CYCLONES....
IS YOUR HOUSE READY?

A Homeowner's Guide

THIS GUIDE WAS PREPARED BY THE CYCLONE TESTING STATION WITH SUPPORT FROM NORTHERN TERRITORY, QUEENSLAND AND WESTERN AUSTRALIAN GOVERNMENTS

Northern Territory Government

Queensland Government
Department of Infrastructure and Planning

Government of Western Australia
Department of Commerce
Building Commission

Cyclone Testing Station

1. INTRODUCTION

This guide has been prepared for the homeowner to create awareness of cyclones and their effect on houses. It also highlights maintenance issues that may need to be addressed to keep the house in good condition in readiness for the cyclone season and provides an overview of key areas in and around the house that may require protection to reduce the risk of cyclone damage.

A checklist is included to help the homeowner conduct a preliminary house inspection to identify potential risks and seek further advice to address any issues if required.

2. WHAT IS A CYCLONE?

Tropical cyclones are low pressure systems which develop in the tropics and can affect subtropical regions of Australia. They produce very strong winds, heavy rainfall with flooding and may also cause damaging storm surges.

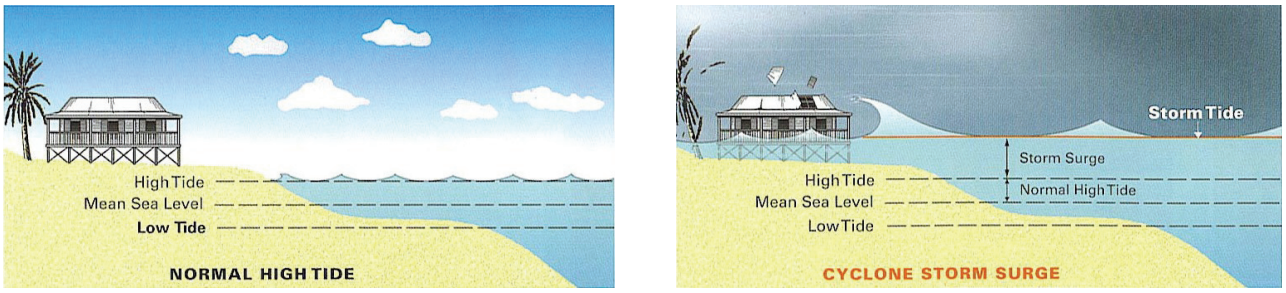
AERIAL VIEW OF A CYCLONE. (IMAGE TAKEN FROM EMERGENCY MANAGEMENT IN AUSTRALIA WEBSITE)

Strong winds generated during severe tropical cyclones can cause extensive property damage and turn airborne debris into potentially lethal missiles.

Tropical cyclones generally hold enormous amounts of moisture and can produce heavy rainfall over extensive areas. This can cause further damage to property and infrastructure and death by drowning.

A storm surge is the most dangerous hazard associated with a tropical cyclone that comes ashore. It is a rapid rise in sea level above its normal level as a result of the strong onshore winds caused by an approaching cyclone. If the storm surge occurs at the same time as the high tide, the area inundated can be extensive, particularly along low-lying

coastlines. Storm surge has been responsible for more deaths than any other consequence of tropical cyclones.



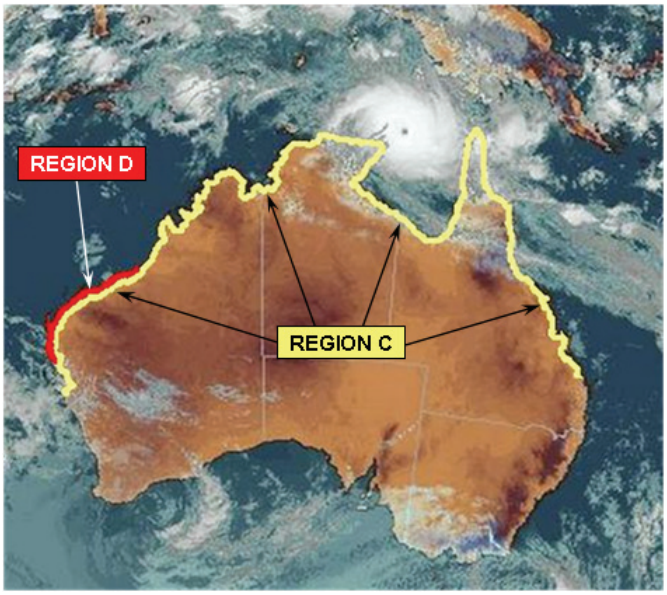
RISE IN SEA LEVEL DUE TO A CYCLONE STORM SURGE. (IMAGE FROM BOM PAMPHLET "SURVIVING CYCLONES – WARNINGS, PREPAREDNESS AND SAFETY")

3. WHEN AND WHERE DO CYCLONES OCCUR

Every year between November and April, coastal areas of Australia such as cyclonic wind regions C and D are at risk of being hit by cyclones.

Wind region C is a 50 km wide coastal strip in Northern Territory, most of Queensland and some parts of Western Australia. Houses built in this region should be designed to resist a Category 4 cyclone with expected wind speeds of nominally 252 km/hr.

On the other hand, wind region D is another 50 km wide coastal strip in Western Australia just beside a 50km wide inland strip of wind region C. Houses built in this region should be designed to resist a Category 5 cyclone with higher wind speeds of nominally 317 km/hr. Check with your local council if your house is located within one of these wind regions.



SATELLITE IMAGE SHOWING CYCLONE MONICA FROM APRIL 2006. (IMAGE FROM BUREAU OF METEOROLOGY, BOM)

4. CATEGORIES OF CYCLONES

The severity of a tropical cyclone is described in terms of the Australian Cyclone Severity Scale. This five-category system is based on the wind speeds generated by the cyclone.

TROPICAL CYCLONES SEVERITY SCALE

Cyclone Category	Strongest Gust (km/hr)	Typical Effect (Indicative only)
1	Below 125	Tropical cyclone causing negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings.
2	125-169	Tropical cyclone causing minor house damage. Significant damage to signs, trees and caravans. Heavy damage to some crops. Risk of power failure. Small craft may break moorings.
3	170-224	Severe tropical cyclones causing some roof and structural damage on old houses. Some caravans destroyed. Power failure likely.
4	225-280	Severe tropical cyclone causing significant roofing loss and structural damage on old houses. Many caravans destroyed and blown away. Dangerous airbourne debris. Widespread power failures.
5	Above 280	Severe tropical cyclone. Extremely dangerous with widespread destruction

5. WIND CLASSIFICATION OF A HOUSE

Every house in Australia is wind-classified based on the wind region and site conditions. For houses built in cyclonic wind regions C and D, there are four wind classifications: C1, C2, C3 and C4. A house with a higher classification number means that the wind speed at the site will be higher than that for a house built somewhere else with a lower classification. Hence, a house with a higher classification number should be built stronger.

Three site conditions are used to establish the wind classification of a house: (a) the roughness of the surrounding terrain, (b) its topography and (c) the density of obstructions of similar or bigger size to that of the house.

RELATIONSHIP BETWEEN THE WIND CLASSIFICATION AND DESIGN WIND SPEED

Wind classification	Design wind speed, V_h	
	m/sec	km/hr
C1	50	180
C2	61	220
C3	74	266
C4	86	310

For instance, houses built on hillsides, especially on slopes facing the sea and at the top of hills where very little shelter exists, are subjected to stronger winds than houses built on flat terrain, shielded by neighboring buildings of similar or bigger size. Houses located on unobstructed terrain such as on the edge of a golf course or in a large field are also susceptible to stronger winds.

Working out the wind class for your house is not an easy task and therefore it is suggested that you contact your local council for advice. Once the wind classification of your house is known, the wind forces that your house should be built to withstand can be readily determined.

6. LESSONS LEARNED FROM DAMAGE SURVEYS

A review of past reports on cyclone damage to houses in Australia shows that the most common types of damage observed were:

- Damage due to failure of rusted fasteners, connector plates, roof battens and other components.
- Damage caused by failure of rotten timbers.
- Garage doors being blown in or out.
- Roofs being blown away in whole or in part.
- Collapse of unreinforced masonry walls.
- Damage to inadequately built housing in exposed locations such as hills and sea frontages.
- Flying debris breaking doors and windows, resulting in further damage from water leakage and strong winds.
- Doors and windows blown open due to inadequate fixing to walls or inadequate locks and door sets.
- Damage to ceilings and walls due to water ingress through the roof, doors, windows, vents, etc.
- Failure of attachments such as guttering, fascias and eaves.
- Damage caused by falling trees.

It is evident that a house requires regular maintenance and protection to reduce the damaging effect of strong winds that develop during a tropical cyclone.

7. MAINTAINING YOUR HOUSE

One of the most important actions you can take to protect your house is to maintain it in good condition. Your house may be at risk of cyclone damage if house elements are weakened due to factors such as rust, rotten timber, termite attack or loose fixings.

7.1 Rust

Check for signs of rust around the house. Look inside the roof space for rusting of metal roof coverings, metal battens, batten straps, fixing bolts, fixing plates, screws, nails, etc. Note that the risk of rusting is particularly relevant in areas near the coast. Metal components showing signs of rusting may need replacing.

RUSTED BATTEN STRAPS CONTRIBUTING TO ROOF FAILURE

7.2 Rotten timber

Non-treated timber rots naturally when exposed to high moisture levels. This damage can affect components of your house such as floor framing, flooring, timber wall lining and timber framing. There is a higher risk of timber rotting if it is continuously exposed to moisture, such as that from a leaking water pipe. Rotten timber may need replacing.

7.3 Termite attack

Cyclonic regions in Australia are often areas of high termite risk and therefore, timbers in these houses may be susceptible to termite attack. Timber protection systems require on-going inspection and maintenance to ensure they provide an effective on-going barrier to termite attack. If it is found that termites have attacked timbers in your house, expert advice should be sought on whether the timber needs to be replaced and to repair the termite barrier.

TERMITE ATTACK TO TIMBER

7.4 Loose fixings

The combined effect of high humidity, high rainfall, strong winds and long dry periods can cause structural components to shrink or expand. This can result in loosened fixings and tie-down bolts. Loose fixings should be re-tightened where possible or additional fixings installed if necessary.

8. KEY AREAS TO PROTECT

As a homeowner, you can minimise the risk of cyclone damage to your house. This can be done by protecting critical areas where wind and rainwater can enter and by identifying any potential hazards around your house that may cause damage. These critical areas include the roof, gable end walls, doors and windows, garage doors, roof eaves, water ingress areas, house attachments and other outdoor objects and equipment.

8.1 Roof

Roof loss is by far the most likely damage that old houses face during a cyclone, so protecting the roof should be given serious consideration.

Houses built before the mid 1980s in Queensland and Western Australia or before 1975 in the Northern Territory may not be built to cyclonic building standards and therefore may not have appropriate connections to resist cyclonic winds.

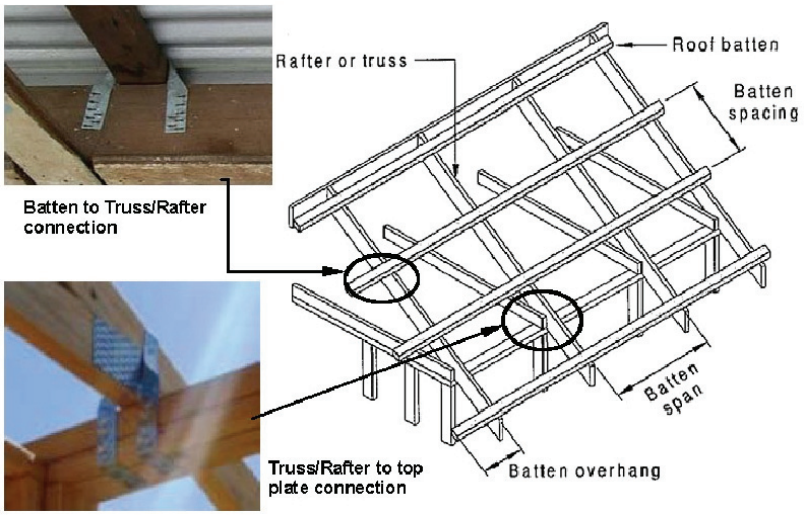
The roof is the most vulnerable part of the building during a cyclone because it is subjected to strong uplift forces. The size of these forces is influenced by the shape of the roof. For example, a house with a near flat roof will be usually subjected to larger uplift forces than a house with a pitched roof.

It is recommended that you have your roof inspected by a qualified building practitioner such as a building certifier, structural engineer, architect or builder so they can advise you whether your metal or tile roof has appropriate connections.

Connections that should be inspected include:

- roof sheet-to-batten connections,
- batten-to-truss or rafter connections,
- truss or rafter-to-wall connections and
- tile connections.

On advice from a building practitioner you may need to consider upgrading these connections to meet current building standards.



TYPICAL ROOF CONNECTIONS – PART OF IMAGE FROM AS1684

Independent of what roof shape your house has, the roof and hence your house will have a higher chance of survival if connections between roof components are built as per relevant Australian Standards' recommendations or in the case of old housing, connections have been upgraded to comply with the relevant standards.

8.2 Gable end walls

The gable end walls of a house can take a tremendous pounding during a cyclone. If not properly braced and anchored, they can collapse and result in significant damage to the rest of the house. In general, the taller the gable end triangle, the greater the risk of damage. However, gable end walls are usually easy to strengthen through bracing. Therefore, engage a qualified building practitioner to advise you on this matter.

FAILURE OF A GABLE END WALL ALLOWING STRONG WIND AND RAIN WATER INTO THE HOUSE

8.3 Doors and windows

A common problem observed during cyclones is windows and doors being broken by the impact of flying debris. This allows strong winds into the house causing high internal pressures which may increase the risk of roof and wall failure.

Impact resistant screens that are either permanent or temporary are recommended for the protection of windows and doors.

Frames of external doors and windows that are inadequately fixed to walls can cause them to be pushed in or out of your house. A similar problem can occur with door and window locks that may not be strong enough to withstand the wind forces.

French doors and some sliding doors can also burst open during cyclones if they do not have a sufficient wind strength rating.

8.4 Garage doors

It is common to see garage doors fail when they are pushed in or out by strong winds.

DAMAGE TO GARAGE DOORS.

Failure of garage doors allows wind to enter the house, which can cause the roof and walls to fail. To reduce the risk of this happening, it is recommended that you install garage doors that are adequately wind and debris rated. Alternatively, you can brace your existing garage door to resist wind forces by installing a temporary bracing system prior to a cyclone striking your area.

8.5 Roof eaves

Damage to the soffit of roof eaves by strong winds is another common cause of damage to houses. This can happen due to inadequate fixing or support for the eaves lining or because the lining spans too far. Eaves lining damage allows rain and wind to blow into the roof space which may result in damage to the ceiling and wall lining inside your house.

DAMAGE TO CEILING DUE TO WATER INGRESS

8.6 Water leakage areas

Improving the structural integrity of your home is not enough to protect your house during a cyclone. Wind-driven water leakage can cause significant damage to walls, ceilings, carpets, etc., which can be disruptive and expensive to repair or replace. Water may enter your house through roof vents, holes, cracks, gaps or wherever a pipe or cable pierces the wall or roof. Permanent sealing of cracks, holes and gaps in your house and temporary sealing of vents will help to minimise water leakage into your home.

8.7 House attachments

House attachments such as porch roofs, carports and screen enclosures can get damaged by strong winds which then could lead to damage to the main part of the house.

Porches and overhangs, if poorly fixed to the house, may become detached and cause extensive damage to both your property and that of others. The uplift forces on these attachments roofs can be quite large so it is important to have a qualified building practitioner check these connections.

8.8 Other outdoor objects and equipment

Other outdoor objects and equipment such as air conditioning equipment, hot water tanks, swimming pool equipment, solar panels, satellite dishes, antennas, trampolines, playground equipment and similar objects may be blown around in a cyclone and can become flying debris that could impact your house or other houses in your neighborhood. You should ensure that all outdoor objects are properly restrained.

FLYING DEBRIS RESTING IN FRONT OF A HOUSE

9. HOUSE INSPECTION

As the homeowner, you have the ability to protect your house from cyclone damage. It is recommended that you undertake a regular inspection of your house by checking and fixing any of the following:

- Rust
- Rotten timber and termite attack
- Loose fixings

You should also check the condition of the following critical areas in and around your house:

- Roof
- Gable ends walls
- Doors and windows
- Garage doors
- Water ingress areas
- House attachments
- Outdoor objects and equipment.

A checklist is attached to aid you undertake a preliminary house inspection.

10. CONCLUDING REMARKS

There is no such thing as a cyclone-proof house. However, if you understand the effect of strong winds on your house and plan ahead to maintain and protect it, you can reduce the likelihood of it being damaged in a cyclone.

You can engage a qualified practitioner such as a building certifier, structural engineer, architect or builder to inspect your house if you have doubts about the condition and/or ability of your house to withstand a cyclone.

You should also consider having your house professionally inspected if it has been subjected to cyclonic winds; even if it survived the cyclone.

11. FURTHER INFORMATION

For more information on cyclones, cyclone preparedness and ways to protect your house, please visit your local council in Queensland and Western Australia or the Building Advisory Services Branch of the Department of Planning and Infrastructure in the Northern Territory and the following websites:

- **CYCLONE TESTING STATION**: www.jcu.edu.au/cts
- **NORTHERN TERRITORY GOVERNMENT**
  - NT Police, Fire and Emergency Services: www.pfes.nt.gov.au
  - NT Building Practitioner Board: www.nt.gov.au/bpb
  - NT Building Advisory Services: www.nt.gov.au/lands/building
- **QUEENSLAND GOVERNMENT**
  - Emergency Management Queensland: www.emergency.qld.gov.au
  - Department of Infrastructure and Planning: www.dip.qld.gov.au
  - Queensland Building Service Authority(QBSA): www.bsa.qld.gov.au (for details of licensed builders & building certifiers)
  - Queensland Board Professional Engineers: www.bpeq.qld.gov.au (for details of registered engineers)
  - Board of Architects of Queensland: www.boaq.qld.gov.au
- **GOVERNMENT OF WESTERN AUSTRALIA**
  - WA Fire and Emergency Services Authority: www.fesa.wa.gov.au
- **BUREAU OF METEOROLOGY**: www.bom.gov.au

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DISCLAIMER

The Cyclone Testing Station (CTS) has taken all reasonable steps and due care to ensure that the information contained herein is correct at the time of publication.

CTS expressly exclude all liability for loss, damage or other consequences that may result from the application of this guide.

APPENDIX – HOUSE INSPECTION CHECKLISTS

CHECKLIST A –HOUSE MAINTENANCE

Ticking one or more boxes indicates that action may be required. If in doubt, please contact a qualified building practitioner to have your house inspected.

A.1 Rust

Are there signs of rust to cladding, structural elements and fixing components such as in:

- ☐ Metal roof cladding
- ☐ Metal wall cladding
- ☐ Metal battens
- ☐ Bolts and nails
- ☐ Columns
- ☐ Beams
- ☐ Column to beam connections
- ☐ Column base connections
- ☐ Brackets
- ☐ Fixing plates
- ☐ Cyclone washers
- ☐ Metal straps

A.2 Rotten Timber and Termite Attack

Are there signs of rotten timber and/or termite attack to timbers components such as in:

- ☐ Flooring
- ☐ Floor structure (bearers and joists)
- ☐ External timber cladding
- ☐ Verandahs
- ☐ Balconies
- ☐ Fencing
- ☐ Carport
- ☐ Pergolas
- ☐ Doors and window frames
- ☐ First floor timber framing
- ☐ Rafters or trusses that have been damaged by water or insects

A.3 Loose fixings

Are there signs of loose fixings such as in:

- ☐ Tie down bolts
- ☐ Roof or wall sheeting
- ☐ Other fixings
- ☐ Roof attachments such as roof vents, solar hot water systems, and satellite antennas

CHECKLIST B - AREAS TO PROTECT

Cyclone damage to houses may also be reduced by protecting and reinforcing eight critical areas in and around your house.

Ticking one or more boxes indicates that action may be required. If in doubt, please contact a qualified building practitioner to have your house inspected.

B.1 Metal or Tile Roofs

- ☐ There is a lack of metal straps or fixing angles holding down the trusses/rafters to the walls.
- ☐ Timber battens are not screw-fixed with metal straps.
- ☐ The tile roof has broken, dislodged or missing tiles.
- ☐ Mortar between tiles is missing or broken especially at ridges and hips or along the perimeter of the roof.
- ☐ The roof does not have sarking membrane.
- ☐ Tiles tie down clips are missing.

B.2 Gable Ends

- ☐ The top and bottom of gable ends walls are not fixed with metal straps or brackets.
- ☐ The gable end studs are not braced.

B.3 Doors and Windows

- ☐ Double entry doors do not have proper locks and hinges to resist wind pressure.
- ☐ Sliding glass doors are not rated for wind pressure.
- ☐ Windows and doors are not rated for wind pressure.
- ☐ There are signs of window and door frames are not well fixed to the house structure.

B.4 Garage doors

- ☐ The garage door is not rated to resist wind pressure.
- ☐ The garage door does not have a provisional bracing system to install during a cyclone.

B.5 Potential areas for water ingress

- ☐ There are cracks in external walls.
- ☐ There are gaps around windows and doors.
- ☐ The trims around windows and doors are deteriorated or loose that may let water in.
- ☐ Water has previously come in around doors and windows.
- ☐ Daylight can be observed from inside the roof space.
- ☐ Daylight can be observed around plumbing penetrations through the roof.
- ☐ Daylight can be observed through the cladding.

- ☐ Daylight can be observed between the boards or sheathing on gable ends.
- ☐ The timber siding (whether plywood or boards) is loose.
- ☐ There are gaps and/or cracks around the dryer, bathroom and rangehood vents.
- ☐ The soffit of roof eaves has large vents where water can easily get in.
- ☐ The soffit of roof eaves is damaged, cracked or deformed.
- ☐ There are bathroom vents, rangehood vents, dryers vents in the roof or side walls of your house.
- ☐ There are vents on the wall end of your house like louvered vents or automatic closing vents.
- ☐ There are vents at gable end walls.
- ☐ There are roof ridge vents or whirly birds.

B.6 House attachments

- ☐ The house has a freestanding carport right next to the house and it may note be well secured to the ground.
- ☐ The carport is attached to the house and this may not be well secured to the house and to the ground.
- ☐ The pool fence is not properly restrained to the ground/wall.
- ☐ The house has a roof or porch roof supported by posts at one of more corners and this may not be well secured to the house and to the ground.

B.7 Outdoor objects and equipment

- ☐ Roof attachments such as air conditioning compressor units, satellite dish antennas, outdoor hot water tanks, hot water panels are not well restrained to the pedestal or platform on which it sits with screw, bolts, ties or straps and/or show any signs of deterioration.
- ☐ There is a trampoline or playground equipment in the garden.
- ☐ There is a caravan in my property not restrained to the ground .
- ☐ There are gazebos, tables or other loose items in your garden.
- ☐ There are trees in my property that if they pivoted from the ground could hit my house.
- ☐ The fence of my house has loose planks.