Large Damage Bills (to buildings) From Cyclones Can Be Reduced By Small Actions
Cyclone Tracy (1974)

- Peak gust estimated 243 km/h (71 Fatalities)
- 70-90% of housing destroyed
- Engineered structures performed better

Hurricane Andrew (1992)

- Peak gust estimated 281 km/h (65 Fatalities)
- >63,000 homes destroyed

Housing Performance

- 1920s: Traditional construction
- Catastrophic cyclones (Tracy and Andrew)
- Achieved life safety goals
- Stronger building codes
- Life safety target
- Financial loss ($) target?
- Tomorrow

Performance

Time

1920s

Today

www.jcu.edu.au/cts
NCC Structural Tenents

- 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

Minimum design standards

NCC: Class 2 Importance level
10% in 50 yrs prob of exceedance
(1:500 Annual probability of exceedance)
Wind Loads on Houses

Consider the forces caused by pressures induced by wind passing over structure
Wind loads on low rise buildings

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

Housing design standard AS4055 requires that a dominant opening is assumed in the design. (for cyclonic regions, C and D, only)
Tropical Cyclone Debbie
Damage to buildings in the Whitsunday Region

https://www.jcu.edu.au/cyclone-testing-station/publications
Why do damage surveys?

- Are our design standards appropriate?
- Was the design criteria (wind speed) exceeded?
- Correct implementation of design criteria?
- Appropriate materials?
- Adequate construction quality?
Investigation commenced 29/3 and included the communities of; Bowen, Proserpine, Airlie Beach, Hamilton Island, Shute Harbour, Hideaway Bay, Dingo Beach, Wilson Beach and Conway Beach.
Adjusted anemometer data as a percentage of $V_{500}$

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<th>Location</th>
<th>$\bar{u}_{3.600,tower}$</th>
<th>$\bar{u}_{3.600,open}$</th>
<th>$\bar{u}_{0.2,600,open}$</th>
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Estimate of wind speed as a % of Design ($V_{500}$)
(referenced to 10 m height in open terrain)

Wind at specific buildings will be influenced by surrounding hills/shielding/exposure.
QFES and F&R NSW - RDA damage survey points for Proserpine

Majority of properties - No observed damage

• QBCC has repair checklists and guides for rebuilding after cyclones:  

• Standards Australia Handbook **HB 132.2** for upgrading structural performance in existing houses
Rust, rot and termites
QFES - RDA damage survey points for Cannonvale and Airlie Beach
Roof structure damage to contemporary (engineered) construction in Airlie and Hamilton Island
Loss of cladding elements from Engineered buildings
From insurance data → Can be $1000/m for repair (includes interiors) (but < $5/m if build it correct the first time)
Changes to cladding Standard to include to minimum requirements of material, strength, thickness and fastener spacings for all flashings for cyclonic regions.

From insurance data → Can be $1000/m for repair (includes interiors) (but < $5/m if build it correct the first time)
Revisions to AS1562.1 for minimum requirements for fixings of attachments
Windows and doors

- Doors and windows are part of the building envelope
- But rare for designers to consider wind loading
Full-scale Testing

Full-scale tests were conducted in the Cyclone Testing Station’s air-box to determine the capacity of generic timber door system arrangements and likely failure modes.
Air-box Video: Test 1
Testing so far...

- Budget 35mm hollow core externally rated doors
- Budget locksets
- Prefab finger jointed pine jambs
  ✓ Prefab steel jambs
  ✓ Mid-range price for 35mm solid core doors
  ✓ Mid-range entrance lockset
  ✓ Mid-range price 40 mm hollow core external doors

- Tested for ramp and cyclic loading (yet to test under simulated wind load for cyclonic trace)
- Have not yet tested “solid” timber jambs
- **Have only tested new products!!!!**
Wind driven rain (WDR) ingress

In every cyclone or thunderstorm damage investigation report conducted by the CTS back to Cyclone Winifred mentions damage due to water ingress

- Extensive damage to Plasterboard linings
- Corrosion of framing elements
- Non structural elements
- Mold and bacteria
- Odour
But don’t need a hole in roof to let the water in
Relationship between ultimate strength design pressure, serviceability design pressure and the test pressure for the Australian Standard water penetration test (AS20147)
Investigate WDRWI from applying a windward wall fluctuating pressure as opposed to static pressure from the standard.

Research supported by Suncorp, IAG and BNHCRC
C2 Rated Sliding Door

1200Pa Max. gust applied over a 3min trace
• **Bad building performance can turn a storm into a DISASTER**
• **Good building performance can make a potential disaster not even newsworthy!**

Need research to inform Codes to help us deliver cost effective standards and materials...

But importantly,

Need paths for encouraging all aspects of design and construction to implement it!
Reduce drivers of loss (and improve resilience of community)

Mitigation needs:

1. For older houses - Upgrading of roof structure (with focus on work occurring during typical renovations) (Examples in HB132.2 and on QBCC web site)

2. Opening protection (i.e. windows, doors, etc.) (applies to all house types and ages for helping to reduce water ingress)

3. Community education/preparedness/maintenance (applies to all house types and ages)

4. On-going builder/trades/engineering/manufacturer education for updates to codes and standards and practices
Storm tide damage from TC Debbie and TC Yasi
CTS supporters