RESILIENCE & MITIGATION THROUGH HARDENING THE BUILT ENVIRONMENT (BUILDINGS & INFRASTRUCTURE)

A9: Cost-effective mitigation strategy for Earthquake Risk
A10: Cost-effective mitigation strategy for Flood Prone Buildings
B7: Improving the resilience of existing housing to severe wind events

Professor Michael Griffith

School of Civil, Environmental & Mining Engineering, The University of Adelaide

An Australian Government Initiative

A9: COST EFFECTIVE MITIGATION STRATEGY FOR BUILDING-RELATED EARTHQUAKE RISK

Project Participants

Univ of Adelaide: **MC Griffith, M Jaksa, AH Sheikh, C Wu, MMS Ali, T Ozbakkaloglu, A Ng & P Visintin**

Univ of Melbourne: **NTK Lam, H Goldsworthy**

Swinburne University: **JL Wilson, E Gad**

Geoscience Australia: **M Edwards, H Ryu, C Collins**

Aim: to develop evidence base to inform decision making for earthquake risk mitigation

- **Establish seismic vulnerability classes for representative building types in Australia**
- **Survey existing retrofit techniques for known performance in recent earthquakes**
- **Develop new cost-effective Australia-specific retrofit techniques**
- **Develop decision-support and earthquake risk forecasting tools to support infrastructure managers**
- **Develop economic loss models for business interruption and casualty costs**

AERIAL VIEW OF CHRISTCHURCH SECONDS AFTER THE 22 FEBRUARY 2011 EARTHQUAKE

Lessons from Christchurch

Christchurch corner shops


Adelaide corner shops

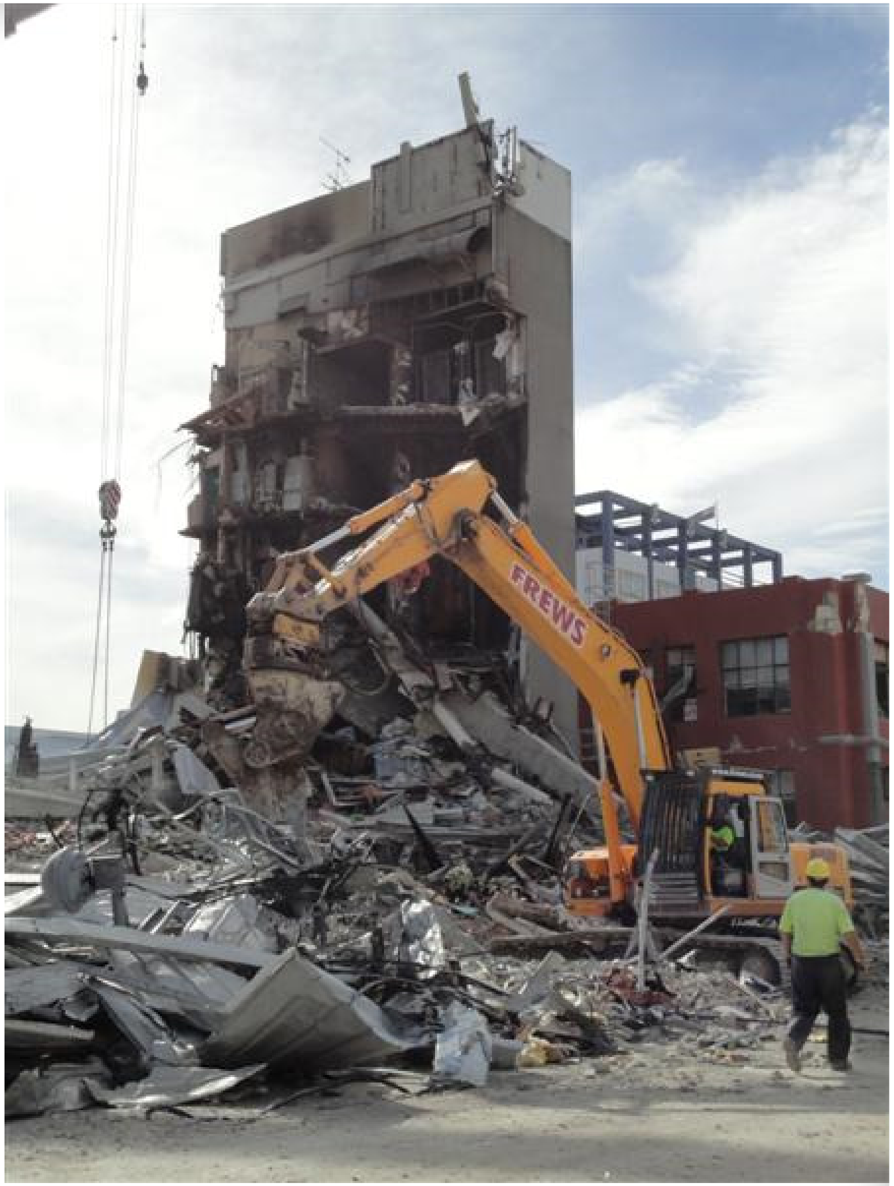
Christchurch theatre


Adelaide arcade


LIBERTY
BOOKS

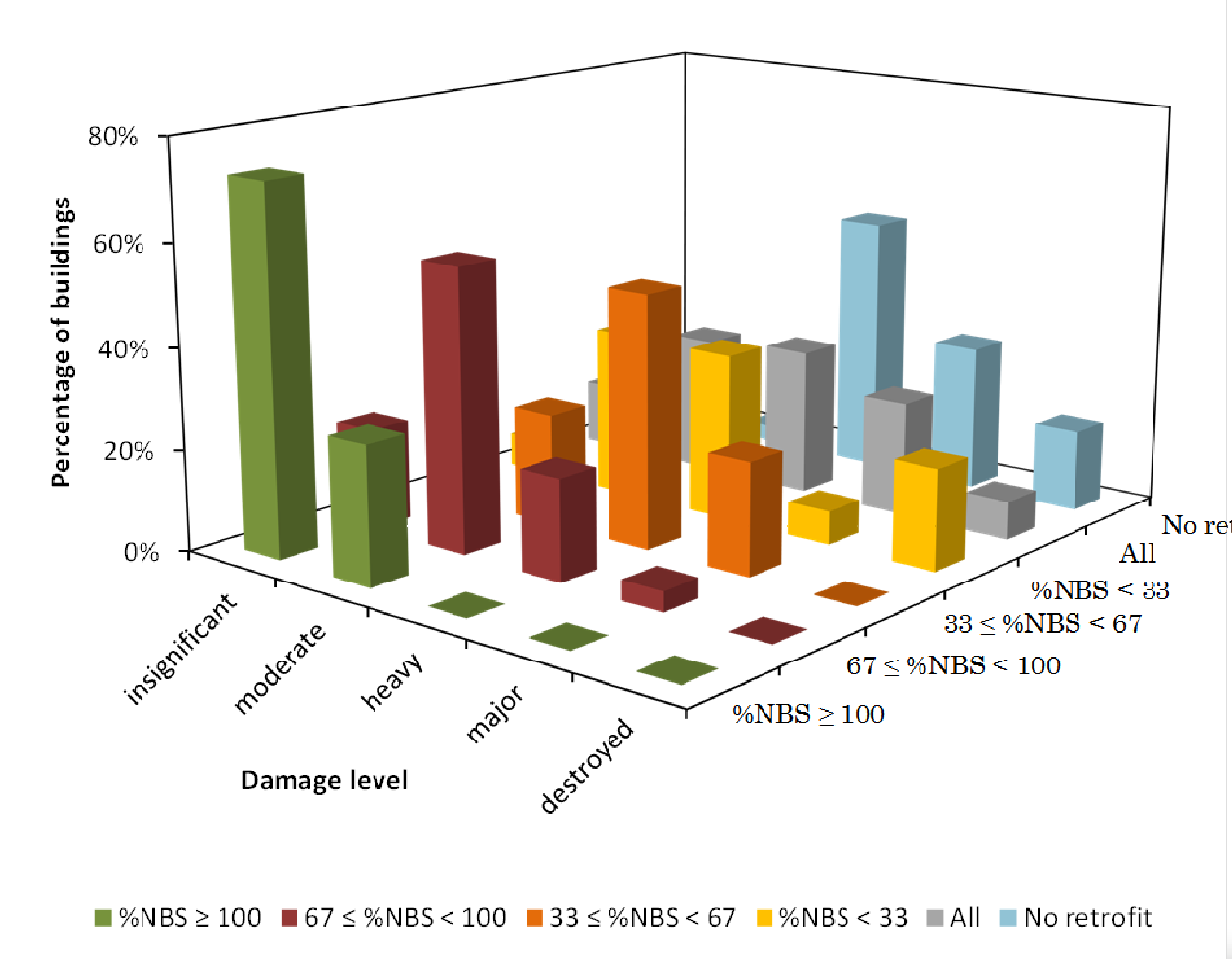
Out-of-plane wall bending failures in Christchurch (42 fatalities in URM buildings)

PGC – 18 fatalities



CTV – 115 fatalities

DAMAGE LEVELS FOR DIFFERENT LEVELS OF RETROFIT



Expected Outputs:

- A cost-benefit analysis methodology for key retrofit options at both the building and regional levels

- Information and models to enable planning authorities to develop policies and legislation, backed up by substantiated economic benefits

A10: COST-EFFECTIVE STRATEGY DEVELOPMENT FOR FLOOD PRONE BUILDINGS

Project Participants

Geoscience Australia: T Maqsood, Ken Dale, Martin Wehner

Aim: mitigate risk posed by urban development in flood prone areas

Specific Objectives

- Develop an evidence base to inform decision making on risk mitigation strategies for flood prone buildings
- Develop cost-benefit analysis methodology for key mitigation options at the building level
- Build on existing work on flood susceptibility of typical Australian building materials and construction

Photos of flood damage to residential buildings after the 2011 Queensland Floods


31 JAN 2011


31 JAN 2011


31 JAN 2011


UNSAFE DO NOT
31 JAN 2011


31 JAN 2011


30 JAN 2011


7 FEB 2011


31 JAN 2011

B7: Improving the Resilience of Existing Housing to Severe Wind Events

Project Participants

Cyclone Testing Station- James Cook University: J Ginger, D Henderson, J Holmes, G Boughton

Geoscience Australia: M Edwards, M Wehner

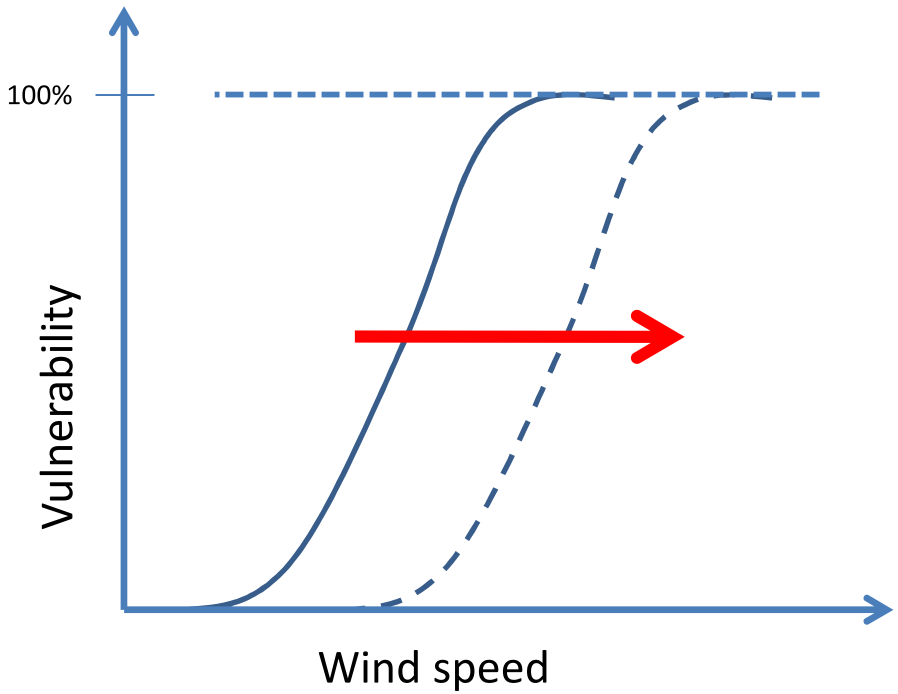
JAMES COOK UNIVERSITY AUSTRALIA

CYCLONE TESTING STATION

www.jcu.edu.au/cts

AIMS - OBJECTIVES

Improve structural performance of Pre-80s houses

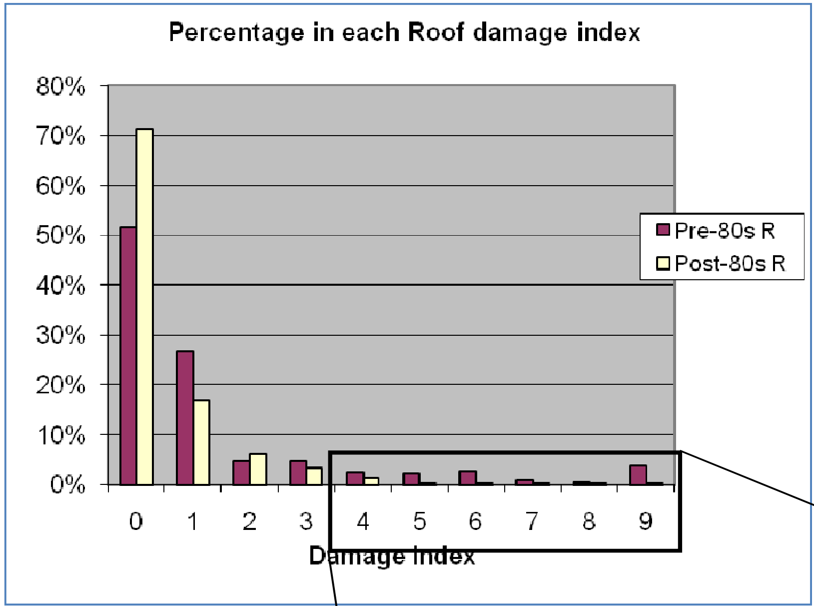


- Develop cost-effective strategies for mitigating damage to housing from severe windstorms across Australia to aid policy formulation in government and industry
- Provide guidelines detailing various options and benefits to homeowners and the building community for retrofitting typical at risk older houses in Australian communities.

HOUSES – COMPLEX STRUCTURAL SYSTEM

- Traditional process – evolved from holding roof up not tying it down
- Many elements, closely spaced
- There is load sharing
- So no easily defined Load path
- They are where we shelter – so have to be secure

DAMAGE DATA – CYCLONE YASI

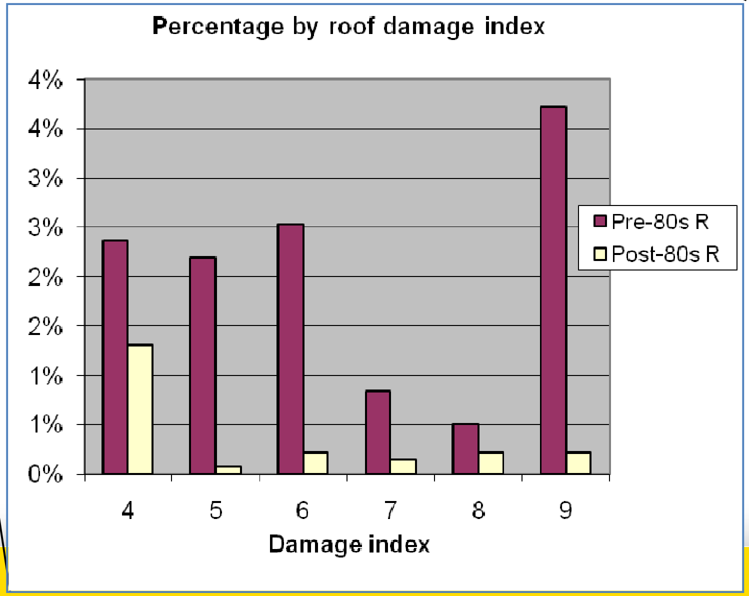


Post 80s (current construction)

- <3% major roof damage
- ~30% all roller doors damaged
- But many houses had water ingress

Pre 80s (older housing)

- >12% major roof damage
- ~2% damaged by large debris
- May have hidden damage



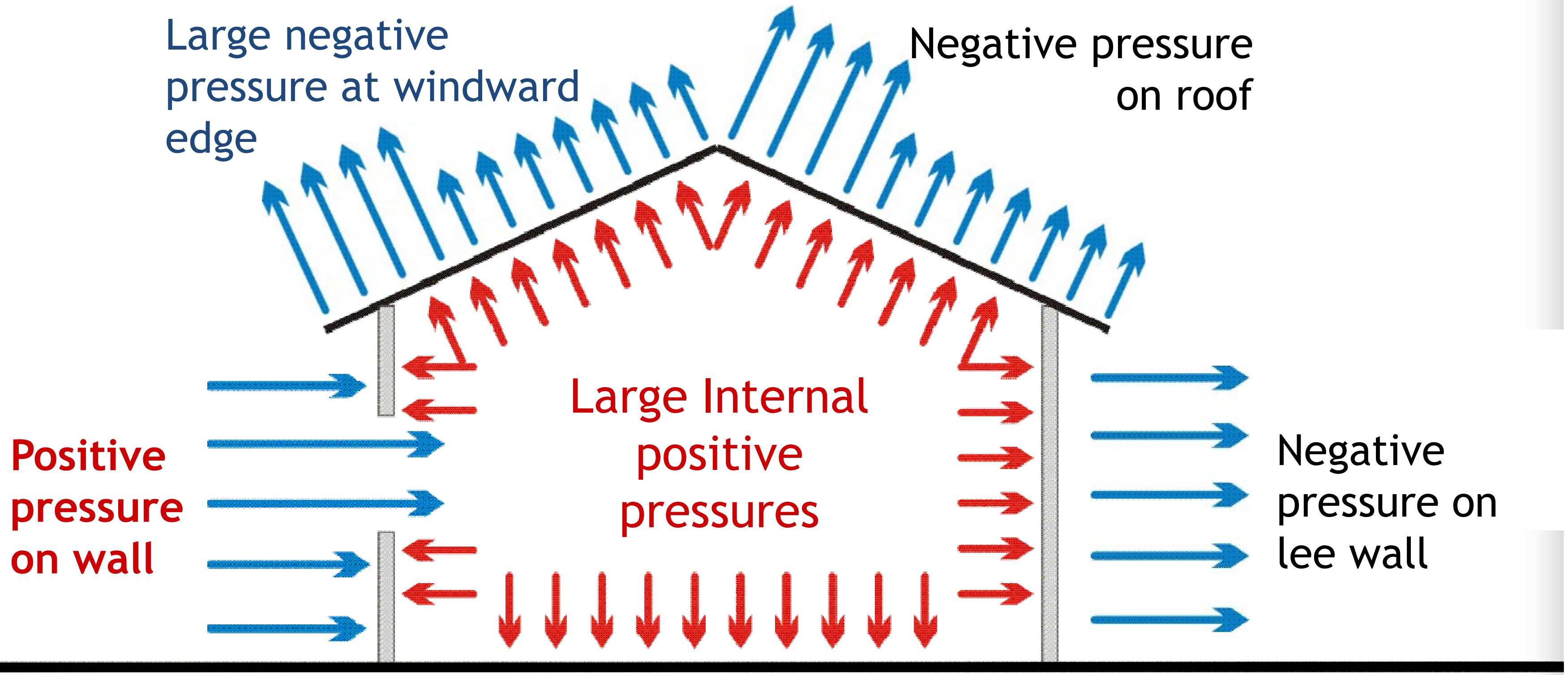
Lower levels of damage of "newer" housing similar pattern in other surveys (e.g. Cyclone Winifred Cyclone Vance, Cyclone Larry)

Lessons have been learnt since Cyclone Tracy!

PRE-80S HOUSES

Wind Loads on Houses

Large internal pressures....If an opening forms in the external envelope of the building e.g. a window is broken or a door blows in



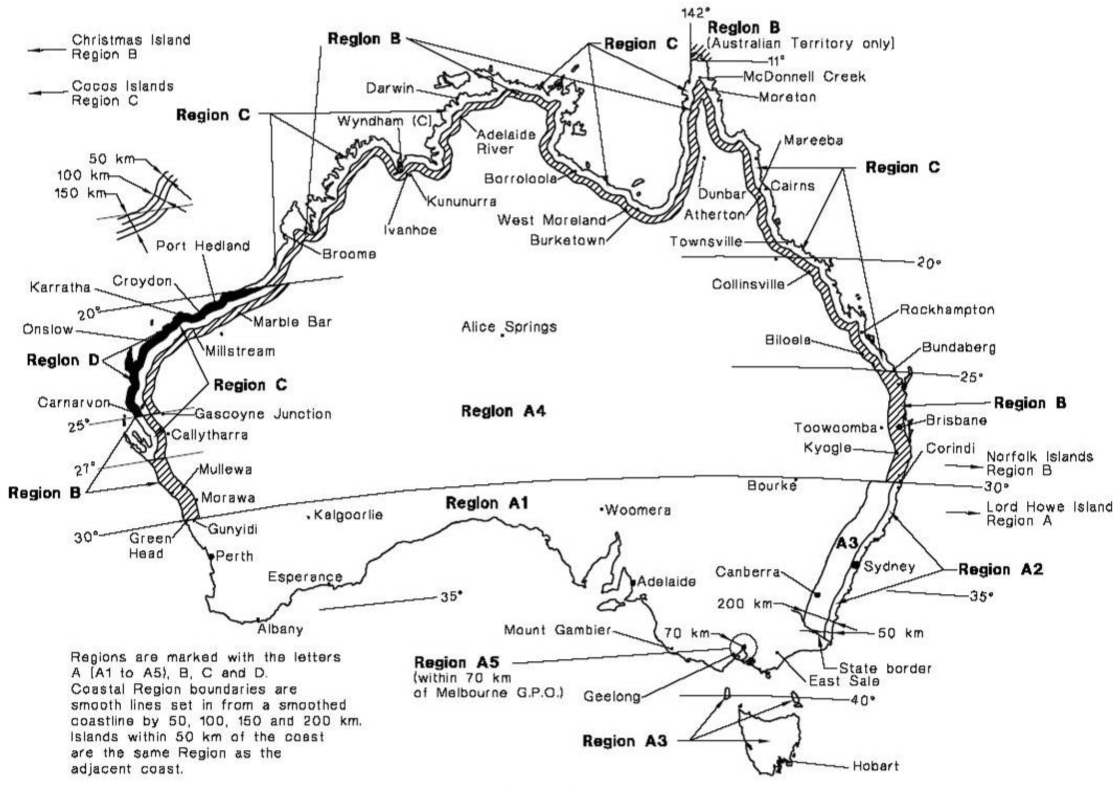
Some common housing types – Cyclonic region

Built During	Example of geometry and features	Generalised features
< 1920s		Hip roof, reduced rafter spans, central core, exposed studs, on stumps (low and high)
1920 – 1950s		Hip and gable, VJ lining, reduced rafter spans, on stumps (low and high)
1960s – 1970s		Gable low pitch, vermin proof flooring (studs not mortise and tenon into bearers), panel cladding, on stumps
> early 1980s		Reinforced masonry block, hip and gable, large truss spans, medium roof pitch, slab on ground

Classification of House Types – All regions

Jurisdiction / Wind Region	Age	Roof Material	Roof Structure	Wall Material	Wall Structure
Qld, NT, WA Cyclonic	Pre-1911	Tile	Timber rafter & Timber battens	Timber	Timber Frame
Qld, NT, Non-cyclonic	1911-1940s	Metal	Tiles & Timber battens	Fiber Cement	Masonry Block
NSW, VIC ACT,	1940-1960s	Other	Timber Truss & Timber battens	Brick Veneer	Brick
WA-Cyclonic	1960-1980s		Other	Other	Other
WA- Non-cyclonic					

Wind Regions – AS/NZS 1170.2



(a) Australia

Cyclonic – C & D

Non cyclonic – A & B