty-like in consistency or in brushable form. These compounds can be used to make semi-permanent repairs to damaged roofs, but they are generally expensive to buy and can be time-consuming to apply.

b. Silicone sealing compounds are effective in sealing water leaks around chimneys, air conditioners and other roof fittings which have been moved in high winds.

WINDOW DAMAGE

4.12 TEMPORARY COVERING

It is quite common for windows to sustain damage from hail or flying debris during storms. Depending on the size and style of window, it is normally a fairly simple matter to provide a temporary covering. Timber-framed windows can normally be covered by nailing a sheet of hardboard or ply to the outside of the window frame. Other methods are used for varying window styles such as:

a. casement and hopper windows;

b. sash windows;

c. sliding aluminium windows;

d. louvres;

e. fixed windows; and

f. large glass areas.

4.13 CASEMENT AND HOPPER WINDOWS

These windows usually can be waterproofed by placing a sheet of plastic over the outside of the window, folding the sheet around the edges of the window frame and then closing the window onto the plastic. The plastic can then be taped into position on the inside of the window frame

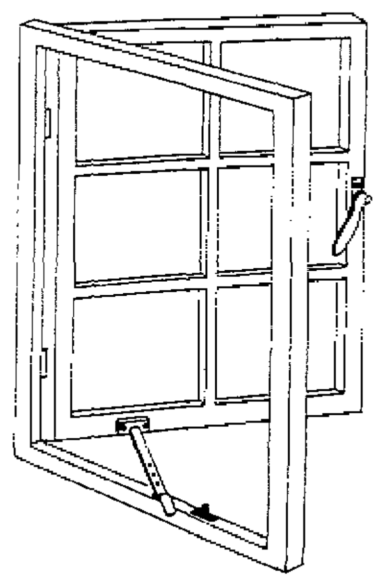


Figure 4:11
Casement Window

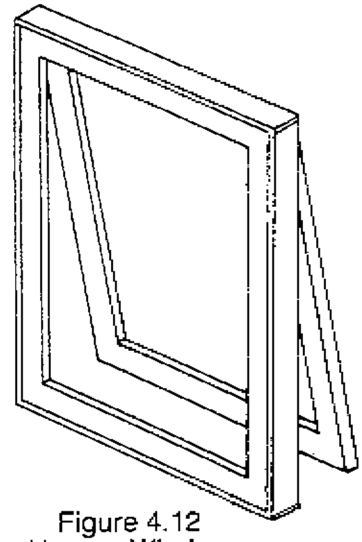


Figure 4.12
Hopper Window

4.14 SASH WINDOWS

These windows can be sealed by either taping a piece of plastic over the outside of the window or by sliding a plastic sheet up the outside of the lower window until it can be folded over the top of the frame and taped into position. The plastic is then folded under the bottom of the frame and the window closed onto the plastic, the plastic is then taped along the inside edge and the external sides of the plastic sheet.

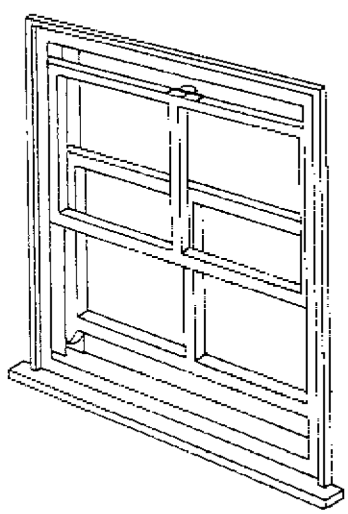


Figure 4:13
Sash Window

4.15 SLIDING ALUMINIUM WINDOWS

The sliding portion of an aluminium window can be easily covered with plastic by first removing it from its sliding track. This is done from inside the house by unlatching the window and lifting the sliding aluminium frame up until the bottom edge is free of the fixed track, then moving the bottom of the window towards you and lowering it until the top of the frame is clear. A plastic sheet can then be placed over the external side of the frame and taped into position. To allow the window to be opened the bottom edge of the frame should not be covered with plastic. Replacing the window is the reverse of removing it.

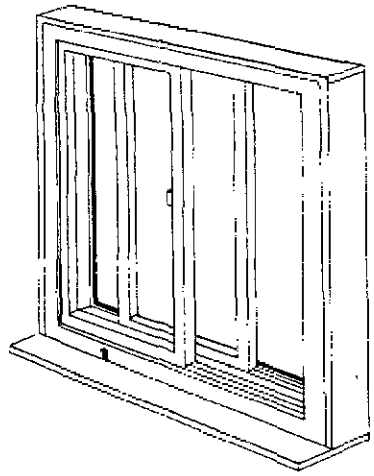


Figure 4:14
Sliding Aluminium Window

4.16 LOUVRES

Broken louvre windows usually require a covering of either timber or plastic, tacked or taped over the external window opening. In some cases, if the sizes are the same, it may be possible to replace broken blades with unbroken ones from another part of the house If this can be done it might mean that only one or two windows require covering instead of four or five.

4.17 It is possible to replace broken louvre blades with pieces of hardboard or ply, cut to size. Although this method is effective it is not recommended as cutting and preparing the boards can be a time-consuming process.

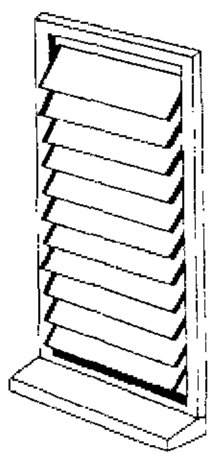


Figure 4:15
Louvre Windows

4.18 FIXED WINDOWS

Immovable fixed windows normally require covering with boards or plastic from the outside. In some buildings the outside of these windows may not be easily accessible and will need to be covered from the inside. Whatever the case, the edges of the covering should be well sealed with waterproof tape.

4.19 LARGE GLASS AREAS

a. In situations where there are large expanses of damaged windows or large picture windows it may be possible and more beneficial to cover the entire area with a larger cover (eg tarpaulin, large sheet of plastic, etc). In these cases the cover is usually fixed in position by tacking timber battens to the external walls of the house across the top, sides and bottom of the covering.

b. Before attempting to cover any damaged windows, all broken glass should be removed from the window frame This prevents injuries to persons and prevents damaging the covering.

WALL DAMAGE

4.20 CAUSES

Walls of premises are at risk of damage in a number of ways. The impact of flying debris or a collapsing tree or branch, or simply the force of the wind can cause damage to walls of all types

4.21 CONSTRUCTION TYPE

Obviously, lightly-constructed walls are more prone to damage than those of double brick, block or stone, but this tends to be offset by the fact that lightly-built walls are generally easier to repair. Regardless of the type of wall, or the cause of damage, a few simple guidelines are appropriate for all operations.

4.22 GUIDELINES FOR REPAIR

a. In instances where a tree or flying debris has penetrated a wall, and particularly in non-storm operations where a motor vehicle has collided with a structure wall, it is recommended that the structure be made safe prior to removal of the cause of damage.

b. Where a wall of any type is damaged to the extent that it may affect the integrity of the structure, a safety area must be secured with cordons or barriers, and the structure must be shored to prevent collapse.

c. Shoring may take the form of dead shores to support a roof or prevent vertical collapse, or raking flying shores to prevent a lateral collapse.

d. Steel or aluminium acrow props are ideal for dead shore systems, but any sound material can readily be employed to prevent collapse and further damage.

e. In keeping with normal shoring practices, dead shores must additionally stablised with diagonal strapping or timbers.

f. Once the structure has been stablised, the premises should be made weather-proof to prevent further damage. This can be effected using plastic sheeting and battens, or tarpaulins in the same manner as roof damage tasks.

CHAPTER FIVE

TREE OPERATIONS

INTRODUCTION

5.01 During storms, trees may be blown over, or major branches may be broken from trees. In residential areas, falling branches or trees will commonly cause damage to buildings which may be severe.

5.02 **TREE DAMAGE PROBLEMS**

Crews responding to tree damage may be faced with

a. damaged trees which threaten to fall or drop branches;

b. trees or branches which are leaning against buildings; or

c. fallen trees or branches on or through building roofs

5.03 **SKILLS REFERENCES**

In any situation involving dangerous trees, the Australian Emergency Manuals - Rescue, and Chain Saw Operation are the required skills references along with this manual, and operators should be trained to those standards.

ASSESSMENT OF TREE OPERATIONS

5.04 **SAFETY ASPECT**

A careful assessment must be made of each situation before any action is commenced A decision to stabilise a damaged tree or remove a tree from a building **must be made in accordance with service policies and with safety as the primary concern.**

5.05 **CONSIDERATIONS**

The assessment must cover

a. possible hazards;

b. the tree itself;

c. the structure involved; and

d. available resources.

5.06 **HAZARDS**

The following points must be considered in the assessment of hazards:

a **Electricity** - The supply authority must be contacted where there is any concern.

b **Water or Gas supplies** - It may be nescessary to shut off supply at main.

c. **Further Collapse** - All possibilities to be considered.

d. **Wind** - Possible effect of further wind action.

e. **Communication Cables** - These cables carry vision and telephone networks to many people, including emergency telephone number services of course. Some cables carry up to 90 volts A.C. current.

f **Loose Material or Debris** - Possible effect on safety of operation.

g. Associated Hazards - Such as a garage complete with car, fuel supplies and so forth, or a store room for hazardous materials.

5.07 THE TREE

Considerations specifically relating to the tree include:

a. tension or compression forces within the tree;

b. the results of a change of balance and any subsequent leverage effect at any time; and

c. the potential for movement if the tree is cut.

5.08 THE STRUCTURE

Considerations relating to the stucture involved must be include:

a. the security of the structure and the need for shoring,

b. the reaction of the structure if the tree is removed,

c. the prevention of further damage; and

d. the need for evacuation.

5.09 RESOURCES

Consideration must be given to:

a. the availability of private contractors to tackle the job;

b. the need for cranes and elevated platform vehicles (cherry pickers); and

c. team competence and experience.

GUIDELINES FOR TREE OPERATIONS

5.10 Guidelines for the management of tree operations will vary with respect to a given situation.

5.11 THREATENING TREES/BRANCHES

In cases where a tree has been damaged or partially uprooted, or major limbs have been broken, the tree or limb may threaten to fall on a building.

a. **Appropriate Action** - In such cases, a decision must be taken on the appropriate action. This decision is taken following the assessment, and emergency teams may.

(1) secure the tree to prevent further collapse;

(2) leave the task to a private contractor; or

(3) remove the tree or branch.

b. **Suitable Methods** - Considerations for securing a threatening tree or branch include:

(1) the use of guy ropes to stabilise the tree/branch, with due regard to the safe working load of ropes, anchorages and other standard considerations; or

(2) use of jacks, hydraulic equipment and Acrow props to support a damaged tree.

c. **Removal Decision** - Removal of a threatening tree must only be undertaken where a clear working area is available and a safe course of action can be clearly set out. The tree may then be felled or winched clear of the building.

5.12 TREES/BRANCHES LEANING AGAINST BUILDINGS

a. These situations must be assessed in a similar manner to cases where a tree or branch is threatening a building.

b. The tree may be left for a contractor to handle, or measures may be employed to secure it so as to prevent further movement and damage. Where the decision is taken to remove the tree, the guidelines laid out in para 5 11b should be followed.

c. A decision to leave a leaning tree or secure it in place must be made with due regard to the force which the tree is exerting on the building, and the possibility of structural damage/collapse.

5.13 TREES/BRANCHES ON OR THROUGH ROOFS

a. As an initial measure, a fallen tree or major branch must be secured to prevent movement which may cause danger to personnel or further damage to the building.

b. Once secured, the tree can be worked on more safely, and personnel may cut and remove all or part of the material in a controlled and systematic manner.

c. Rescue personnel should be protected with a fall prevention system or a belayed rope in such operations.

d. The removal process must follow a series of logical steps such as:

(1) safe access for rescuers to the work area;

(2) a sequence of cutting operations which causes least movement of the tree or damage to the roof;

(3) provision of a safe working area for personnel,

(4) use of cranes or roping systems to remove cut sections, and the possible use of elevated platform vehicles as work platforms for chainsaw operators;

(5) continual re-assessment of the situation; and

(6) minimal disposal of cut timber and clean-up of the area.

TREE OPERATIONS SUMMARY

5.14 Storm operations involving the felling of dangerous trees or the removal of trees from contact with buildings must only be undertaken following a careful assessment and appreciation of all factors.

5.15 All tree operations must be conducted in accordance with service policies and procedures, and with local legislative arrangements.

CHAPTER SIX

LOCAL FLOODING

INTRODUCTION

6.01 The development of residential areas, which include vast masses of concrete and bitumen, inevitably leads to local flooding during periods of heavy rain. The rainfall run-off that results can very rapidly cause local, and sometimes, flooding of residential, shopping and business areas.

6.02 Apart from the effect of run-off, drains blocked by plastic bags, leaves and other debris, together with overflowing gutters and stormwater channels will worsen the flooding.

TYPES OF PROBLEMS

6.03 The major problem will be low level flooding of houses and shops, with severe damage to furnishings, fixtures and stock. Additional problems will be created by the pooling of large quantities water in basements, underground car parks and garages.

SOLUTIONS

6.04 There is a range of possible solutions to the problem of local flooding. They incorporate prevention, diversion or removal measures.

6.05 **PREVENTION**

a Water can be prevented from flowing into unaffected areas by damming the openings into them with tarpaulins or material to hand, such as sacking, which can be folded to size.

b It is important to locate drains and keep them clear of debris. A wire mesh guard is the most suitable means of achieving this (Figure 6:1), but it is often possible to find suitable material and improvise a barrier. Where there is a lot of debris, it may be desirable to assign a person specially to keep the guards clear, but otherwise occasional visits should suffice.

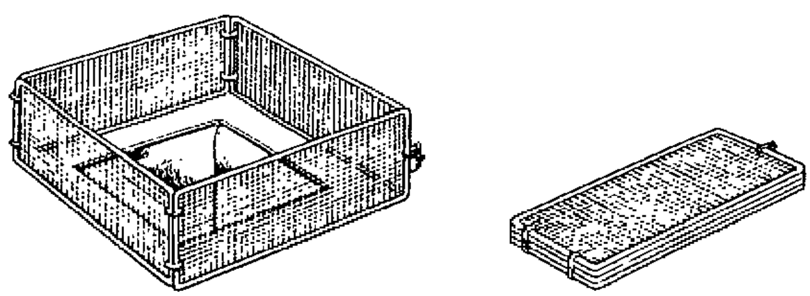


Figure 6:1
Wire Mesh Drain Guard

c. Where water is entering premises, considerable damage can be prevented by moving furniture and fittings to the safest place in a room, lifting stock from the floors onto tables, counters, benches, shelves or other support and sheeting them over. Put any rugs and carpets over furniture before covering, and collect together fragile items such as glass, china and pictures, putting them somewhere where they will be safe from breakage before covering them. It is often better to use transparent polythene sheeting rather than tarpaulins when covering fragile items, so that it is possible to see what is underneath the covering.

d Ensure that all items are thoroughly covered at top and sides, with the bottom of the sheet reaching, but not dragging on, the floor. When one sheet is not sufficient, place successive sheets around the side so that they are overlapped by the upper sheets and water can drain off.

6.06 DIVERSION

a Where possible, water should be diverted out of or away from a building, or into suitable drains. A trough can be improvised by opening a tarpaulin to its full length but only half its width, then folding in the edges lengthways to give the depth required Several tarpaulins so arranged can be placed end to end with an overlap in the direction of the flow (Figure 6:2).

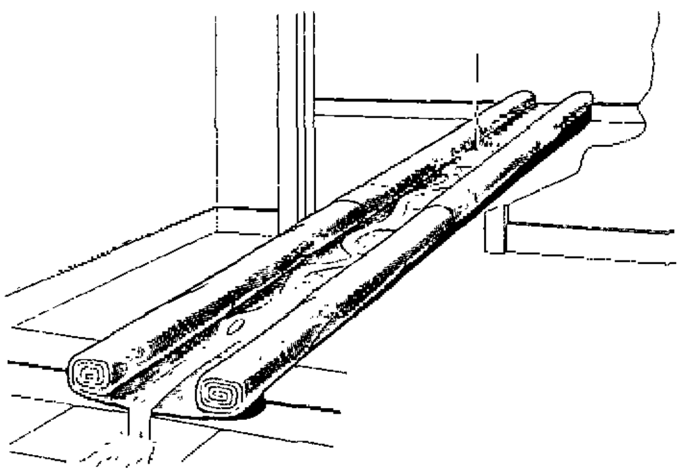


Figure 6:2
Using Tarpaulins to Create a Trough

b. Sandbagging is another method of effectively diverting storm water. Sandbags are made of hessian and, when empty, measure 825mm x 250mm. They may be used to build walls to protect property.

c When building walls, it must be remembered that a sandbag wall will not stand with a vertical face. The face must have a slope, with the base of the wall being on firm ground. The ratio of wall height to depth must be 4:1. Examples of sandbag constructions are shown in Figure 6:3.

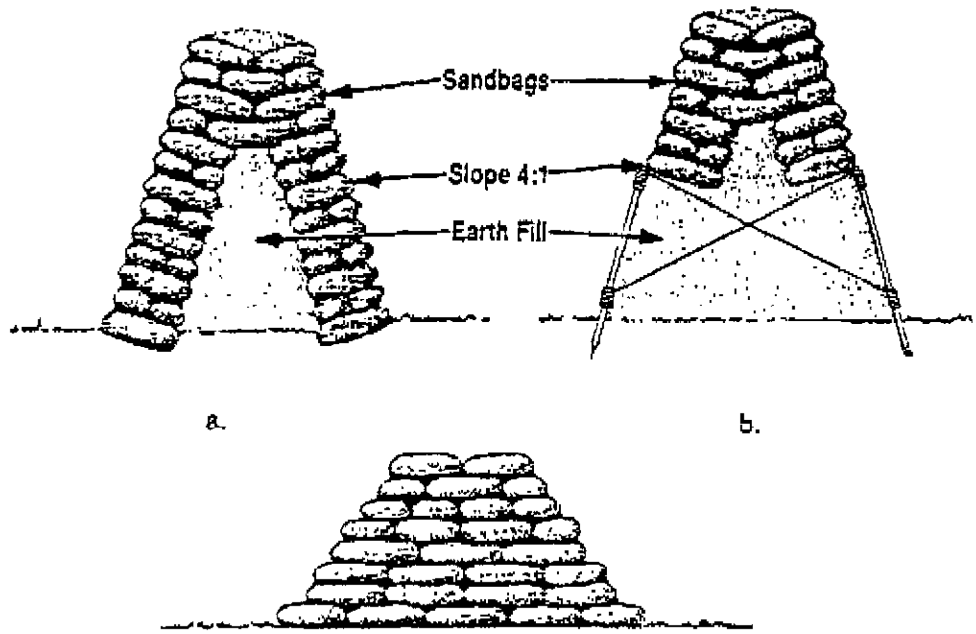


Figure 6:3
Examples of Sandbag Wall Construction

d. When laying sandbag walls, the following points should be remembered:

(1) Sandbags should be three-quarters filled, and with their necks tied with string.

(2) The bags are laid in horizontal courses like bricks. The first course is laid as 'headers', at right angles to the length of the wall. The second course is laid as 'stretchers', parallel to the wall. Subsequent courses are composed alternatively of headers and stretchers. The wall is always finished with headers.

(3) Joints in adjacent courses should be staggered A wall so constructed with broken joints is said to be correctly 'bonded'.

(4) Because sandbags tend to burst at the necks and side seams, they should be laid so that neither necks nor side seams are on the outer face of the wall. Also, corners must be tucked in as each bag is laid.

(5) After each bag is laid, it should be beaten into standard size and shape with pick handles or similar implements.

e. The method of forming a corner in a sandbag wall is shown in Figure 6:4.

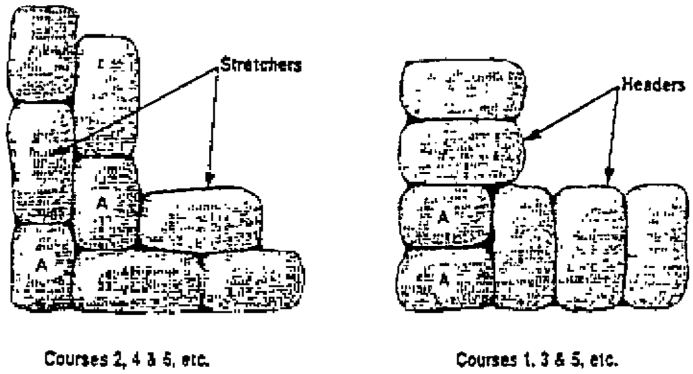


Figure 6:4
Turning a Corner

f In the absence of regular sandbags, plastic garbage bags or grain bags may be used. Consider however weight versus strength when handling filled plastic bags, and do not completely fill grain bags because of their weight

g To provide a better seal and additional protection, the sandbag wall may be covered with plastic sheeting on its exposed side This is achieved by placing the edge of the sheeting under the first course when laying it, and extending the plastic up the outer face of the wall to be held in place by the final course (Figure 6:5). Alternatively, in the event of dry sand being used when sandbags will not sufficiently mould or conform to prevent seepage. It is desirable to place the plastic sheeting within the sandbag wall to allow the outer surface bags to become moist and to conform, filling small crevices etc.

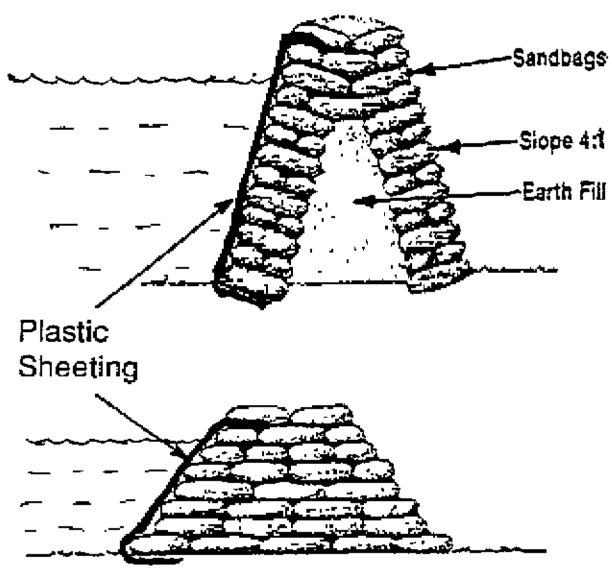


Figure 6:5

h. A guide to the number of sandbags required to erect a wall of varying height is shown in Figure 6:6.

HEIGHT OF WALL	BAGS REQUIRED
300mm	600
600mm	2000
900mm	3400

Figure 6:6
Bags Required for 30 Metres of wall

6.07 REMOVAL

There are a number of methods for removing flood water from buildings, including.

a. pushing out the water by keeping it on the move with brooms and squeegees so that it does not collect or increase in depth;

b. boring small holes in the floor with an auger, or by using a crowbar to prise up a floorboard where it joins another, and using a wedge to keep the joint open;

c. baling the water out of the building;

d. syphoning to a lower point;

e. pumping the water into drains or tankers; and

f. wet and dry vacuum cleaners.

PUMPING OPERATIONS

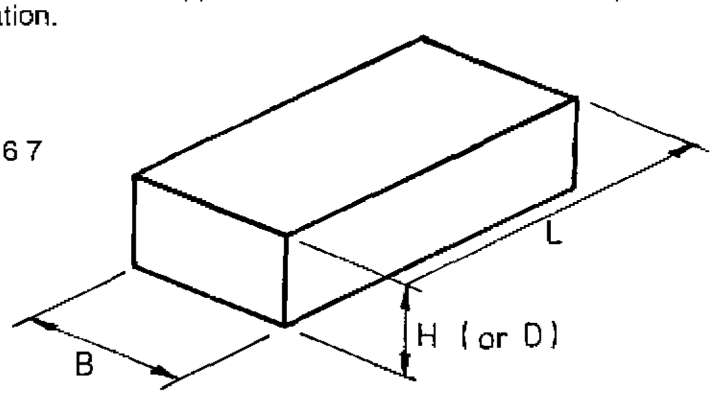
6.08 WATER VOLUME

When a large quantity of water is required to be moved from an area, it may be necessary to employ a pump or pumps to carry out the task. In order to determine which pump is appropriate to the task, the volume of water to be displaced must be estimated. The weight of water may also need to be estimated in circumstances where a water containment is threatening to collapse, therefore requiring a sense of urgency.

6.09 CALCULATING WATER CONTAINMENT

These formulas are approximate and have been developed for ease of calculation.

Figure 6 7



Volume:

Volume = length x breadth x height (or depth)
Vol (M3) = L x B x H (or D)

Capacity:
Cap (Litres) = Vol x 1000

Weight:
Weight (tonnes) = Vol (M3)

Example:

Where L = 6m, B = 3m, and C = 2m

Capacity = 6 x 3 x 2 x 1000
= 36 x 1000

= 36000 litres

Weight = 36 tonnes

6.10 PUMP CATEGORIES

Pumps for moving fluids fall broadly into the three categories of:

a. positive displacement pumps;

b. centrifugal pumps; and

c ejector pumps.

6.11 POSITIVE DISPLACEMENT PUMPS - There are four main types of pump in this category.

a. **Force Pumps** - Fluid is forced out by a solid piston, a diaphragm (eg a petrol pump) or compressed air.

b. **Lift Pumps** - Fluid can pass freely in one direction through a hollow piston with a one way valve (eg a well pump)

c. **Bucket and Plunger Pumps** - A combination of a and b. above, with a column mounted above the hollow piston to displace fluid during the downstroke.

d. **Rotary and Semi-Rotary Pumps** - Fluid is moved from one part of a partially cylindrical chamber to another part, for discharge, by projections located around an axis (eg the gear pump circulating oil in an internal combustion motor).

6.12 CENTRIFUGAL PUMPS

A centrifugal pump has no valves, pistons, plungers or diaphragms and does not work by displacement. It makes use, instead, of centrifugal force and consists essentially of a number of vanes embodied in circular side plates known as an 'impeller'. This type of pump can run at full speed with deliveries closed (ie no output and high pressure), or with open deliveries (ie large output and low pressure), or at any intermediate point, **without damage to the pump.**

6.13 Both the positive displacement and centrifugal pumps are fed with fluid either by gravity, under pressure from a main supply or other sources eg compressed air, or by atmospheric pressure.

6.14 EJECTOR PUMPS

These are special pumps with no moving parts, in which a jet of water is injected into a larger orifice causing reduction in atmospheric pressure. Special filters are required at the inlet to the supply of the jet. This type of pump is particularly suitable for use where it would not be possible to place a normal pump in the categories mentioned above, including use on ships and for dredging.

6.15 PUMP CONSIDERATIONS

The common pumps used during storm operations are those in the positive displacement and centrifugal pump categories. In each category, pumps can be grouped as follows:

a. **Surface** - Where the pump is isolated from the fluid to be moved and reliant on a suction hose through which the fluid is drawn to the pump, then pushed to the discharge point. Limitations to this group can include mobility/portability, toxic fumes produced by motors and the required close proximity to the fluid.

b. **Submersible** - Where the pump is located within the fluid and immediately draws fluid in to be pushed to the discharge point. Such a pump can push the fluid further than a similar surface pump can lift or draw the same fluid. Limitations to this group include their restricted size and power sources (ie only electricity, compressed air or a shaft, driven by a surface mounted motor).

6.16 PUMP SELECTION

The following list is offered as a guide to selecting the right pump to complete a water displacement task:

a. **Positive Displacement (PD) Pumps** - As a general rule, these pumps are not as efficient as centrifugal pumps. With portability as a major requirement in storm operations, the only type of submersible PD pump worthy of consideration is an air operated diaphragm (force) pump. Various types of PD pumps for surface usage are readily available, including the hand operated stirrup pump, motorised portable and trailer-mounted pumps. Where the water contains debris and suitable strainers are not affixed to inlets, the use of a surface diaphragm style pump is recommended.

b. **Centrifugal Pumps** - These are the most efficient and versatile pumps, therefore they are more common in both the submersible and surface groups. Because there are fewer moving parts, they are smaller in size in relation to the volume of water and pressure that they can discharge. The majority of submersible pumps fall into this category and are well suited to discharging water from inside buildings. Surface operated centrifugal pumps are certainly the most effective, under the right conditions, when a large volume of water is to be moved in a short time. The disadvantage is that the suction hose must be primed prior to commencement of pumping

6.17 USING PUMPS

The following general rules apply when using most pumps:

a. Refer to the manufacturers handbook for specific operating, safety and maintenance procedures.

b Determine an appropriate discharge point with relation to the suction hose access to the flood water.

c Install strainers to protect the pump.

d. Position the hoses, avoiding sharp bends and protecting against sharp edges. Before lowering the inlet into deep water, secure it with a line This will also assist during retrieval.

e. Ensure the inlet remains submerged. With surface pumps this is particularly important as air in the suction hose will cause the vacuum to break and the pump will require to be primed again.

f. Constantly monitor the pumping operation, including the cleaning of strainers.

g. When using surface pumps, locate the pump as close as possible to the flood water so that no more suction hose than is necessary is used. Each additional length of hose increases friction loss The suction hose must be specifically designed to withstand external pressure when the vacuum is created.

WARNING: Ensure adequate ventilation is provided at all times where combustion motor powered pumps are used as carbon monoxide build up may be rapid and fatal.

6.18 PUMP RESOURCES

Pumps of various types and for various purposes are available from a number of sources for either purchase, hire or loan. The major sources are:

a. local government authorities,

b. state government water and drainage authorities;

c. commercial suppliers and hire companies; and

d. private businesses such as mining companies and liquid waste disposal experts.

6.19 SPECIAL CONSIDERATIONS

Sewage, septic and storm water systems can present specific operational problems. Some of these are:

a. back-flowing of effluent into houses which may be prevented or reduced by the placement and securing of a party filled sandbag in toilet bowls or other points of effluent exit;

b. health problems caused by effluent in floodwaters Refer to local health authorities for planning and response advice;

c. health problems due to insects in plague proportions triggered by flood conditions; and

d. electrical, fire and chemical hazards.

REFERENCES

Material used in the development of this manual was taken or adapted from a number of existing publications. The national working party extends its appreciation and acknowledgement to the authors, editors and publishers of the following:

Queensland State Emergency Service

Storm Damage Operations

British Home Office (Fire Department)

The Manual of Firemanship - Practical Firemanship II