bnhcrc.com.au

LARGE DAMAGE BILLS TO BUILDINGS FROM CYCLONES CAN BE REDUCED BY SMALL ACTIONS

David Henderson[1,2], John Ginger[1,2], Daniel Smith[1,2]
[1] Cyclone Testing Station, James Cook University
[2] Bushfire and Natural Hazards CRC
Corresponding author: david.henderson@jcu.edu.au

Version	Release history	Date
1.0	Initial release of document	05/09/2018

Disclaimer:
James Cook University and the Bushfire and Natural Hazards CRC advise that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, the James Cook University and the Bushfire and Natural Hazards CRC (including its employees and consultants) exclude all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

Publisher:
Bushfire and Natural Hazards CRC

September 2018

ABSTRACT

LARGE DAMAGE BILLS TO BUILDINGS FROM CYCLONES CAN BE REDUCED BY SMALL ACTIONS

David Henderson, John Ginger, Daniel Smith, *Cyclone Testing Station, James Cook University, QLD*

Recent severe tropical cyclones and storms impacting Australian cities and towns have resulted in large financial losses due to damaged buildings and property. Disruption to livelihoods during the repair/rebuilding prolongs recovery for the community. Damage investigations by the Cyclone Testing Station estimate the wind speeds for the majority of the regions investigated were less than the design wind speeds for contemporary construction (i.e. for buildings less than 35 years old). The damage building assessments show a significant proportion of the losses are due to contemporary buildings. This raises issues as to appropriateness of our building construction, Codes, engineering design practices, and ongoing maintenance.

BACKGROUND

Findings from damage investigations following severe weather events provide critical information for understanding building performance. CTS damage investigations following cyclones such as Cyclone Yasi [1] and Cyclone Debbie [2], have clearly shown a significant improvement in structural performance of housing built after the introduction of the engineered provisions introduced in the early 1980s. The damage investigations did however highlight issues with contemporary construction (post mid-80's) such as loss of soffits and poor performance of ancillary items and roller doors which led to some damage.

Notwithstanding improved structural performance of buildings, the damage investigations detailed wind driven rain water ingress damage in residential construction. There were cases of wind-driven rain entering through the building envelope at openings such as windows and doors (even if closed), around flashings, through linings or where the envelope had been damaged.

The Insurance Council of Australia (ICA) engaged the Cyclone Testing Station in 2013 to conduct a review of insurance claims on strata properties that resulted from recent cyclones. The aim of this study was to identify factors that may be contributing to insurable losses.

That pilot study scope examined the ICA provided data for strata properties with claims and those without claims in the NQ/FNQ region during 2010/11. The claims have been taken following Cyclone Yasi. The claims data was related to the impacting local wind speeds which are influenced by terrain and topographic features as well as shielding. By incorporating these factors in concert with the loss data, and property information, damage levels relating to building form may then be compared.

One of the findings of the study was the trend of higher claims in relation to their sum insured for newer properties than pre-80s properties. It was postulated that the losses of the contemporary might be associated with the introduction of different building materials and styles which could include plaster board linings, metal fascia, larger openings, minimal eaves, large partly enclosed living areas, and complex roof shapes (lots of valleys and ridges). These different features may increase susceptibility to wind driven rain water ingress as well as not being designed or constructed in appropriate manner. The data contained within the claims did not allow an assessment of the various components. However, in analysing available text descriptors from the clams, the study did highlighted that 80% of the claims mentioned rain water ingress damage [3].

To combat these losses, a two prong approach for mitigation of damage through both (a) updates to current Australian building standards and equally, (b) a set of simple strategies/tasks for building and home owners (maintenance, envelope checklist, and opening protection), is required.

The National Construction Code of Australia's [4] stipulated structural objectives, with respect to wind loads, include;

- Safeguard people from injury caused by structural failure,
- Safeguard people from loss of amenity caused by structural behavior,
- Protect other property from physical damage caused by structural failure,

The NCC also prescribes the societal risk for the ultimate limit state strength of a structure. The level of risk is evaluated depending on the location and type of structure. For typical residential building this is 1:500 year probability of exceedance.

The wind speed at ultimate limit state is the design level that the structure is meant to withstand and still protect its occupants. For a residential building in Region C, the 1:500 probability of exceedance wind speed is 69 m/s (0.2 second gust at 10 m height in open terrain). It is interesting to note that this regional gust wind speed of 69 m/s is in the range of gust wind speeds for a Category 4 cyclone.

The regional design speed is further modified for the building location and geometry using factors from AS/NZS1170.2. These factors can either increase or decrease the local wind speed (i.e. building height, terrain, topography, shielding from other structures, suburban terrain, etc). Therefore a building in an exposed location (e.g. on top of a hill), that is designed without proper consideration for the increase in wind speed, is at an increased risk of failure.

Structures designed according to Australian building standards load combinations should have a negligible probability of failure (i.e. < 0.001 or as a percentage, < 0.1 %) at ultimate limit state loads. Therefore failures of structural elements would not be expected to occur at the ultimate limit state design load.

However, for recent impacts of Tropical Cyclone Marcia and Tropical Cyclone Debbie, structural damage was detailed by CTS for wind speeds less than the design level. Examples of damage included roof structural beams, cladding, flashings, fascia, soffits, and failed roof top equipment. Wind driven rain water ingress damage was greatly exacerbated by the damage to these buildings' envelopes.

CONCLUSION

Damage investigations have shown that Australian building regulations in terms of the structural objectives generally appear to be appropriate with respect to wind loading. However, issues such as poor construction practice and/or design results in significant damage to properties. Lack of ongoing maintenance is also a factor.

Water ingress from wind driven rain has been identified as a key factor in insurance claims. As structural issues have been identified and acted upon, the damage from wind driven rain ingress and the damage to ancillary components are a major factor on losses for events with wind speeds less than design level.

We are all a part of disaster mitigation. The resilience of our communities is up to all of us. It is recommended that education and awareness of consequences of such failures (e.g. damage to property and risk to life) is required in all steps of the building process (regulation, design, construction, certification and maintenance) and by all parties (designer, builder, certifier, and owner).

ACKNOWLEDGEMENT

The Cyclone Testing Station would like to acknowledge the support from the Queensland Government Department of Housing and Public Works, Bushfire and Natural Hazards CRC, Suncorp, and Insurance Australia Group for supporting this research.

REFERENCES

1. Boughton, G. N., D. J. Henderson, J. D. Ginger, J. D. Holmes, G. R. Walker, C. Leitch, L. R. Somerville, U. Frye, N. C. Jayasinghe and P. Kim., Tropical Cyclone Yasi Structural Damage to Buildings, Cyclone Testing Station, James Cook University, Townsville. TR 57. 2011
2. Boughton, G.N., Falck, D.J., Henderson, D.J., Smith, D.J., Parackal, K., Kloetzke, Mason, R. Krupar III, M. Humphreys, S. Navaratnam, G. Bodhinayake, S. Ingham, and J.D. Ginger, Tropical Cyclone Debbie; Damage to buildings in the Whitsunday Region, TR63, Cyclone Testing Station, James Cook University, Townsville. 2017
3. D. J. Henderson, D. J. Smith, and J. D. Ginger, Strata Title and wind storms, Strata and Community title in Australia Conference, Gold Coast, 2015.
4. NCC. National Construction Code. Australian Building Codes Board. Australia, 2016.