AUSTRALIAN EMERGENCY MANUALS SERIES

PART IV

Skills for Emergency Services Personnel

Manual 1

STORM DAMAGE OPERATIONS

second edition

EMERGENCY MANAGEMENT AUSTRALIA

First published 1991
Second edition published 1996

ISBN 0 642 25610 1

Edited and published by Emergency Management Australia

Typeset by Director Publishing and Visual Communications, Department of Defence

Printed in Australia by Better Printing

NOTE: Expansion of the Australian Emergency Manuals Series

In August 1996 the National Emergency Management Principles and Practice Advisory Group decided to expand the original AEM Series to cover a more comprehensive range of emergency management principles and practice publications. The new Series incorporates the 20 original AEMs as PART IV of a five-part structure as follows.

PART I - The Fundamentals
PART II - Approaches to Emergency Management
PART III - Emergency Management Practice
PART IV - Skills for Emergency Services Personnel
PART V - The Management of Training

From November 1996, the title, number and Part colour of relevant new or revised EMA publications will reflect their place within the structure. Additionally, manuals in Part IV will be individually colour-coded to match the original AEMs. Existing manuals will remain current until their review date when they will be revised and integrated into the new Series. The first stage of this transition is indicated below in lists which will change as each new manual is published.

Original AUSTRALIAN EMERGENCY MANUAL SERIES
(available until integrated into new series upon review)

AEM-DISASTER RESCUE (3rd edition)
AEM-FOUR-WHEEL-DRIVE VEHICLE OPERATION
AEM-COMMUNICATIONS
AEM-TRAINING MANAGEMENT
AEM-MAP READING AND NAVIGATION
AEM-DISASTER MEDICINE
AEM-INSTRUCTIONAL TECHNIQUES
AEM-FLOOD RESCUE BOAT OPERATION
AEM-COMMUNITY EMERGENCY PLANNING GUIDE (2nd edition)
AEM-ROAD ACCIDENT RESCUE
AEM-CHAINSAW OPERATION
AEM-VERTICAL RESCUE
AEM-DISASTER RECOVERY
AEM-LAND SEARCH OPERATIONS

New AUSTRALIAN EMERGENCY MANUALS SERIES
PART IV - Skills for Emergency Services Personnel

Manual 1	STORM DAMAGE OPERATIONS (2nd edition)	A
Manual 2	OPERATIONS CENTRE MANAGEMENT	A
Manual	LEADERSHIP	D
Manual	LAND SEARCH OPERATIONS (incorporating Urban Search)	R
Manual	ROAD ACCIDENT RESCUE	R
Manual	RESCUE (formerly Disaster Rescue)	R
Manual	EVACUATION MANAGEMENT	D
Manual	COMMUNICATIONS	R
Manual	EMERGENCY FOOD SERVICES	D
Manual	CIVIL DEFENCE	D

Publishing status (11/96): A=Available; D=Development; R=Revision; P=Planned

NB. Manuals will be issued subject to availability and guidelines in the latter paragraph of the Foreword, page v.

AMENDMENT LIST

Amendment		Effected	
No	Date	Signature	Date

FOREWORD

THE PURPOSE OF THIS MANUAL IS TO PROVIDE A BASIC REFERENCE FOR STORM DAMAGE OPERATIONS IT IS INTENDED FOR USE IN PLANNING, TRAINING AND OPERATIONS BY ALL DISASTER/EMERGENCY PERSONNEL AND ORGANISATIONS

THIS MANUAL HAS BEEN DEVELOPED BY A NATIONAL WORKING PARTY REPRESENTATIVE OF THE STATE AND TERRITORY EMERGENCY SERVICES. THE WORKING PARTY WAS INITIATED AND SPONSORED BY EMERGENCY MANAGEMENT AUSTRALIA.

THIS MANUAL IS ISSUED IN LOOSE-LEAF FORM TO FACILITATE AMENDMENT AND INSERTION OF INDIVIDUAL ORGANISATIONAL SUPPLEMENTS

AS SITUATIONS CHANGE AND IMPROVED TECHNIQUES ARE DEVELOPED THE STORM DAMAGE OPERATIONS MANUAL WILL BE AMENDED AND UPDATED BY THE NATIONAL WORKING PARTY

PROPOSED CHANGES SHOULD BE FORWARDED TO THE DIRECTOR GENERAL, EMERGENCY MANAGEMENT AUSTRALIA, AT THE ADDRESS SHOWN BELOW THROUGH THE RESPECTIVE STATE/TERRITORY COUNTER DISASTER ORGANISATION.

THE USE OF TRADE NAMES IN THIS MANUAL IS NOT INTENDED TO BE RESTRICTIVE, PREFERENTIAL OR PROMOTIONAL, RATHER, TRADE NAMES ARE USED WHERE DESCRIPTIVE CLARITY IS REQUIRED.

CONSIDERATION WILL BE GIVEN TO REQUESTS FROM DEVELOPING COUNTRIES FOR SUPPLIES WITHOUT CHARGE.

ENQUIRIES SHOULD BE SENT TO THE DIRECTOR GENERAL, EMERGENCY MANAGEMENT AUSTRALIA PO BOX 1020 DICKSON ACT 2602 AUSTRALIA.

THE MATERIAL INCLUDED IN THIS MANUAL LARGELY CAME FROM THE STORM DAMAGE OPERATIONS MANUAL PRODUCED BY THE QUEENSLAND STATE EMERGENCY SERVICE THE ASSISTANCE OF THE DIRECTOR, QUEENSLAND STATE EMERGENCY SERVICE IS GRATEFULLY ACKNOWLEDGED.

CONTENTS

		Page
AMENDMENT LIST		iii
FOREWORD		v
CONTENTS		vii
INTRODUCTION		xi
		Para
CHAPTER ONE	**PRINCIPLES AND PREPARATION**	
	Principles of Operations	1.01
	Preparation	1 03
	Local Authority Preparation	1.07
	Emergency Service Preparation	1.08
	Individual Preparation	1.09
	Planning	1.12
	Unit Preparation	1.16
	Resources	1.18
	Human Resources	1 20
	Stores and Equipment	1.22
	Procedures	1.26
	Activation and Standby	1.28
	Operations	1.29
	Close-Down	1.30
	Debriefing	1 31
	Return of Stores	1 32
	Personal Preparation	1.33
	Physical Fitness	1 35
	Mental Preparation	1.36
	Training	1.37
	Dress and Personal Equipment	1.38
CHAPTER TWO	**BUILDING CONSTRUCTION**	
	Introduction	2.01
	Building Styles	2.03
	Roof Styles/Construction	2.07
	Gable Roof	2.09
	Hip Roof	2.10
	Composite Roof	2.11
	Skillion Roof	2.12
	Flat Roof	2.13
	Gambrel Roof	2.14
	Jerkin Head Roof	2.15
	'A'-Frame Roof	2.16
	Roof Construction Terminology	2.17
	Main Components	2.18
	Trusses	2.19
	Roof Fixing	2.20
	Roof Cladding Materials and Damage Characteristics	2.21
	Corrugated Iron	2.23
	Damage Characteristics of Corrugated Iron	2.26
	Corrugated Aluminium	2.27

	Damage Characteristics of Corrugated Aluminium	2 28
	Corrugated Fibro	2.29
	Damage Characteristics of Corrugated Fibro	2.31
	Metal Roof Decking	2.32
	Damage Characteristics of Metal Roof Decking	2.33
	Concrete or Terra Cotta Tiles	2.34
	Damage Characteristics of Concrete or Terra Cotta Tiles	2.36
	Metal Tiles	2.37
	Damage Characteristics of Metal Tiles	2.39
	Slate Tiles	2.40
	Damage Characteristics of Slate Tiles	2.41
	Shingles	2.42
	Damage Characteristics of Shingles	2.43
	Bituminous Felt	2 44
	Damage Characteristics of Bituminous Felt	2 45
	Fibre-Resin Sheets	2.46
	Damage Characteristics of Fibre-Resin Sheets	2.47
	Gutters	2.48
	Gutter Types	2.49
	Blockages	2.50
	Fragility	2.51
	Roof Protrusions	2.52
	Damage Problems	2.53
	Skylights	2.54
	Pipes/Chimneys	2.55
	Flashing	2.56
CHAPTER THREE	**SAFETY**	
	Hazard Assessment	3.01
	Making the Assessment	3.06
	Taking Appropriate Action	3.07
	Common Hazards	3.08
	Summary of Hazard Assessment	3 09
	Fall Prevention Systems	3.10
	Using the System	3.13
	Safety Responsibilities	3.14
	General	3.14
	Unit Responsibilities	3 16
	Team Leader Responsibilities	3.17
	Team Members' Responsibilities	3.18
	Standard Safety Points	3.19
	Summary	3.20
CHAPTER FOUR	**TEMPORARY REPAIR METHODS**	
	Introduction	4.01
	Damage Types	4.03
	Temporary Repairs to Structural Damage	4.04
	Roof Damage	4.05
	Temporary Repairs	4.05
	Replacing Roofing Materials	4.06
	Tarpaulins	4 07
	Internal Tarping	4.08

	Plastic Sheeting	4.09
	Tape	4.10
	Sealing Compounds	4.11
	Window Damage	4.12
	Temporary Covering	4.12
	Casement and Hopper Windows	4.13
	Sash Windows	4.14
	Sliding Aluminium Windows	4.15
	Louvres	4.16
	Fixed Windows	4.18
	Large Glass Areas	4.19
	Wall Damage	4 20
	Causes	4.20
	Construction Type	4.21
	Guidelines for Repair	4.22
CHAPTER FIVE	**TREE OPERATIONS**	
	Introduction	5.01
	Tree Damage Problems	5.02
	Skills References	5.03
	Assessment of Tree Operations	5.04
	Safety Aspects	5.04
	Considerations	5.05
	Hazards	5.06
	The Tree	5.07
	The Structure	5 08
	Resources	5.09
	Guidelines for Tree Operations	5.10
	Threatening Trees/Branches	5.11
	Trees/Branches Leaning Against Buildings	5.12
	Trees/Branches on or Through Roofs	5.13
	Tree Operations Summary	5.14
CHAPTER SIX	**LOCAL FLOODING**	
	Introduction	6.01
	Types of Problems	6.03
	Solutions	6.04
	Prevention	6.05
	Diversion	6.06
	Removal	6.07
	Pumping Operations	6.08
	Water Quality	6.08
	Calculating Water containment	6.09
	Pumps Catergories	6.10
	Positive Displacement Pumps	6.11
	Centrifugal Pumps	6.12
	Ejector Pumps	6.14
	Pump Considerations	6.15
	Pump Selection	6.16
	Using Pumps	6 17
	Pump Resources	6.18
	Special Considerations	6 19
REFERENCES		Last Page

INTRODUCTION

POLICY STATEMENT

Storm damage operations can involve hazardous situations, due either to weather conditions, working environment or a combination of both. Personnel involved in storm damage operations will not be put at any undue risk to effect temporary repairs to damaged buildings. If a potentially dangerous situation arises that cannot be overcome, then other methods of assistance should be sought.

It is important that persons involved in storm damage operations are competent, familiar with and practised in:

a. safety and correct use of equipment;

b. characteristics of building construction;

c. on-site hazard identification, and

d. methods of effecting temporary repairs.

This publication contains a number of methods for the provision of temporary relief for occupants of wind or storm-damaged dwellings. The methods have been developed over a number of years experience in storm/cyclone operations.

Other techniques will, no doubt, be developed in the future and suggestions for amendments and the inclusion of further information are encouraged.

This manual is not to be regarded as a self-teaching medium and is provided as a reference work only. Any training in, or practical adaptation of, the methods or techniques covered in this publication should be conducted by an experienced, competent instructor.

SCOPE

This publication details recommended methods, management considerations and options available to effect temporary repairs in the conduct of storm damage related operations.

AIM

The aim of this publication is to detail the steps necessary to prepare personnel to control storm damage operations and provide timely, temporary storm-related damage assistance.

OBJECTIVES

This manual will enable emergency service personnel, when conversant with the subject matter to:

a. employ effective resource management;

b identify common types of building construction and possible storm damage related problems;

c. identify specific hazards associated with storm damage and take appropriate remedial action;

d. employ safe working practices with regard to personnel and equipment; and

e. select and apply appropriate techniques and methods for temporary emergency repairs that suit the situation.

CHAPTER ONE

PRINCIPLES AND PREPARATION

PRINCIPLES OF OPERATIONS

1.01 The basic concept of an emergency service should be the fostering of community self-help and mutual assistance during emergency and/or disaster situations. Storm damage operations fall into this category and emergency services members provide community support mainly by assisting residents to effect temporary repairs to damaged buildings. This assistance should be based on these principles:

a. Prevention of damage resulting from storms is far preferable to carrying out repairs. Responsible organisations should embark on regular education, information and pre-storm assistance programmes advising members of the public, and assisting them to, take steps that could reduce the effects of future storms. Emergency Management Australia publishes free material on severe storm and cyclone awarness and preparedness for dissemination to the public, by State/Territory Emergency Services.

b. Community members should be encouraged to effect their own repairs and given assistance in the form of advice and materials

c. Where residents have a genuine requirement for further assistance it should be provided on a priority basis with preference being given to those most in need. These cases can largely be categorised as follows:

(1) **Urgent** - Hospitals, aged persons homes, etc.

(2) **Priority** - Private dwellings where the occupants are aged, infirm or have specific medical requirements.

(3) **Normal** - Private dwellings where the occupants genuinely cannot effect their own repairs or arrange for friends or relatives to assist.

(4) **Low Priority** - Private dwellings where the occupant requires assistance to effect repairs

(5) **Other** - Commercial and industrial premises. These premises may warrant being given a higher priority if they provide an essential community service.

d. Any repairs carried out are designed to be of a temporary nature only, to provide the community with protection until permanent repairs can be completed. These temporary repairs normally do not provide full weather-proofing of damaged buildings under all conditions, but the protection is usually sufficient to maintain the main part of a building in a livable condition.

e. Any assistance provided to residents should normally be on a once-only basis Any adjustments required to coverings should preferably be carried out by the occupant and when permanent repairs have been completed any materials issued should be returned to pre-arranged collection centres.

f The safety of personnel should take precedence over the provision of assistance Subjecting personnel to unsafe or hazardous situations to prevent further damage to property is not warranted under any circumstance.

g. To protect the interests of the building owner, the occupants and emergency service personnel, temporary repairs to any damaged building should not be undertaken unless the building owner, a representative or a person in authority is present throughout the operation.

1.02 These principles form the basis of all storm damage operations and if taken into account will have a direct bearing on the success of subsequent operations.

PREPARATION

1.03 A frequent cause of emergency service activation is the regular occurrence of storms in the form of random hailstorms, wind-associated thunderstorms, small tornadoes, land gales and cyclones.

1.04 Except for cyclones, these natural phenomena can occur almost anywhere in Australia and at almost any time of the year. They can cause damage to dwellings and other structures ranging from isolated, relatively minor cases, to severe widespread damage and, in some cases, even total collapse or severe damage causing the structure to be uninhabitable.

1.05 Because of the frequency, unpredictability and widespread geographical likelihood of storms, it is necessary for emergency services to be fully prepared to cope with all aspects of operational necessities experienced in handling these events.

1.06 The preparation for storm damage operations can be divided into three basic areas:

a. Local authority preparation.

b. Emergency service preparation.

c. Individual members' preparation.

1.07 LOCAL AUTHORITY PREPARATION

This is the planning stage of the process and deals with the identification of possible disasters and the determination of measures to deal with their affects. The planning process is dealt with in more detail later in this chapter.

1.08 EMERGENCY SERVICE PREPARATION

This involves the arrangements made or actions taken to prepare local emergency service units to be able to carry out their roles and responsibilities efficiently and effectively. The following points, which are covered in more detail later in this chapter should be addressed:

a Identification, availability and condition of resources.

b Formulation and production of standard operating procedures.

1.09 INDIVIDUAL PREPARATION

This covers the points that should be addressed by emergency service members so that they are capable of performing their allotted tasks. This preparation involves a number of factors which are also covered in later sections of this chapter.

1.10 The preparation phase of counter-disaster operations is sometimes neglected and often attracts only limited consideration. This phase of storm damage operations is a critical part of the efficient conduct of the operation and the effective provision of assistance to the community.

1.11 Remember the six 'p's:

Prior
planning and
preparation
prevents
poor
performance.

PLANNING

1.12 Australia is a vast country and suffers from the effects of a number of natural disasters of which storm damage is one. To counter the effects of these occurrences it is necessary to identify the types of incident that could affect the community and to coordinate the response of the various emergency organisations. This is achieved by the production of local authority counter-disaster or emergency management plans.

1.13 Each local authority is responsible for the production of a counter-disaster or emergency management Plan for its area. As planning for disaster is not something that can be done in isolation, the local authority forms a counter-disaster planning or emergency management planning committee which is made up of representatives from various organisations that could have some role or responsibility in disaster situations

1.14 There are a number of stages and factors that must be considered in the process of producing a counter-disaster or emergency management plan and it is not intended to cover this process in any detail in this manual. More detailed information on the production of such plans is available from state/territory counter-disaster/emergency management authorities and the Australian Emergency Manual - Community Emergency Planning Guide.

1.15 The local counter-disaster or emergency management plan is an important part of disaster/emergency management. As well as providing a coordinated approach to the control of disaster situations it also enables involved organisations to determine their own priorities and arrangements with regard to training, equipment, etc.

UNIT PREPARATION

1.16 The aim of an emergency service at local level is to be capable of carrying out the roles and responsibilities as laid down in legislation or plans. To achieve this aim the unit must firstly consider several factors, make specific arrangements and formulate procedures. In other words the unit must **prepare** itself.

1.17 The preparation for storm damage operations involves the consideration of resources and procedures.

RESOURCES

1.18 It is necessary for units to identify available resources and determine policies for procurement, siting and storage, maintenance and training.

1.19 Resources can be divided into:

a. human;

b. stores; and

c. equipment.

1.20 HUMAN RESOURCES

The most important resource is people. Without adequate personnel it can be difficult or impossible to complete the task at hand effectively. It is therefore important to predict the number of personnel that may be required to deal with the effects of storm damage. By comparing this figure with the number of personnel currently available, possible shortfalls will become evident. It may then be necessary to eliminate or reduce this shortfall by:

a. recruitment of members;

b training of personnel from other organisations; and

c public education.

1.21 While it is important to have personnel, it is also important that these personnel are capable of performing the tasks required with minimal supervision. To ensure this, a training program should be formulated and should include all storm damage-related subjects. It is also necessary to evaluate the level of training of personnel by conducting testing exercises in all facets of storm damage operations.

1.22 **STORES AND EQUIPMENT**

To deal effectively with the common tasks involved in storm damage operations, emergency service units will need to have available, sufficient stocks of:

a. tarpaulins;

b. rope;

c. ladders;

d. hand tools;

e. portable and hand held lighting;

f. chainsaws,

g. fall prevention systems;

h acrow props and shoring materials;

i. expendable stores items (tape, plastic bags/sheet etc); and

j. communications equipment.

1.23 To ensure the efficient and effective use of these resources, it is important that all stores and equipment are in a serviceable condition and that personnel are familiar with their use and operation. It is therefore necessary to arrange regular maintenance and servicing of all items of stores and equipment.

1.24 This maintenance and servicing does not apply only to major items of equipment such as generators and chainsaws but also involves:

a. inspection, repair of tarpaulins;

b. inspection of ropes;

c. checking of lighting equipment including torches;

d inspection and maintenance of ladders; and

e. maintenance of handtools.

1.25 One useful way of maintaining stores and equipment is to combine maintenance and training periods where personnel are trained in the operation and maintenance of particular items of equipment. This method allows members to gain a greater appreciation of the use and care of equipment by carrying out basic maintenance themselves. Note that this method is only for the normal day to day maintenance and is not intended to replace specific servicing requirements.

PROCEDURES

1.26 To allow for the smooth operation of the unit during storm damage activation it is recommended that normal routine procedures be formulated and documented to form standing operating procedures, commonly abbreviated to SOPs.

1.27 The stages of an operation normally covered by SOPs are:

a. activation/standby;

b. operations;

c. close down; and

d. debrief.

1.28 ACTIVATION/STANDBY

This stage details how the unit will be activated and by whom and the initial steps to be taken upon activation to place the unit on standby. It also details the callout method including who calls whom and the action to be taken upon callout.

1.29 OPERATIONS

The normal operating procedures are stated in this phase. These could involve:

a. headquarters establishment and staff rosters;

b. headquarters duties and operation;

c. tasking procedures;

d. communications;

e. stores control;

f. safety procedures; and

g. prolonged operations.

1.30 CLOSE-DOWN

The actions to be taken and the procedures to be followed at the conclusion of activities. This stage could detail:

a. return of stores and equipment;

b. maintenance; and

c. administration.

1.31 DEBRIEFING

When, where and who is to conduct the debrief and the final reporting procedure.

1.32 RETURN OF STORES

The method to be used to recover stores issued to property owners.

PERSONAL PREPARATION

1.33 It is important for individual members to be personally prepared for storm damage activation. This preparation enables members to be an effective part of the operation as well as making arrangements for their own personal benefit.

1.34 There are a number of points that should be considered by emergency service members prior to activation. These include:

a. physical fitness;

b. mental preparation;

c. training; and

d. dress and personal equipment.

1.35 PHYSICAL FITNESS

Members should be aware of their physical abilities and should take into account their medical condition. Storm damage operations can involve periods of intense physical exertion under adverse conditions. It would be unwise and in some cases unsafe to undertake this type of activity if suffering from some form of physical or medical debility. Any doubts about physical condition should be brought to the attention of the appropriate leader or officer. This will allow for the allocation of suitable tasks.

1.36 MENTAL PREPARATION

Hand in hand with physical condition is the mental attitude of members Each member should be mentally prepared for all possible tasks involved in storm operations. Personal attitude plays an important part in this type of activation as members are sometimes required to deal with distraught and/or confused members of the public who need to be approached and dealt with in a considerate manner. It is also important for each member to be aware of any fears or phobias. Fear of height, enclosed spaces, sight of blood, etc might cause problems for members involved in storm operations. Leaders must avoid placing members in situations that could aggravate fears.

1.37 TRAINING

Members should recognise their level of knowledge in relation to storm damage tasks. Any lack of knowledge and/or experience or doubt about personal abilities should be brought to the attention of the unit or group to allow for further training. Team leaders must constantly monitor the performance of members and provide for on-going skills maintenance and re-assessment on a regular basis. On-going training should include the use of expert advisors such as builders, architects and so forth.

1.38 DRESS AND PERSONAL EQUIPMENT TRAINING

When an emergency service member is activated for a storm damage operation, a little thought can save certain inconvenience and can provide personal safety and comfort:

a. Dress and equipment required to be worn by emergency service personnel under various operational conditions is laid down by various state and territory occupational health and safety legislation and by each service's regulations

b. Overalls and boots are not always the most appropriate or comfortable clothing during storm damage operations. In some cases overalls can become a hazard because of their restrictive nature and boots can actually be dangerous on slippery, uneven roofing materials where joggers or sand shoes would be safer. Consideration should be given to other more suitable dress with regard to current weather conditions. However some form of protective foot wear and clothing should be worn at all times to guard against the possibility of injury from jagged edges, nails and other projections. Protective headgear should be worn at all times.

c. Some items of personal comfort and safety that should be considered and which are the responsibility of the member to arrange are:

(1) small notebook and pencil;

(2) easily carried high energy food such as small packet of sultanas, pieces of fruit, muesli bars, etc;

(3) full water bottle/s;

(4) foul-weather gear;

(5) sunscreen and insect lotion;

(6) headache tablets;

(7) a good sharp pocket knife or a pair of sidecutting pliers;

(8) coins for telephone;

(9) work gloves or similar;

(10) change of clothes; and

(11) bag or pack to carry the above.

d. Some of these items are self-explanatory, but the less obvious ones are the items that can provide greater comfort to those who have the foresight to carry them.

CHAPTER TWO

BUILDING CONSTRUCTION

INTRODUCTION

2.01 The most common storm damage normally affects residential buildings in the form of roof, window and occasionally structural damage. For safety reasons and if it is necessary to effect shoring of damaged buildings, it is desirable for personnel involved in storm operations to have a basic knowledge of the common styles of residential buildings.

2.02 As the roof is normally the area of the building which receives the most damage, it is important for personnel to gain an understanding of common roof styles, basic roof construction methods and roofing materials. This knowledge can be of great use for the effective application of suitable temporary repair methods and for the assessment of possible hazardous situations.

BUILDING STYLES

2.03 It is becoming more difficult to give an overall description of a typical dwelling as many architectural influences apply to the construction of homes. However the basic construction could largely be categorised as follows:

a. **Full Brick** - Double skinned brick construction used for all external walls and all or some internal walls. In some cases the cavity between the bricks is filled with an insulating material.

b. **Brick Veneer** - Exterior walls constructed of single skin of brick with internal surfaces framed in timber or steel and sheeted in one of several materials available.

c. **Block** - Either solid concrete block exterior with block interior partitions, or solid block exterior with internal framed and sheeted walls.

NOTE: All of the above are commonly built on concrete slab foundations as low or high set houses. High set houses can have either concrete or timber floors.

d. **Frame and Sheet** - All walls constructed of timber or metal frame. The exterior can be covered using a number of different materials (eg fibrous cement strips or sheets, timber weather boards or chamfered boards, metal or plastic cladding or siding). The interior walls are normally as for brick veneer. This type of construction is commonly used for high-set houses built on concrete or timber stumps or metal posts. However it can be built on concrete slab foundations.

e. **Log** - Usually low-set houses constructed on concrete foundations using logs horizontally laid around a substantial log frame of power pole dimensions.

f **Other** - Self-constructed houses of various designs using some of the above methods and comprising alternative materials (eg mud brick, compacted earth, composition bricks, corrugated iron, etc).

2.04 Regulations covering the construction of buildings are stringently controlled and regularly reviewed and updated by appropriate authorities. However buildings built prior to current regulations may suffer considerable structural damage or even total collapse. The older-style, fibro-sheeted houses can suffer major damage from severe hail or flying debris. This type of house can be affected by strong wind gusts causing the building to move off its stumps or foundations.

2.05 Apart from buildings which fall into the 'other' category, remaining styles of construction may suffer similar types of damage, to a lesser degree, due to greater structural integrity. However, under extreme conditions severe damage can be caused to these buildings which could involve the partial or even total collapse of walls. It has been evident that the majority of structural damage caused during storm conditions is from the impact of debris, trees and branches.

2.06 No matter what the cause of the damage, to avoid further damage and for safety reasons, careful investigation and assessment of the situation should be made prior to attempting any temporary repair.

ROOF STYLES/CONSTRUCTION

2.07 Several common styles of roof construction are used in the building industry. Although these styles can be separately identified, many roof construction methods commonly incorporate several styles to form individually designed roofs. These combined designs incorporate the attributes of each style. It would be impossible to give examples of all possible combinations of roof styles, as the number of combinations is limited only by imagination. Therefore, only the main designs have been described in this manual.

2.08 Teams must choose the most effective temporary repair method by identifying potential hazards and determining safety requirements. To assist in this process, it is important that members understand the basic parts, terms and methods used in roof construction. The basic method of roof construction is covered in this section without detailed technical information or involved techniques. For further information on this subject, consult the local authority building inspector, a registered builder, or refer to a detailed building construction manual.

2.09 GABLE ROOF

This is one of the most common roof styles used. Pitch can vary from almost flat, to 'A'-frame The steeper the pitch the harder it is to affect temporary repairs

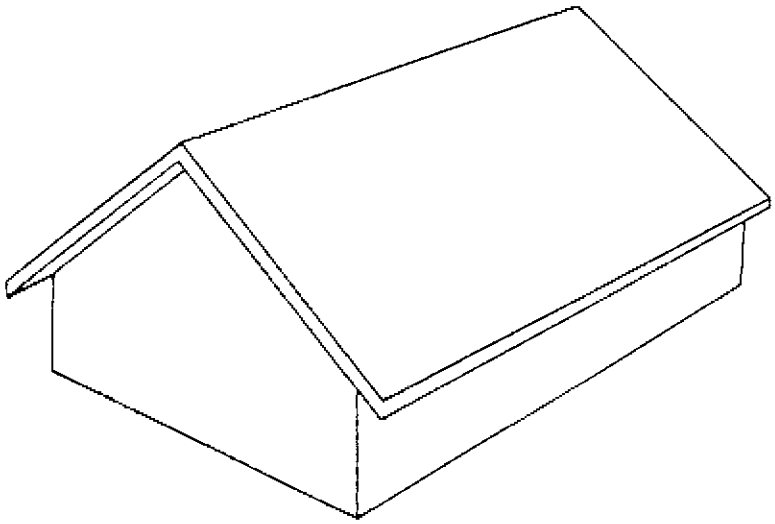

Figure 2:1
Gable Roof

2.10 HIP ROOF

A very common roof style. Can cause some problems if tarping is required at or near hip joints.

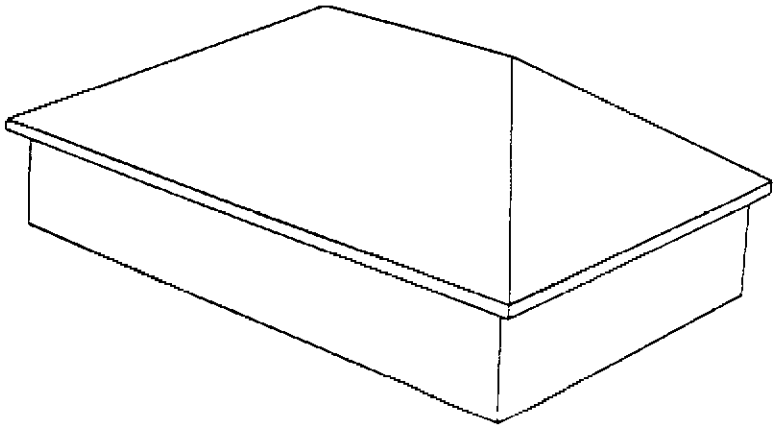

Figure 2:2
Hip Roof

2.11 COMPOSITE ROOF

A composite roof can be a combination of different styles.

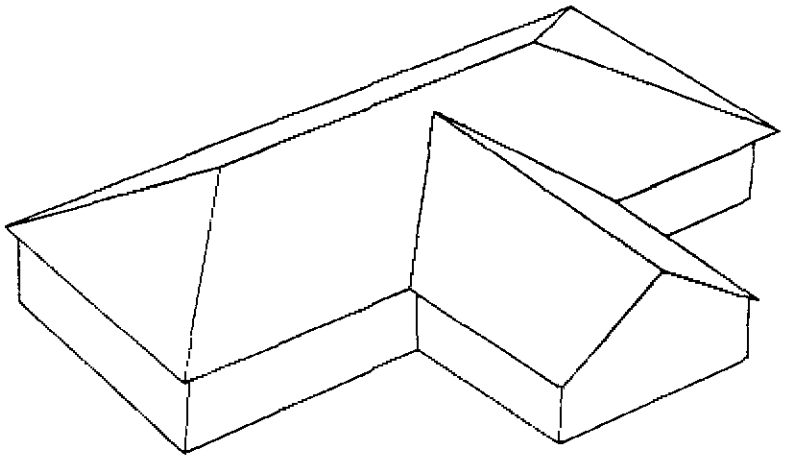

Figure 2:3
A Common Composite Roof

2.12 SKILLION ROOF

This is simply one-half of a gable roof.

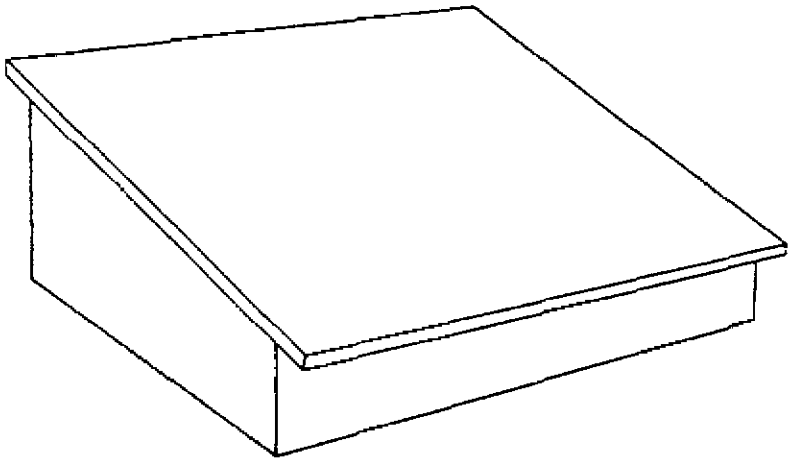

Figure 2:4
Skillion Roof

2.13 FLAT ROOF

This style of roof offers the least resistance to wind and usually experiences least damage. Repair methods may have to take into account an allowance for water run-off.

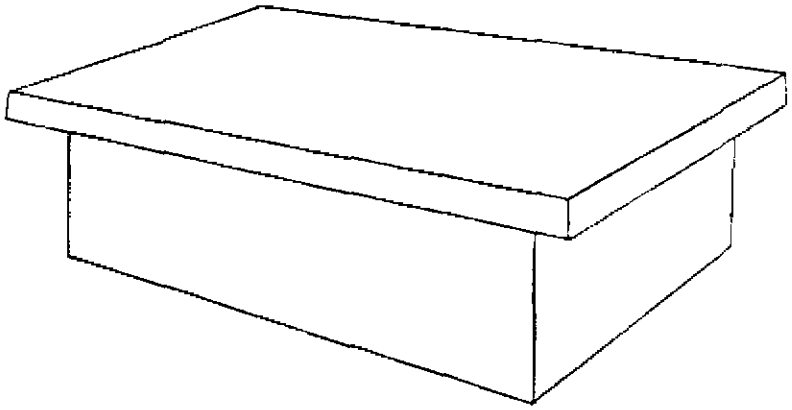

Figure 2:5
Flat Roof

2.14 GAMBREL ROOF

The centre section of this style can be quite steep and will require special safety considerations.

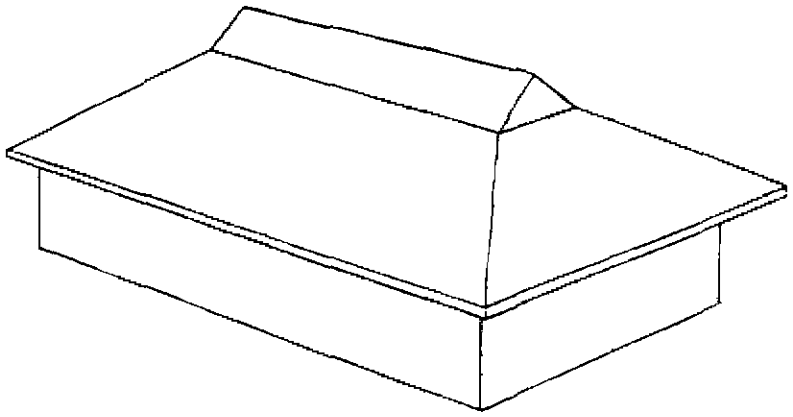

Figure 2:6
Gambrel Roof

2.15 JERKIN HEAD ROOF

The edge of this roof can be quite a steep pitch.

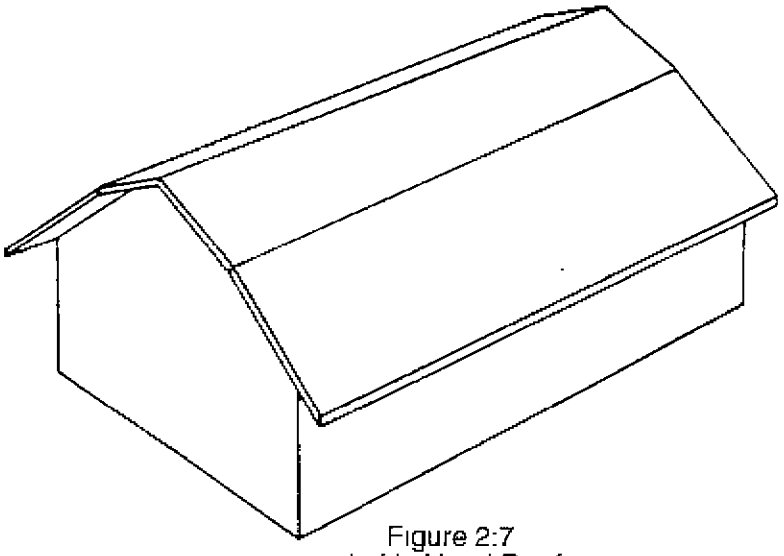

Figure 2:7
Jerkin Head Roof

2.16 'A'-FRAME ROOF

Although this is really a gable-style roof with the roof edges extending to the ground it requires separate consideration because of its pitch or steepness. This type of roof can be subject to considerable damage as the entire roof surface can be affected by wind gusts and debris impact. Temporary repairs can be time-consuming as any work would need to be carried out using safety restraints and/or several ladders.

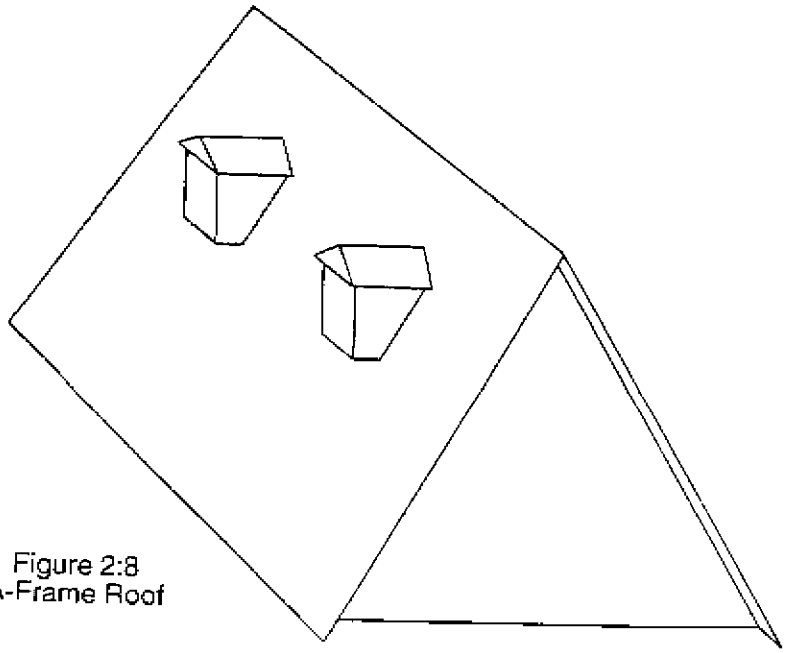

Figure 2:8
A-Frame Roof

2.17 ROOF CONSTRUCTION TERMINOLOGY

The following terms are used to describe specific structural components used in the construction of roofs:

a. **Rafters** - Rafters run in the same direction as the roof pitch and form the main structural support onto which the roof structure is built.

b. **Purlins** - Form a part of the roof frame and are attached to the rafters, across the roof pitch normally at 90o to the rafters. They act as supports and braces for the roof frame Where purlins are attached to the underside of the rafters, battens must be fixed.

c. **Battens** - Battens are fixed to the top side of the rafters across the roof pitch. They are the components onto which the roofing material is laid. Spacing of battens varies according to the type of roofing material being used. Close spacing is used to lay tiles.

d. **Fascia** - The fascia is the piece of timber or metal attached to the lower edge of the roof onto which the edge gutter is fixed.

e. **Barge Board** - Similar to the fascia but is attached to gable edge of the roof and has no guttering.

f. **Eaves** - The eaves form the sealed area under the roof overhang.

g. **Ceiling Joists** - The structural framework onto which interior ceiling is fixed.

h. **Sarking** - Normally a bitumen-impregnated material sometimes with a reflective coating placed directly under the roofing material

i. **Trusses** - Prefabricated structural roof framework constructed to the shape of the roof cross-section. The trusses are lifted into position and fixed to the building frame. Additional bracing and framework are added as necessary.

j. **Noggins** - Timbers which are positioned between rafters and wall frame timbers to provide a point for securing purlins, sarking battens and wall panel material.

2.18 MAIN COMPONENTS

Figure 2:9 shows the position of the main components in a typical roof construction.

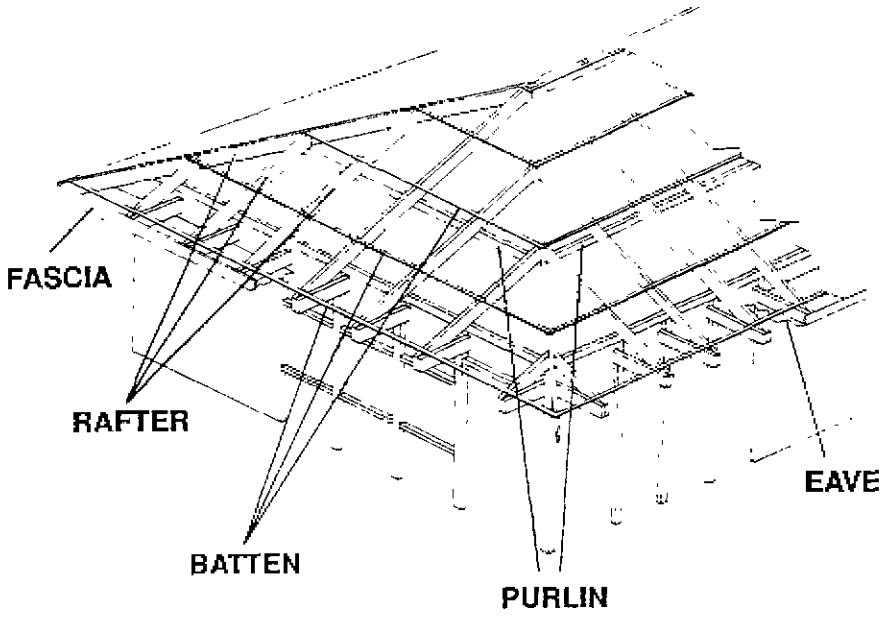

Figure 2:9

2.19 TRUSSES

Figure 2 10 shows the use of prefabricated trusses to construct the roof.

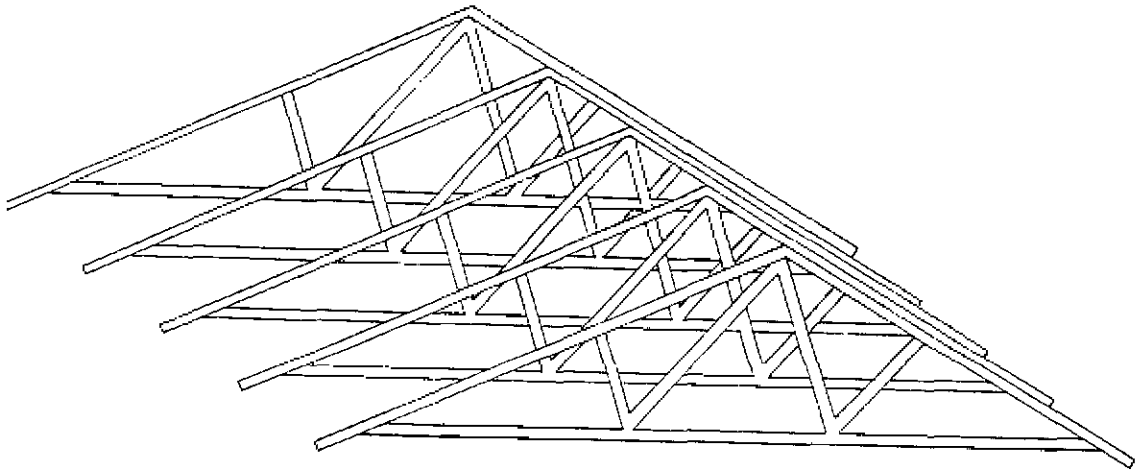

Figure 2:10

2.20 ROOF FIXINGS

The framework is built using a number of different fixing methods from nails, bolts and nuts to the currently more commonly used triple grip fastenings Some older-style houses used mortise and tenon joints and dovetailing methods.

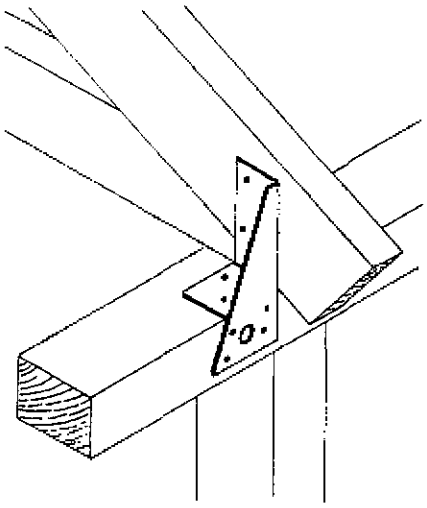

Fig. 2:11
Triple Grip Fastener

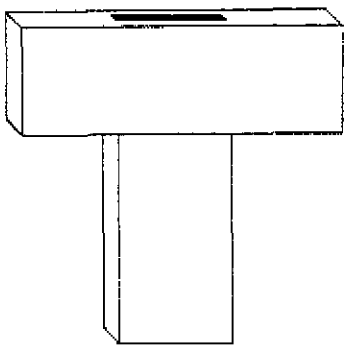

Fig. 2:12
Mortise & Tenon

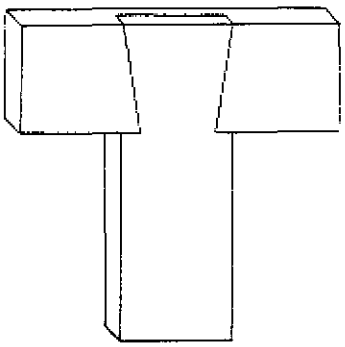

Fig. 2:13
Dovetail Joint

ROOF CLADDING MATERIAL AND DAMAGE CHARACTERISTICS

2.21 Materials used in roof covering are almost too numerous to mention. To assist teams to choose the most effective temporary repair method, identify potential hazards and determine safety requirements, only the major roofing materials employed and their characteristics are covered in this section

2.22 Temporary repair methods and associated problems are not included in this section, but are covered in detail in Chapter Four of this manual

2.23 CORRUGATED IRON

Sheets of galvanised, zinc-annealed or colour-coated corrugated steel laid by overlapping the sheets to prevent water penetration. Probably one of the most widely-used roofing materials

2.24 Older manufacturing techniques required numerous short sheets to cover the roof resulting in many overlapped joins. The current method is to manufacture sheets in continuous lengths requiring less overlapping.

2.25 Fixing methods include self-sealing lead head or cup head galvanised nails and zinc-plated, cadmium-plated or stainless steel self-tapping screws with a rubber sealing gasket.

2.26 DAMAGE CHARACTERISTICS OF CORRUGATED IRON

a Older roofing is prone to wind damage causing the sheets to lift or completely blow off.

b. Prone to corrosion with age, resulting in water leaks and causing sheets to lift in windy conditions.

c Hail can cause denting or bending of sheets, normally without causing water leaks.

d. If roof structure is weak or not fixed properly, wind pressure can cause sheeting and roof frame to be dislodged.

e. Large objects can cause severe penetration damage in strong wind conditions.

2.27 CORRUGATED ALUMINIUM

Sheets of corrugated aluminium normally colour-coated and manufactured in continuous lengths. Laid as for corrugated iron and fixed with self-tapping screws

2.28 DAMAGE CHARACTERISTICS OF CORRUGATED ALUMINIUM

a Prone to wind damage causing sheets to lift, bend or blow off.

b Sheets able to be torn/punctured by flying debris or hail.

c Not prone to serious corrosion.

d. Care should be taken when walking on this type of roof as further damage can be caused. Walk only along the line of roof fixing screws (on the purlins or battens).

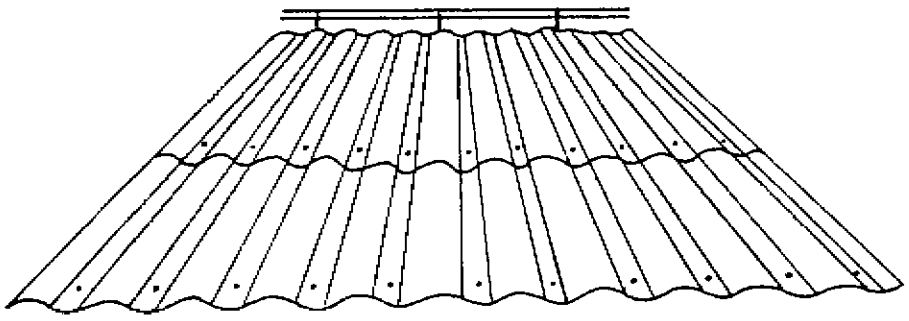

Figure 2·14
Corrugated Iron/Aluminium Roofing

2.29 CORRUGATED FIBRO

Sheets of corrugated fibrous cement manufactured in standard lengths and laid as for corrugated iron. This material comes in two forms:

a. **Standard** - Corrugations similar to corrugated iron.

b. **Super Six** - Thicker material with larger corrugations.

2.30 These fibro sheets are normally fixed with screws, sealed with diamond-shaped washers and sealing compound.

WARNING: Roof or wall sheets containing fibrous materials pose a significant health hazard. Appropriate protective measures must be employed. (Refer Chapter 3).

2.31 DAMAGE CHARACTERISTICS FOR CORRUGATED FIBRO

a. Serious damage caused from debris and hail resulting in extensive areas being holed or broken.

b. Prolonged heavy rain can cause water penetration through the material.

c. Prone to wind damage causing sheets to lift, break or completely blow off.

d Extreme care should be taken when walking on this type of roof as further damage can be caused. Walk only on the line of roof fixing screws (on the purlins or battens).

WARNING: A large percentage of the injuries sustained by emergency workers in the past have been as a result of accidents involving fibro roofs. This material becomes very brittle with age and a build-up of a black fungus makes it very slippery when wet. Extreme caution should be taken when confronted with this type of roof

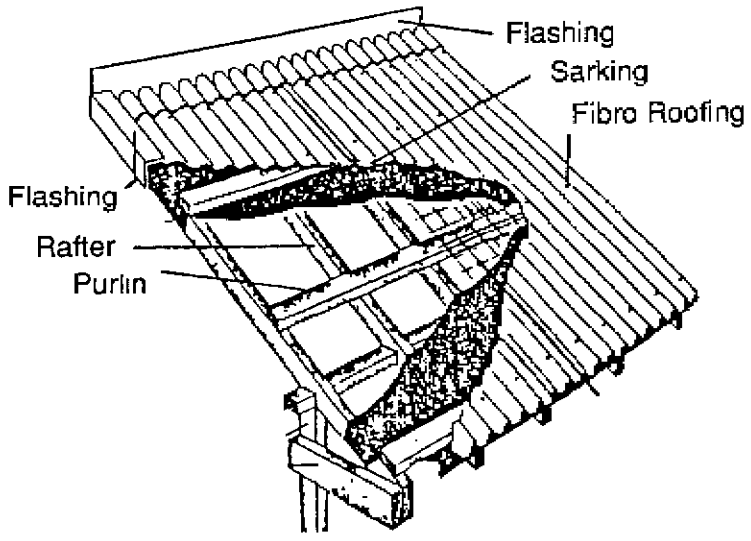

Figure 2:15
Corrugated Fibro Roofing

2.32 METAL ROOF DECKING

This type of material is constructed of narrow sheets of galvanised, zinc-annealed or colour-coated steel laid by overlapping the sheets to prevent water penetration. It is normally fixed by metal clips nailed/screwed to the roof battens onto which the sheets clip. It can be fixed in a similar way to corrugated iron.

2.33 DAMAGE CHARACTERISTICS OF METAL ROOF DECKING

a. Hail can cause denting of sheets, normally without causing water leaks.

b. Prone to corrosion with age resulting in water leaks and wind damage.

c. Large objects can cause severe damage in strong wind conditions.

d. Wind can have a peeling effect which can result in large expanses of the roof peeling off.

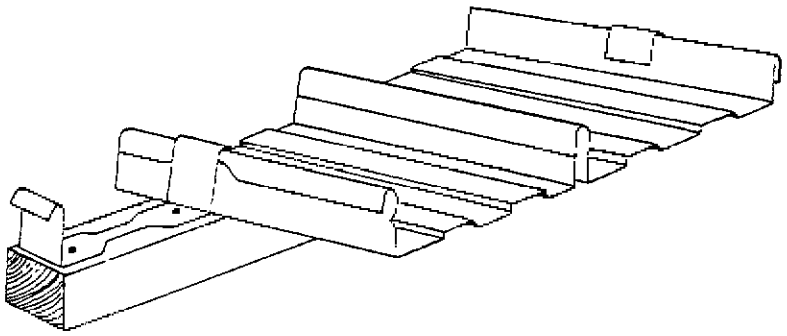

Figure 2:16
Metal Roof Decking

2.34 CONCRETE OR TERRA COTTA TILES

These are single tiles manufactured from either cement or baked clay and glazed or colour-coated.

2.35 Tiles are laid in horizontal rows starting from the roof edge and working up. Each tile overlaps the tile on one side and each row overlaps the lower row. Fixing methods include wire ties passing through a hole on the underside of the tile and around the batten or by nailing through a hole in the tile under the overlap. Ridge cap tiles are laid along the apex of the roof with the end tiles fixed with nails and all tiles mortared into position

2.36 DAMAGE CHARACTERISTICS OF CONCRETE OR TERRA COTTA TILES

a. Susceptible to damage from hail and flying debris causing tiles to crack or break.

b. Prone to wind damage resulting in tiles being blown off if not tied down properly and/or tiles lifting causing water leaks.

c. Ridge tiles are commonly displaced by wind because of dry mortar causing water leaks and further damage to other tiles.

d. Care should be taken when walking on this type of roof as further damage can be caused Old terracotta tiles become brittle with age and can crack when walked on.

WARNING: Displaced tiles can be easily dislodged if disturbed causing them to slide down the roof or fall through the internal ceiling resulting in serious injury to persons below.

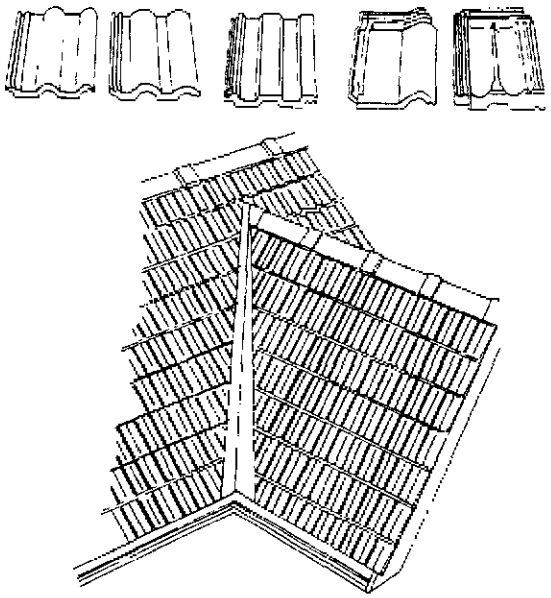

Figure 2:17
Concrete or Terra Cotta Tiles

2.37 METAL TILES

Tile-shaped metal strips manufactured from various metals including aluminium and steel and coated with a number of different materials (vinyl, plastic, tar and pebbles)

2.38 Metal tiles can be laid over existing roofs or as the original roof. They are normally laid horizontally with each strip overlapping the lower strip and are fixed with galvanised nails hammered under the overlap and on the batten edge.

2.39 DAMAGE CHARACTERISTICS OF METAL TILES

a. They are not prone to serious wind damage, but strips can lift, bend or blow off in strong wind conditions.

b. Strips can be torn/punctured by flying debris or hail.

c. They are not prone to serious corrosion.

d. Care should be taken when walking on this type of roof as further damage can be caused. Walk only along the lines of the purlins or battens.

2.40 SLATE TILES

These are rectangular flat tiles made of slate and laid as for concrete or terracotta tiles. Slate tiles can be fixed by tying or nailing. These tiles are more common on large old buildings such as schools and on some of the more modern, expensive homes.

2.41 DAMAGE CHARACTERISTICS OF SLATE TILES

a. They are susceptible to damage from hail and flying debris causing tiles to crack or break.

b. They are prone to wind damage resulting in tiles being blown off and/or tiles lifting causing water leaks.

c. Care should be taken when walking on this type of roof as further damage can be caused. These tiles become brittle with age and can easily crack when walked on.

WARNING: This material becomes very brittle with age and very slippery when wet. Extreme caution should be taken when confronted with this type of roof.

2.42 SHINGLES

Shingles can be made of flat rectangular pieces of timber or fibro and are laid in a similar fashion to tiles. They are not widely used, but some of the more modern houses have incorporated them in their construction.

2.43 DAMAGE CHARACTERISTICS OF SHINGLES

a. Shingles deteriorate with age and may be seriously affected by wind and rain.

b. They are prone to wind damage resulting in tiles being blown off and/or tiles lifting causing water leaks.

c. They are prone to debris and hail damage causing severe splitting or shattering

2.44 BITUMINOUS FELT

This is a covering of felt material impregnated with a hot bitumen compound normally placed over a flat timber deck. It is used on older style buildings for small extensions such as kitchen recesses, toilets, etc

2.45 DAMAGE CHARACTERISTICS FOR BITUMINOUS FELT

a. It is not normally severely damaged by wind or rain but can leak under heavy rain conditions if felt covering is worn or if bitumen compound is old and cracked

b. The surface can be damaged by heavy hail or flying debris, causing punctures in the felt material.

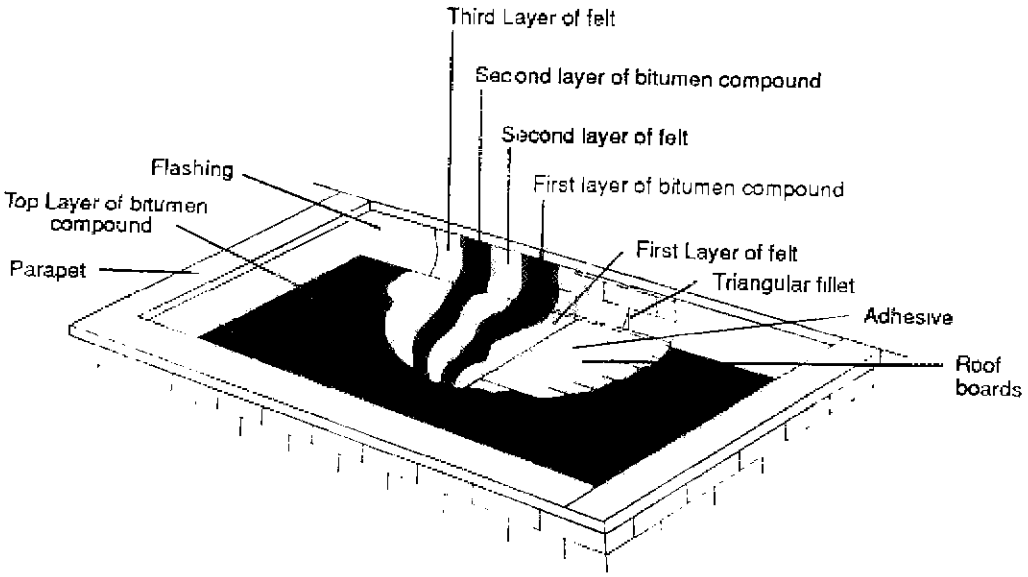

Figure 2:18
Bituminous Felt Roofing

2.46 FIBRE-RESIN SHEET

This is corrugated clear or coloured translucent material, such as Alsynite, and is laid as for corrugated iron and fixed with self-sealing screws. It is commonly used on patios, carports, greenhouses and for skylights.

2.47 DAMAGE CHARACTERISTICS OF FIBRE-RESIN SHEETING

a. This material deteriorates with age because exposure to ultra-violet rays causes brittleness and cracking or breaking when subjected to wind and/or heavy rain.

b. It is extremely susceptible to damage from hail and flying debris. Sheets can disintegrate on impact.

c. Do not walk on this type of sheeting as further damage can be caused.

WARNING: This material is not very strong and weakens with age. Extreme caution should be taken when confronted with this type of sheeting, and ladders or boards must be laid to span such sections

GUTTERS

2.48 Most houses have a guttering system to collect the run-off water and channel it away from the building. These gutters are manufactured from various materials such as:

a. galvanised iron;

b. aluminium; and

c. poly-vinyl carbonate (PVC).

2.49 GUTTER TYPES

Two main types of guttering system are used:

a. **Edge Gutters** - Moulded gutters manufactured from any of the above materials and normally fixed to the fascia board along the lower edge of the roof.

b. **Box Gutters** - Pressed gutters fabricated from galvanised iron and normally fitted to large roofs between two roof surfaces or along the edge of a roof where a parapet wall extends above the roof.

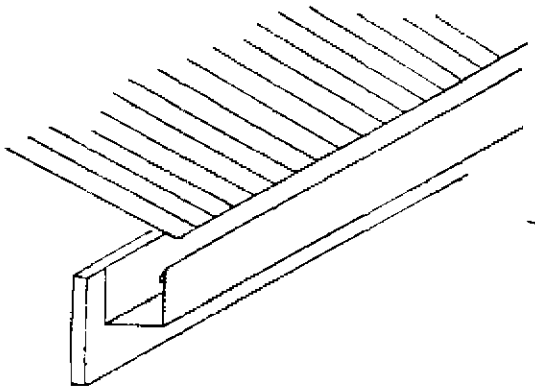

Figure 2:19
Edge Gutter

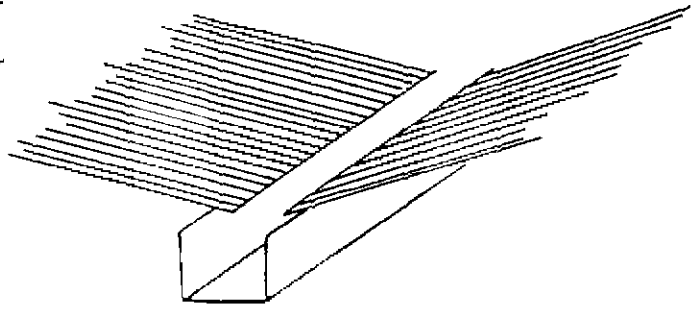

Figure 2:20
Box Gutter

2.50 BLOCKAGES

Although the guttering can be damaged or dislodged during storms, generally there is no need to effect any repairs. The only problem commonly encountered is the blockage of the gutter with hail, debris or leaves, causing water to overflow back into the eaves and eventually into ceilings and walls.

2.51 FRAGILITY

Care should be taken when working around edge gutters, especially those of aluminium or PVC, as these materials can bend or break under pressure. This is a particular problem when a ladder is placed for access to a roof.

ROOF PROTUSIONS

2.52 Most buildings have pipes and/or vents of some description projecting past the roof edge or protruding through the roof. Some buildings also have chimneys for internal fireplaces and skylights to allow internal lighting or ventilation.

2.53 DAMAGE PROBLEMS

These protusions can be damaged etc during storms and can cause damage to the roof surface. They also present problems when temporary repairs need to be effected.

2.54 SKYLIGHTS

Skylights are normally constructed of sheets of glass, fibreglass or plastic compounds fitted into a metal or wooden frame They are prone to damage from flying debris and hail.

2.55 PIPES/CHIMNEYS

Pipes and chimneys can be damaged by wind or flying debris and can be dislodged causing further damage to the roofing material and/or the roof frame. For safety reasons and to prevent further damage it is important to check the condition of these objects before commencing operations.

2.56 FLASHING

The joint where these items pass through the roof is normally sealed with a strip of metal which is known as flashing. This flashing can be corroded or loosened with age causing water leaks during heavy rain.

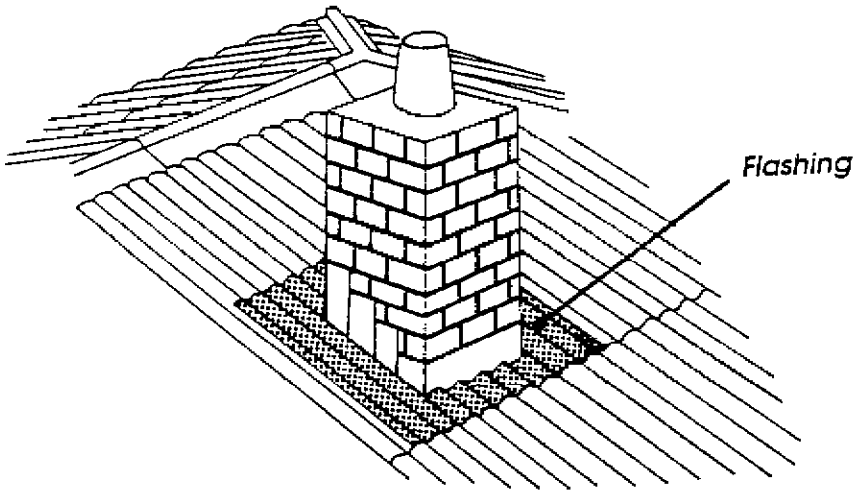

Figure 2:21