bushfire&natural HAZARDSCRC

IMPROVING THE RESILIENCE OF EXISTING HOUSING TO SEVERE WIND EVENTS (VULNERABILITY MODELING)

To date and Work ahead

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An Australian Government Initiative

CRC AUSTRALIA

Australian Government
Geoscience Australia

CYCLONE TESTING STATION

PROJECT OUTLINE

- **Objective** - To develop cost-effective retrofitting details for mitigating structural damage to "pre-code" housing from severe windstorms across Australia.

- These strategies are to be (a) tailored to both aid policy formulation and decision making in government and industry, and (b) provide guidelines detailing various options and benefits to homeowners and the building community for retrofitting the large percentage of at risk houses in Australian communities.

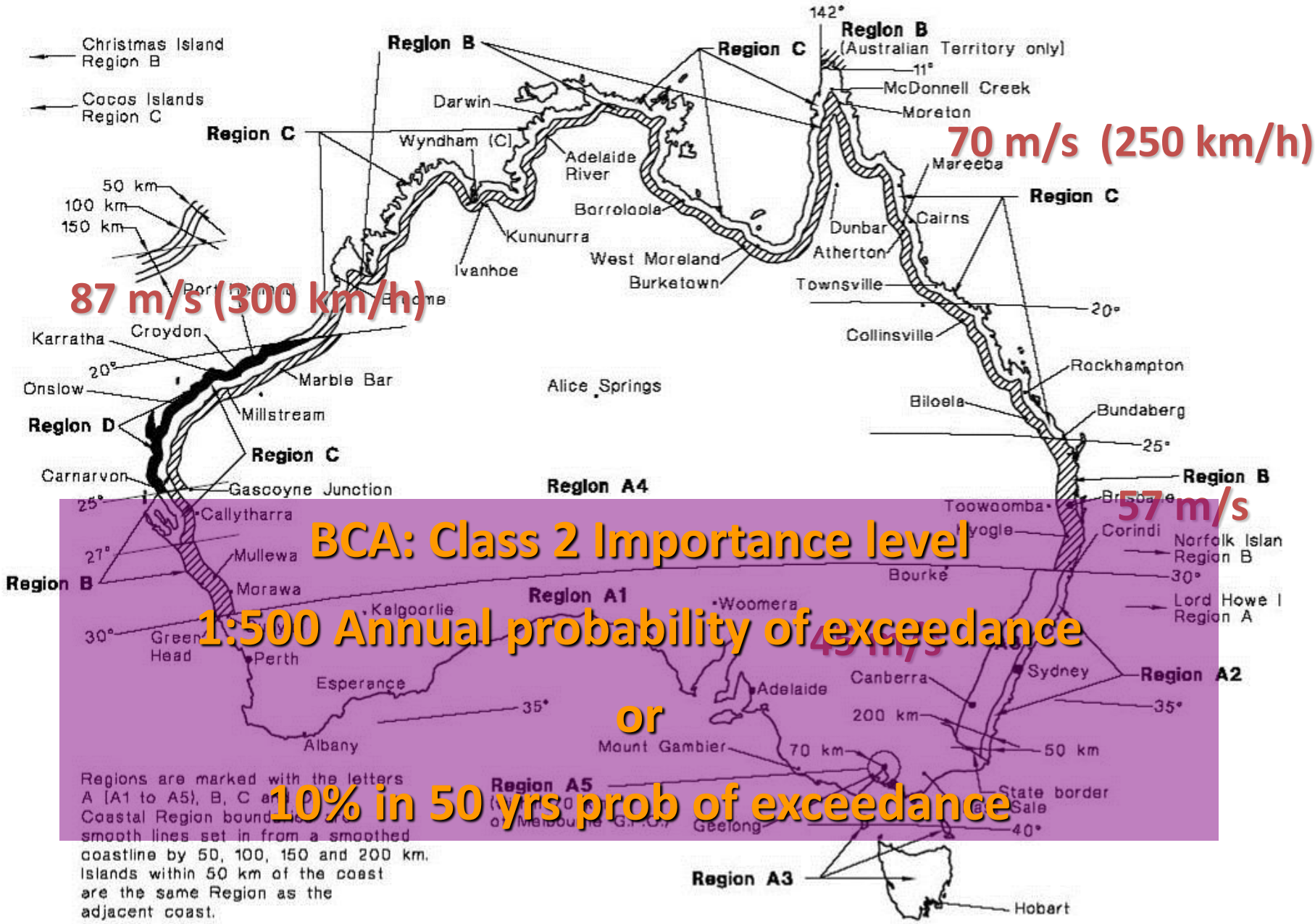
- Project to support work across other BNHZ-CRC harden-up themes (flood and earthquake) on vulnerability, and resilience

National Construction Code of Australia:

Structural objectives

- Safeguard people from injury caused by structural failure,
- Safeguard people from loss of amenity caused by structural behaviour,
- Protect other property from physical damage caused by structural failure, and
- Safeguard people from injury that may be caused by failure of, or impact with, glazing.

AS/NZS1170.2 Wind load standard



70 m/s (250 km/h)

57 m/s

45 m/s

BCA: Class 2 Importance level

1:500 Annual probability of exceedance

or

10% in 50 yrs prob of exceedance

Regions are marked with the letters A (A1 to A5), B, C and D. Coastal Region boundaries are smooth lines set in from a smoothed coastline by 50, 100, 150 and 200 km. Islands within 50 km of the coast are the same Region as the adjacent coast.

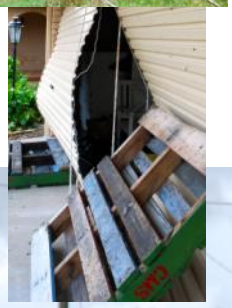
CONTEMPORARY STANDARDS (e.g. Post-80)

Australian Building Standards:

- AS1170.2 /AS4055
- AS1562.1
- AS1684

Great for new construction….

…doesn't address older homes

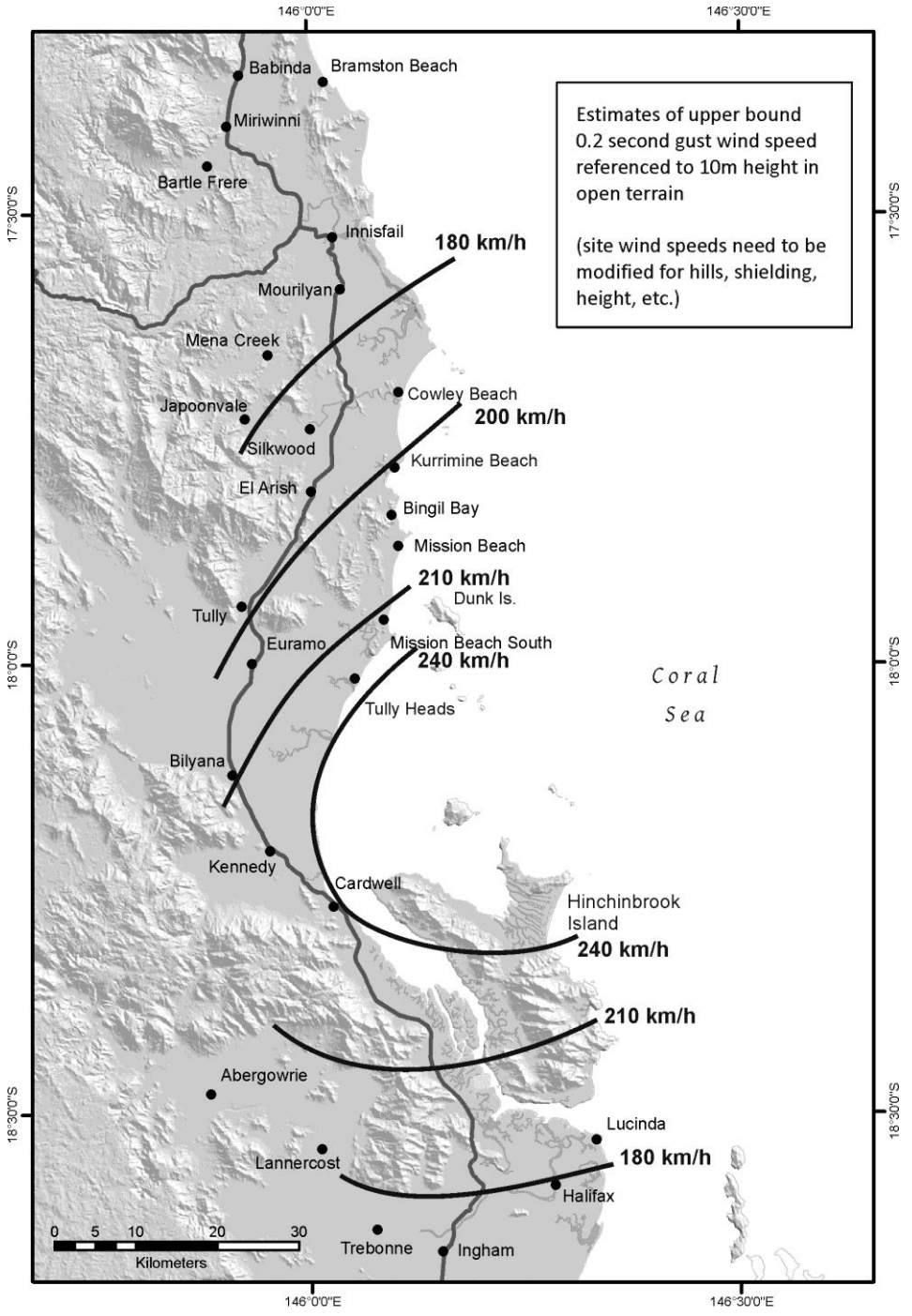


Estimated wind speeds

- Max gust speed estimated at 245 km/h
- (Design wind speed houses 250 km/h)

- Max gust ~90% design speed
  Cardwell, Tully Heads, South Mission Beach
- Max gust ~80% design speed
  Tully, Kurrimine Beach

Communities in these areas subjected to Cat 3 to Cat 4 wind speeds (mainland)



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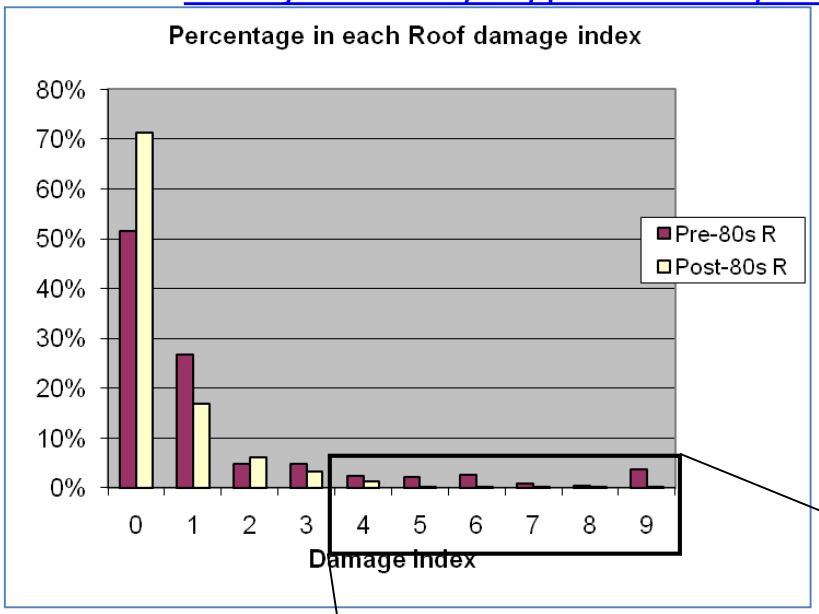
Post-80s housing (current construction)

Pre-80s houses

Damage Data

www.jcu.edu.au/cts/publications/content/technical-reports/jcu-078421.pdf/view

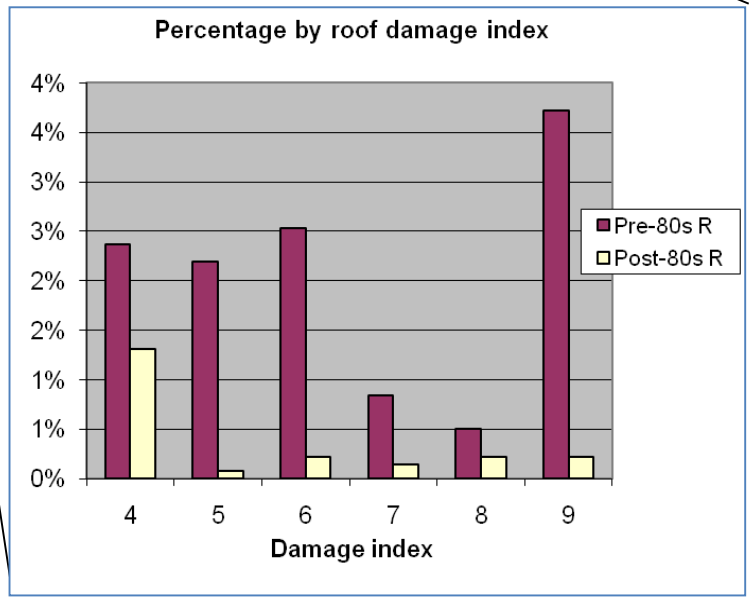


Post 80s (current construction)

- <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!

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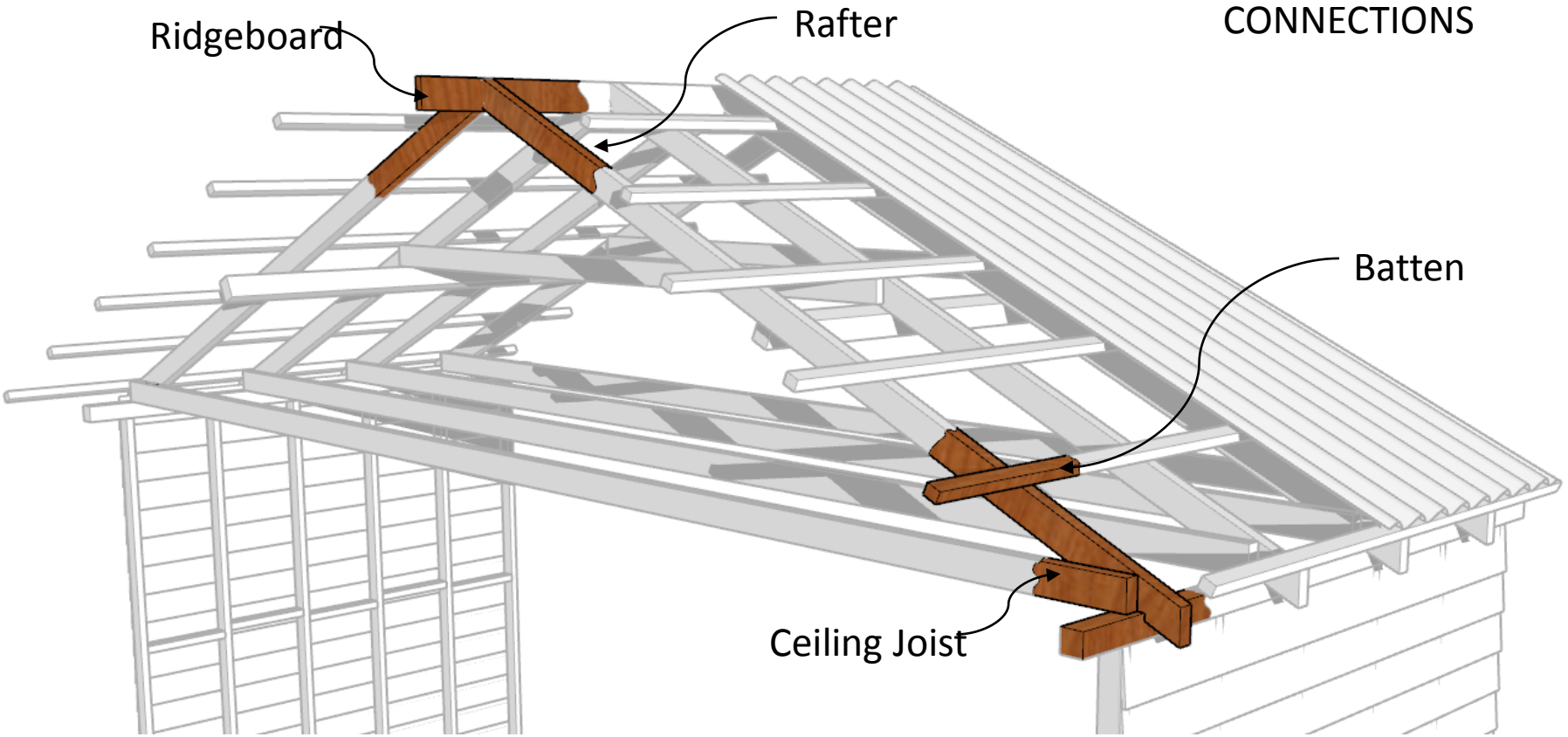
Older housing - Traditional pitched roof framing

STRENGTH OF CONNECTIONS



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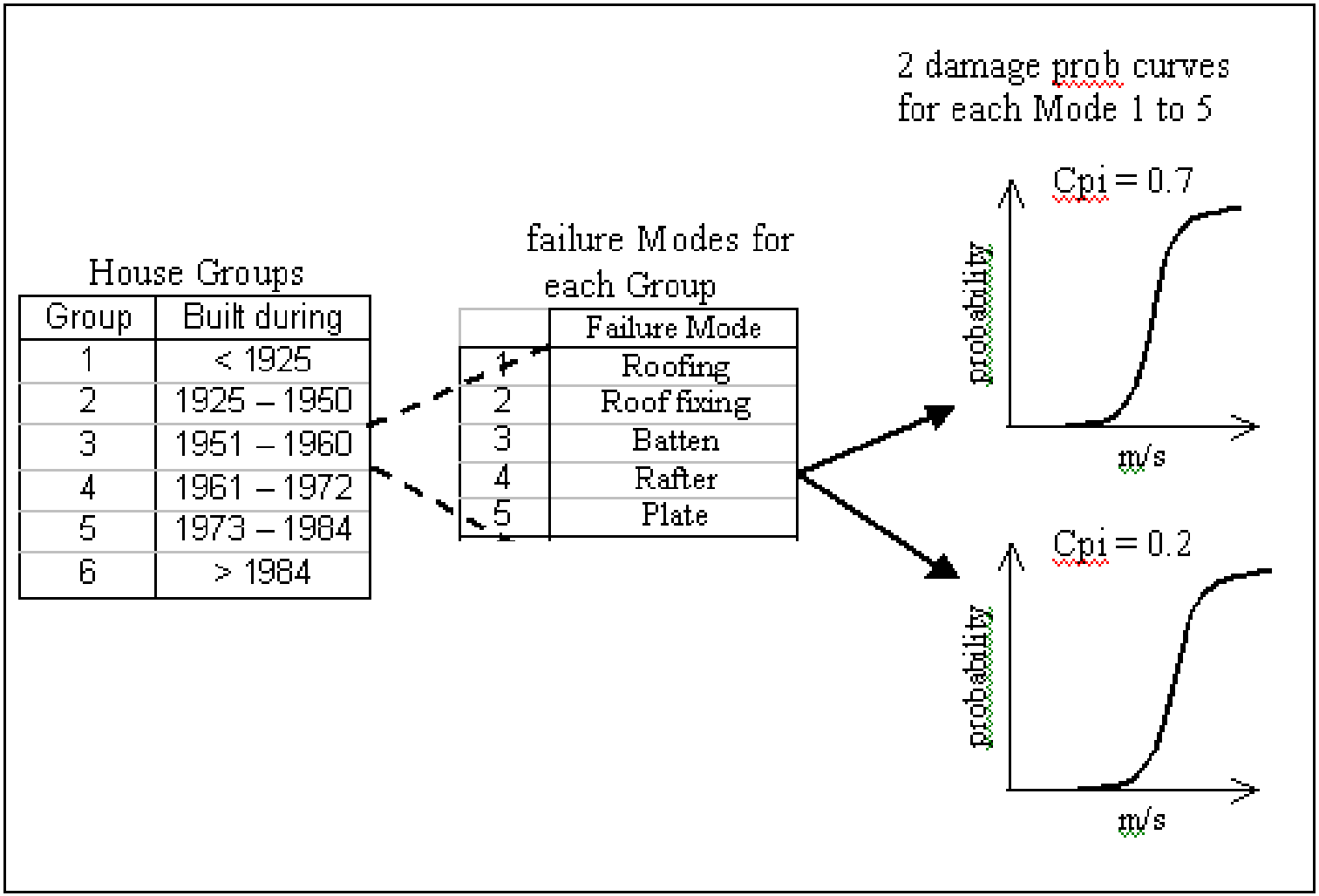
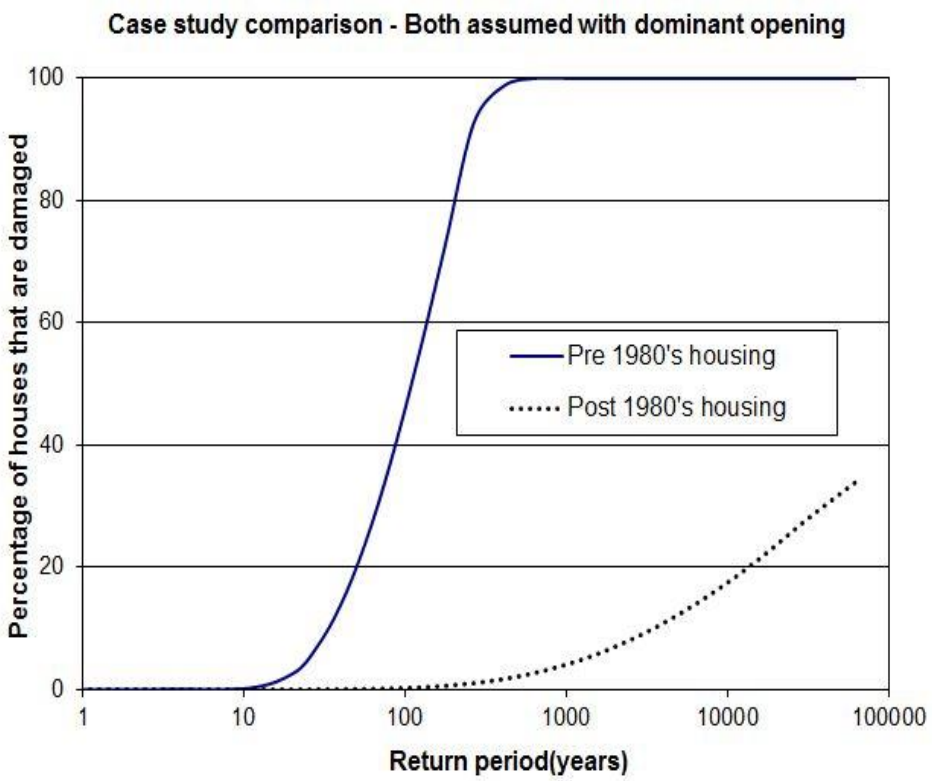
BRISBANE STORMS - 2014

House wind resistance models

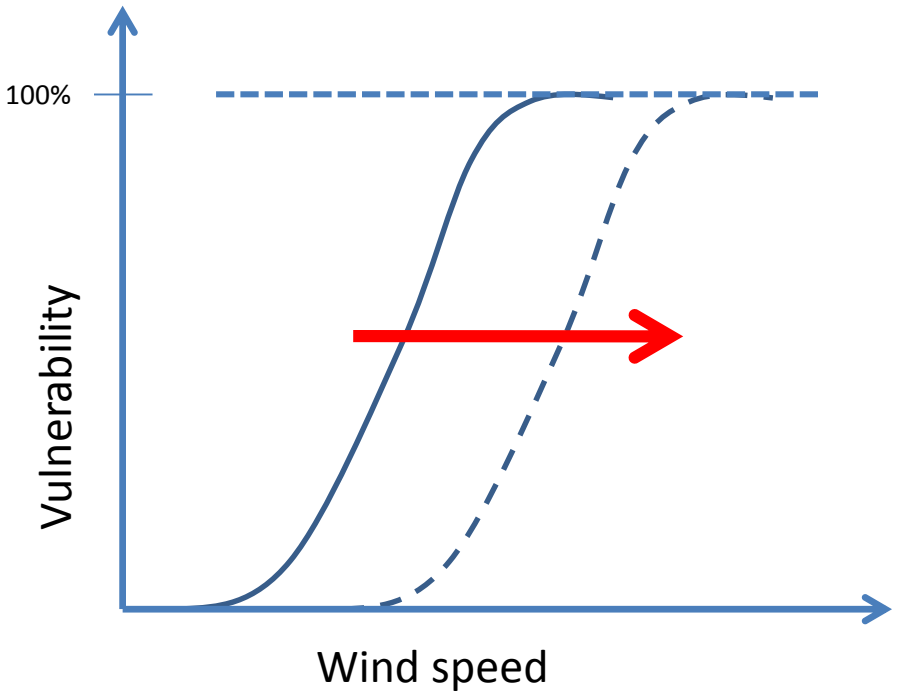


Estimated damage comparison (for cyclonic region)



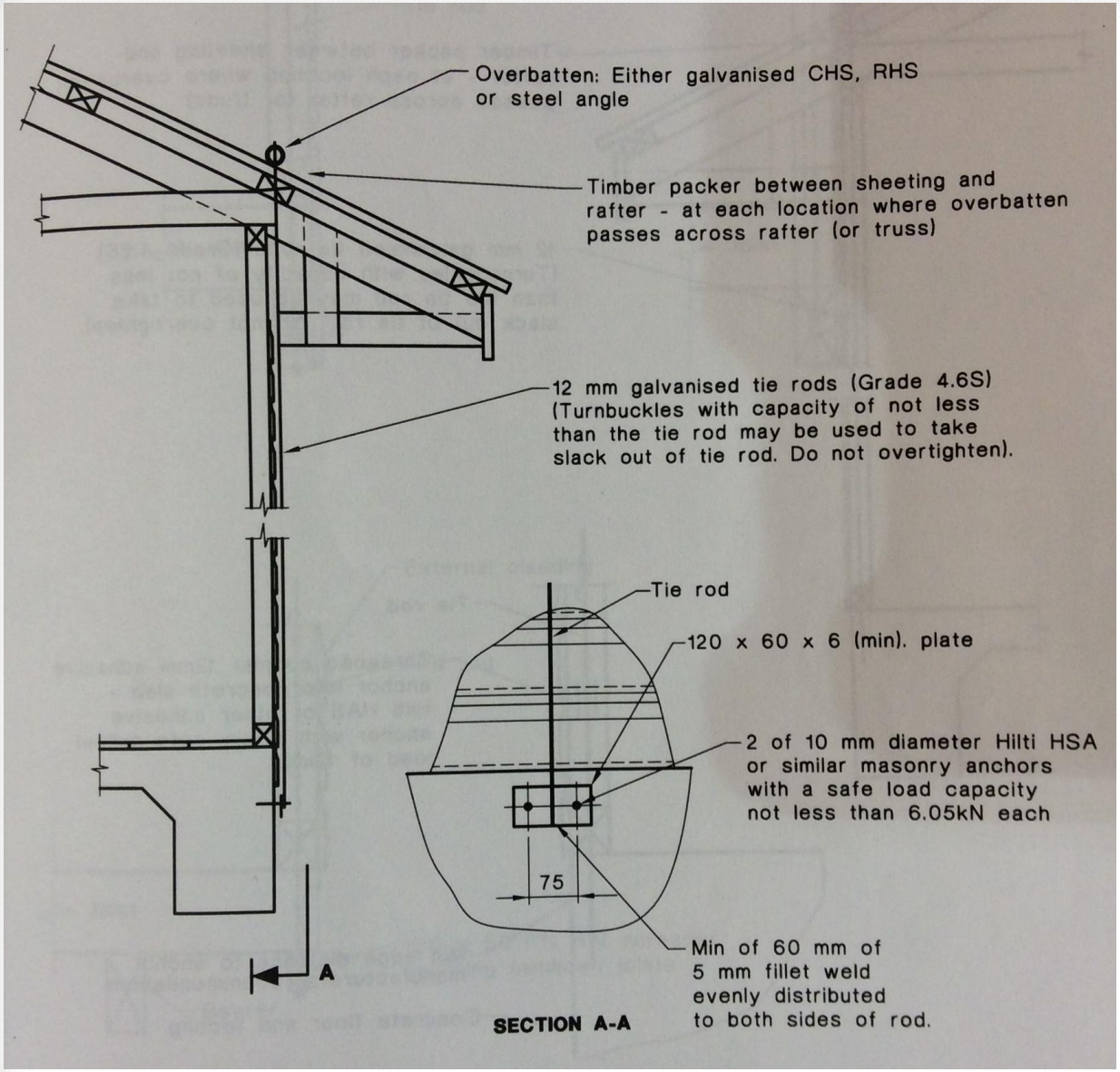
- Failure of structural connections in older housing at wind speeds less than design

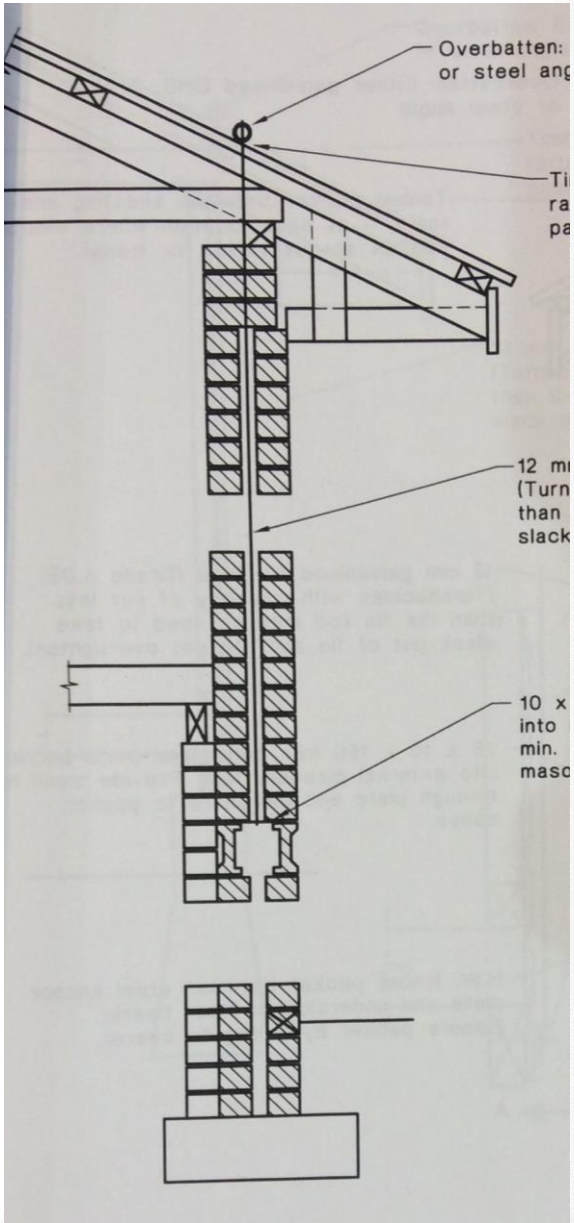
Improve structural performance of older houses



Improving future for Pre-80s housing

- General information on upgrading structural performance in existing houses can be found in Standards Australia Handbook HB 132.2 and Timber Qld builder notes





Details from HB132.2

IS HB132 EFFECTIVE?

Cladding connection improved during reroof but…

…moved failure to next link in chain – the batten / truss joint

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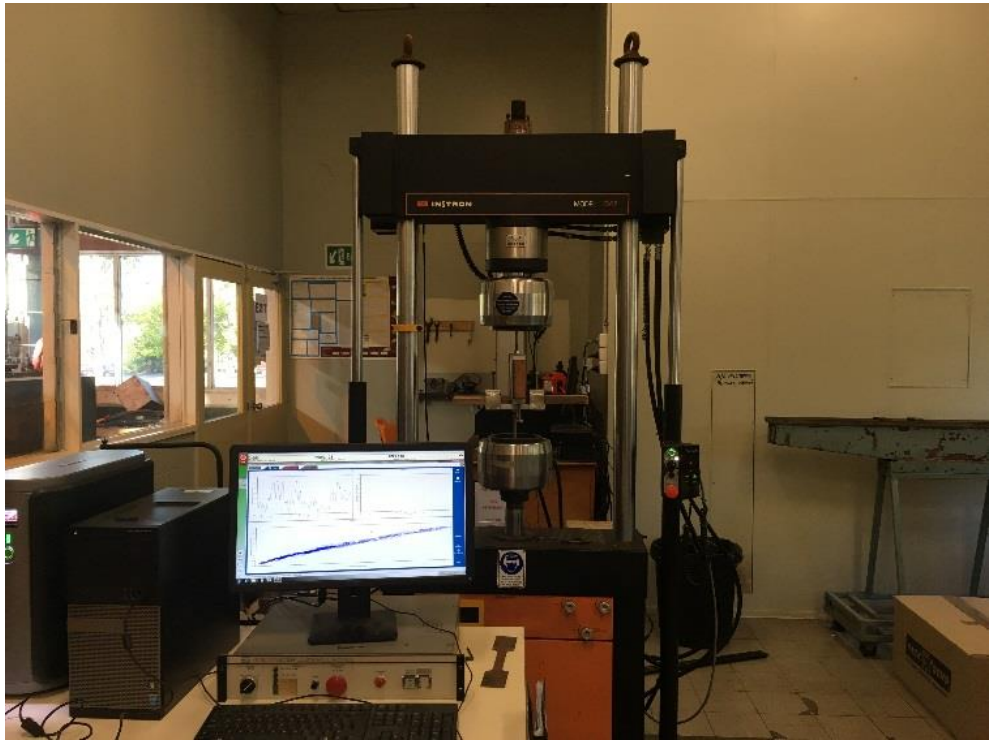
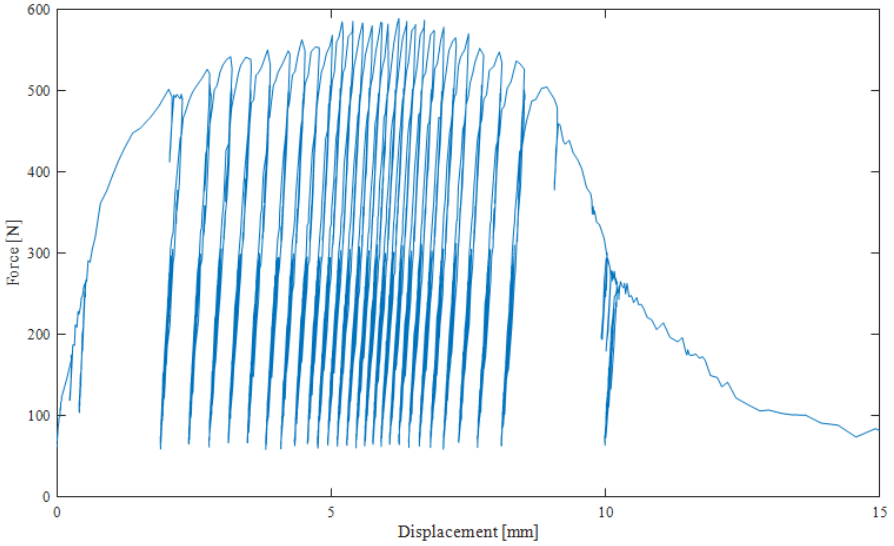


Aged nail connection up to 50% less capacity



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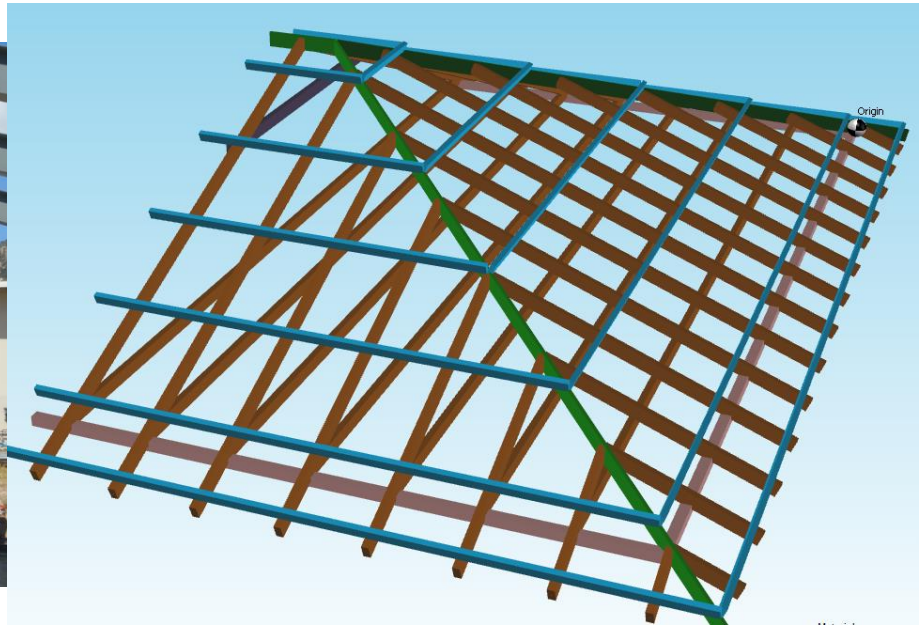
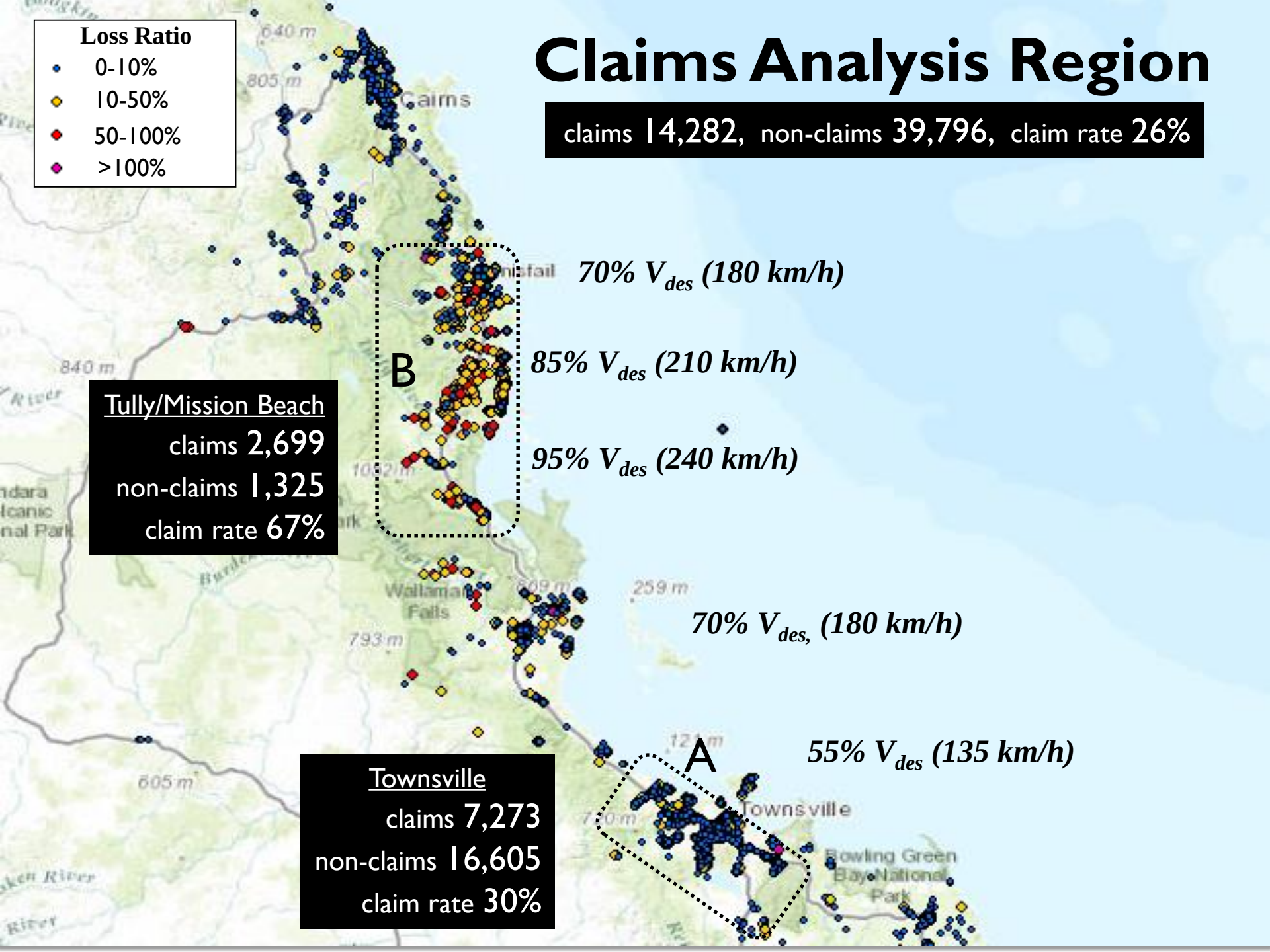
Modelling of structural system with focus on load sharing and damage progression based on validated FEA model

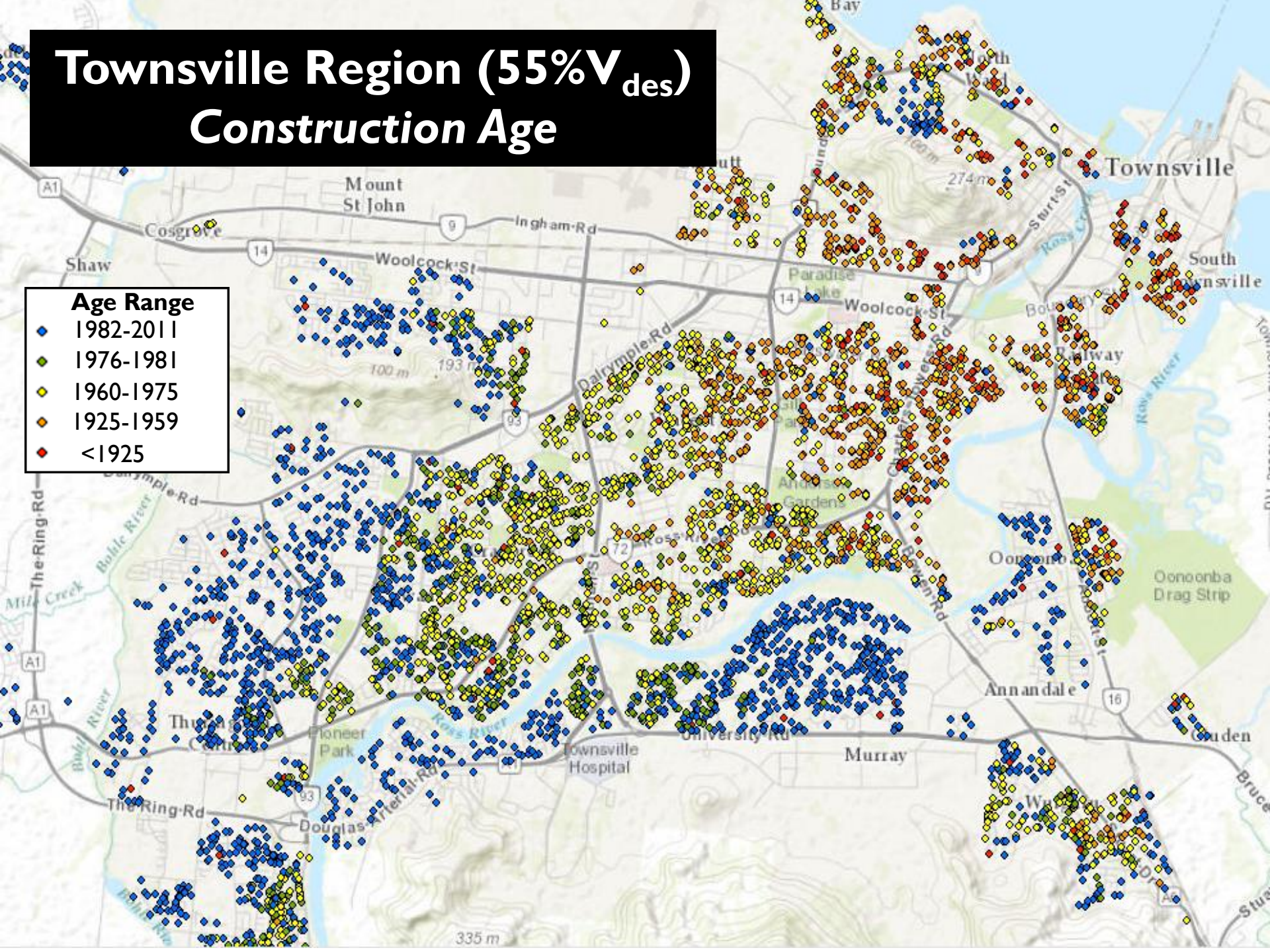




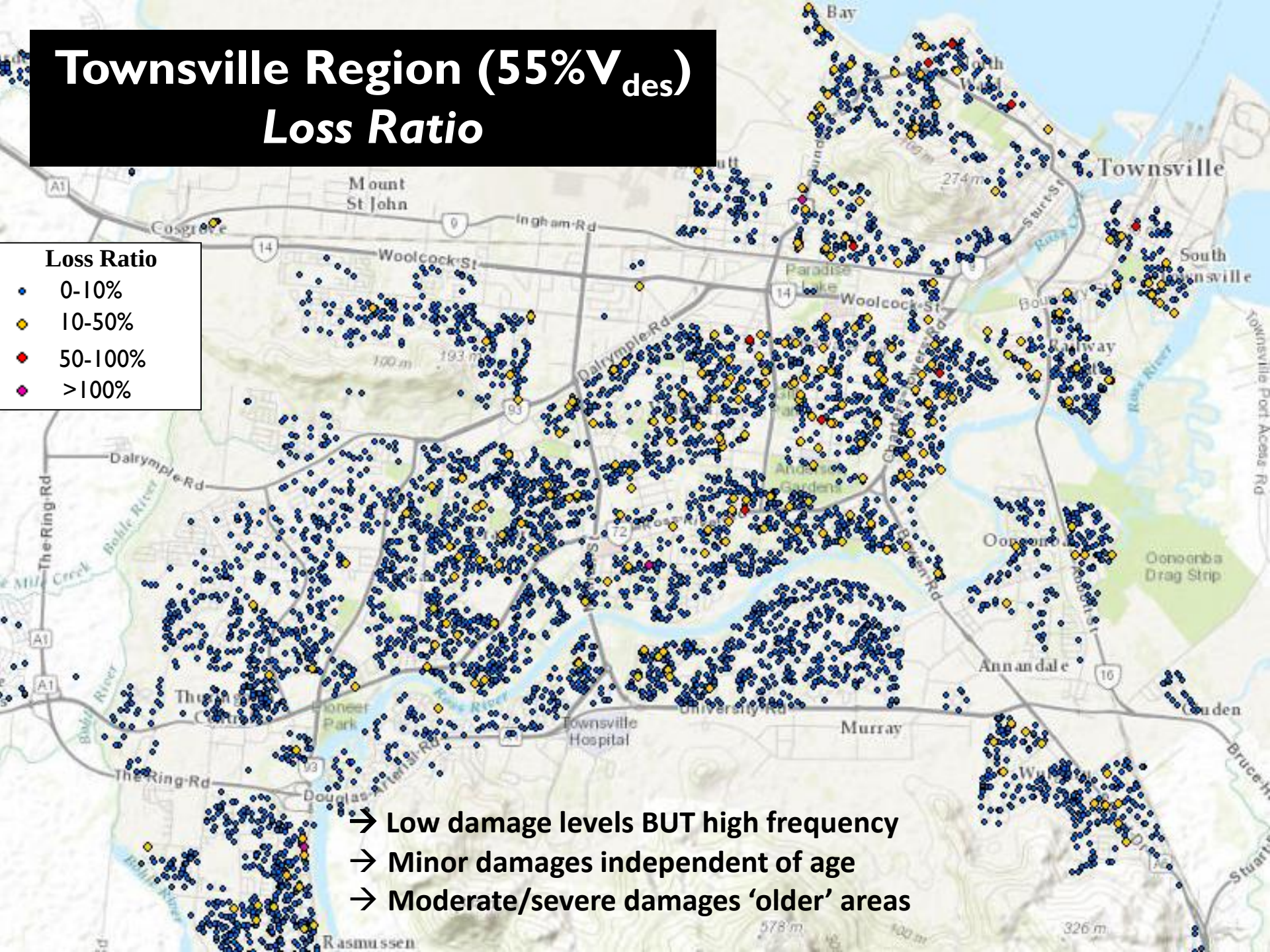
Claims Analysis Region

claims 14,282, non-claims 39,796, claim rate 26%

Townsville Region (55%V_{des})
Construction Age



Townsville Region (55%V_{des})
Loss Ratio



Low claim ratio <0.1 Townsville region

Loss of roof in Townsville

SOURCES OF LEGACY HOUSING DATA

1. **CTS Database**

→ 40 yrs of housing surveys, damage assessments, etc.
→ TCCIP report (2003)

2. **NEXIS Database (GA)**

→ Valuer-general, etc.
→ Includes TAS, NSW, ACT, WA data from various sources

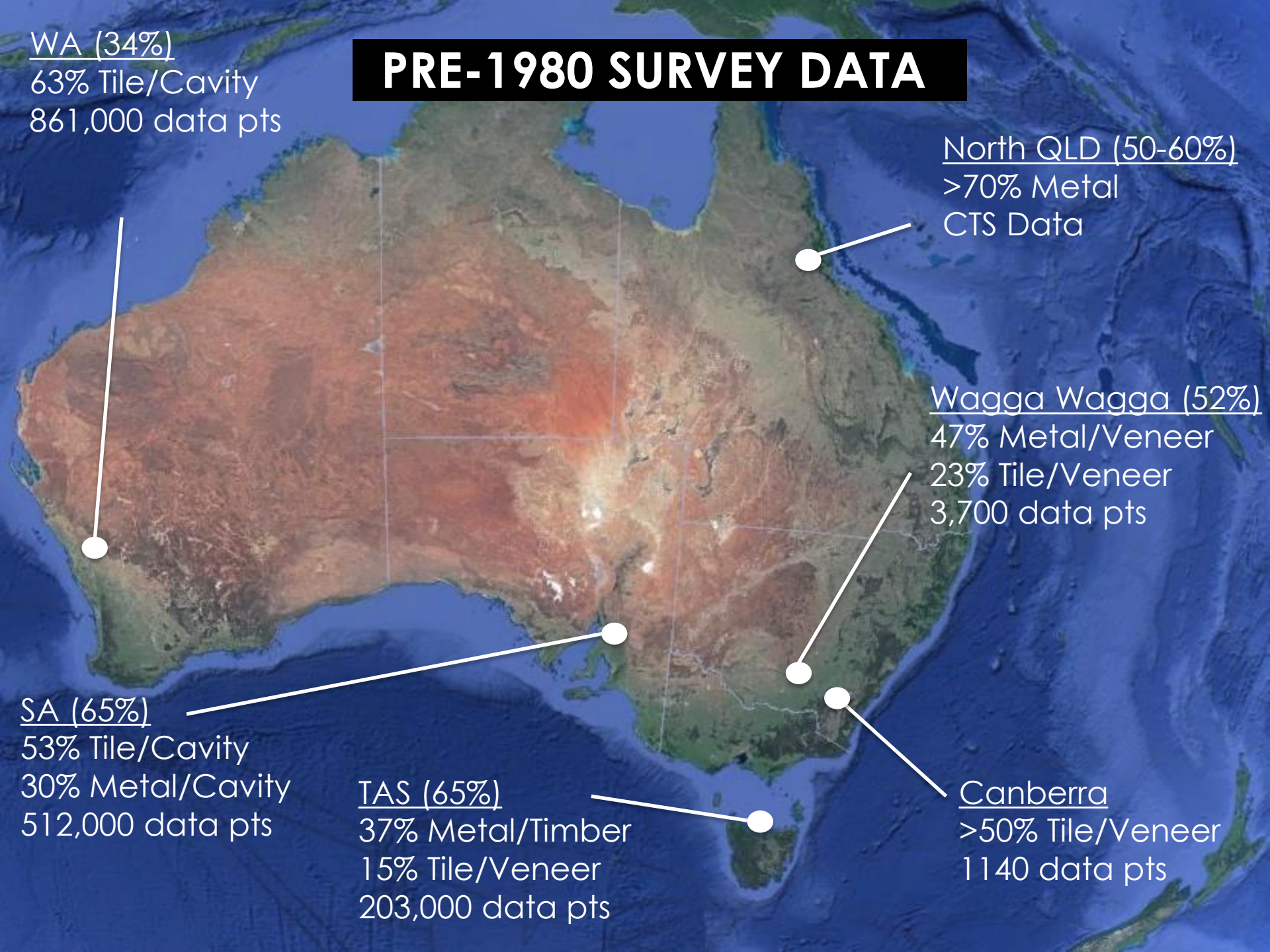
3. **Field Surveys (non-cylonic)**

→ Compiled by CTS and GA
→ Detailed construction information for Adelaide and Canberra

4. **Aggregated Insurance Policy Data**

→ 54,000 policies in north Queensland
→ Proportion of building ages and roof type

PRE-1980 SURVEY DATA



WA (34%)
63% Tile/Cavity
861,000 data pts

North QLD (50-60%)
>70% Metal
CTS Data

Wagga Wagga (52%)
47% Metal/Veneer
23% Tile/Veneer
3,700 data pts

SA (65%)
53% Tile/Cavity
30% Metal/Cavity
512,000 data pts

TAS (65%)
37% Metal/Timber
15% Tile/Veneer
203,000 data pts

Canberra
>50% Tile/Veneer
1140 data pts

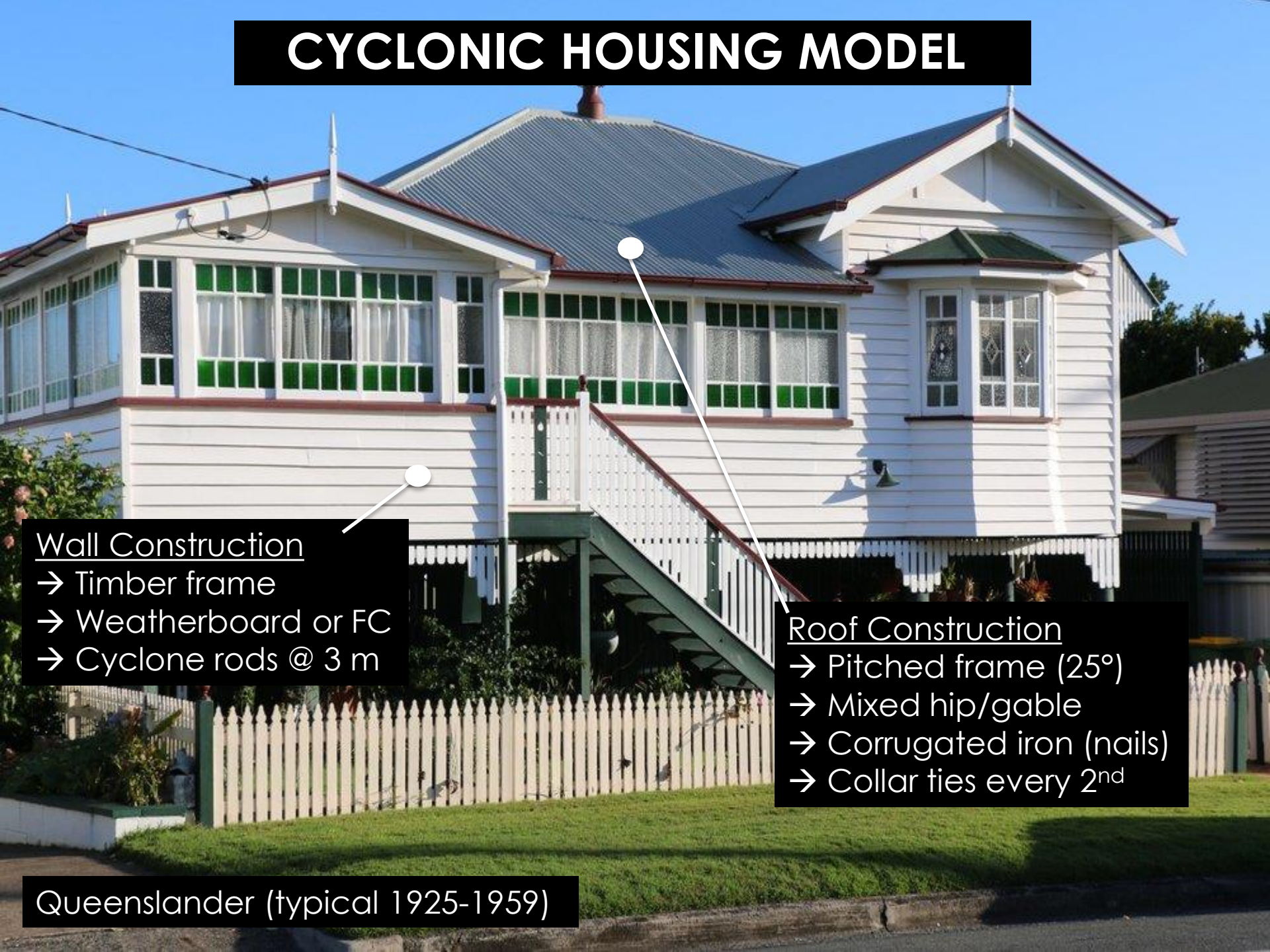
NON-CYCLONIC HOUSING MODELS

Roof Construction
→ Pitched frame (22-25°)
→ Collar ties every 2nd
→ Weak batten/rafter conn.
→ Unsecured tiles (ridge, etc.)
→ Tile/metal

Wall Construction
→ Minimal roof tie-down
→ Raised timber floors
→ Brick cavity or veneer

Four Housing Models
- Typical 1950-1970
- Southern AU
- Tile/metal
- Brick cavity/veneer

CYCLONIC HOUSING MODEL



Wall Construction
→ Timber frame
→ Weatherboard or FC
→ Cyclone rods @ 3 m

Roof Construction
→ Pitched frame (25°)
→ Mixed hip/gable
→ Corrugated iron (nails)
→ Collar ties every 2nd

Queenslander (typical 1925-1959)

RESILIENCE RATING SYSTEM

COMPONENT/SYSTEM	Bronze	Silver	Gold
ROOF	X	X	X
· Sarking installed for entire roof (if applicable)			
· Roof cladding attachment meets CTS standards			
· Roof cladding condition meets CTS standards			
ATTIC VENTILATION	X	X	X
· Whirly birds are high-wind rated			
APPURTENENCES	X	X	X
· Fencing is structurally sound			
· Shade sails, antennas, etc. wind rated? (or removable?)			
· Guttering is securely attached			
SHEDS (if applicable)	-	X	X
· Shed is cyclone rated			
OPENINGS	-	X	X
· Impact-protected windows with an approved system			
· Doors have appropriate locking mechanisms			
· Roller door installed post-2012 or has aftermarket bracing			
ATTACHED STRUCTURES – PORCHES/CARPORTS	-	X	X
· Roof connected to beam to resist uplift			
· Beam connected to column to resist uplift			
· Column anchored to structure to resist uplift			
OPENINGS	-	-	X
· Meet CTS standard pressure ratings			
CONTINOUS LOAD PATH	-	-	X
· Roof-to-wall connection			
· Wall-to-floor connection (i.e. cyclone rods)			
· Floor-to-foundation connection			

e.g. clips for all tiles (including ridge/hip lines) and cyclone washers for metal in addition to no corrosion of metal roofing and weathering of tile pointing

May include windows and sliding glass doors for water ingress

How do we get homeowners to invest in mitigation?

UNDERSTANDING BEHAVIOR CHANGE

PROPOSED NEXT STEPS

1. Review validity of current GA/CTS vulnerability modelling logic
2. Expand model to include new housing types
3. Develop input data for selected house types in both existing and retrofitted conditions

Vulnerability modelling

4. Develop proposed retrofit details
5. Costing of retrofit works on selected house types
6. Economic analysis of retrofit effectiveness

Cost-benefit

7. **Reporting and dissemination**