Oct 2018

North Queensland Study into Water Damage from Cyclones

Project partners: IAG and SUNCORP

Overview of study

Insurers, IAG and Suncorp, engaged with the Cyclone Testing Station to investigate drivers of loss for Strata properties from cyclone impacts. The Insurers provided claims data for strata and homes that were damaged during Tropical Cyclones Marcia and Debbie. This data coupled with the Station's damage investigations of buildings from severe events such as Cyclones Yasi, Marcia, Olwyn and Debbie, allowed research relating elements of the buildings' performance to financial losses from the impacts of the cyclones. Importantly, assessments of damage from aspects of the cyclone impacts, such as wind speed and wind driven rain water ingress, could be analysed and coupled with costs for repair.

Recommendations from the study included;

- Awareness in the design and construction industry (and developers) for all elements of the building envelope in their importance in mitigating losses (and expense to repair). This includes flashings, soffits, awnings etc. This has been in part started with the revisions Australian Standards on minimum fixing requirements for flashings and attachments.

- Awareness of residents of the importance of maintenance and pre-cyclone season preparations. The maintenance includes inspections and repairs of structural details (veranda posts, roof screws, etc.) as well as non-structural details (e.g. sealant around window sills, replacement of UV damaged vents)

- Insurance and Window and door industries work together to promote the importance of having secure weather resistant openings for cyclonic regions. This will result in less stress for the occupants during the cyclone, lower damage costs, quicker recovery, and help lower premiums due to reduced risk of loss.

Wind Driven Rain Water Ingress

One of the findings from the study was the widespread issue of damage to interiors of buildings from water ingress from wind driven rain. It has been identified as a key factor in insurance claims.

As structural issues in terms of resisting the wind loads have been identified and acted upon, within building codes and standards, the damage from wind driven rain ingress is a major factor on losses for events with wind speeds less than design level.

Damage from the rain

From the CTS damage investigations, the majority of buildings resisted the severe wind loads and remained substantially intact – as they should have as the wind speeds impacting the buildings were less than the design levels for contemporary construction. However, **approximately 70% of Strata claims reviewed had some form of damage from water ingress**. That number rises to almost all properties in exposed locations. Of the detailed strata claims reviewed, **the percentage of claim costs associated with the water ingress damage varied from 2% to 60%** (with min and max costs for water ingress varying from $70,000 to $1,700,000). For the housing claims reviewed, the average cost of repairing damage from the water ingress was $25,000.

The combined damage survey including wind field assessments with the claims data highlighted several issues such as; wind driven rain water ingress, poor design and/or construction practice of structural elements especially in exposed locations (e.g. hills or waterfront), the need for more robust materials and connection choices for building components in hard to reach (and maintain) areas (e.g. soffits and flashings on multistorey buildings), damage to non-wind load designed elements such as fences, and the need for continued maintenance. The study also showed that these issues are the same across single dwelling homes as well.

During strong winds, differential pressure between the outside and inside of a building can drive rain through any small openings or gaps on the windward side. The report showed that in the four cyclone events analysed, wind-driven rain had entered some buildings through weepholes or gaps around seals in windows or doors; under missing or damaged flashings and gutters; or through eaves, gable or roof vents.

Videos taken during TC Debbie by residents showed that considerable volumes of water came through windows and sliding glass doors, under swinging doors, and through light fittings and ceilings. In many cases, the water entered buildings that had no damage to the building envelope. The rain caused damage to vulnerable elements such as plasterboard wall linings and ceilings; floor coverings; and personal belongings. In multistorey buildings, the rain percolated down through the building for a number of storeys below the original point of entry.

(a) **(b)**

Figure 1 (a) Towels placed in front of large windward wall windows to control large amounts of water, and (b) water spaying into living room from under the door (CTS TR63)

Water ingress through windows and sliding doors

There is a large range of window sill designs in the marketplace; some window sealing and drainage systems are simple, while others are very complex. All windows must satisfy performance criteria in AS 2047 (Standards Australia, 2014), which includes a test to exclude water penetration at the prescribed test pressure. However, **this test pressure is only one-third of the serviceability design pressure (Serviceability design means that the building remains functional during and after this loading).**

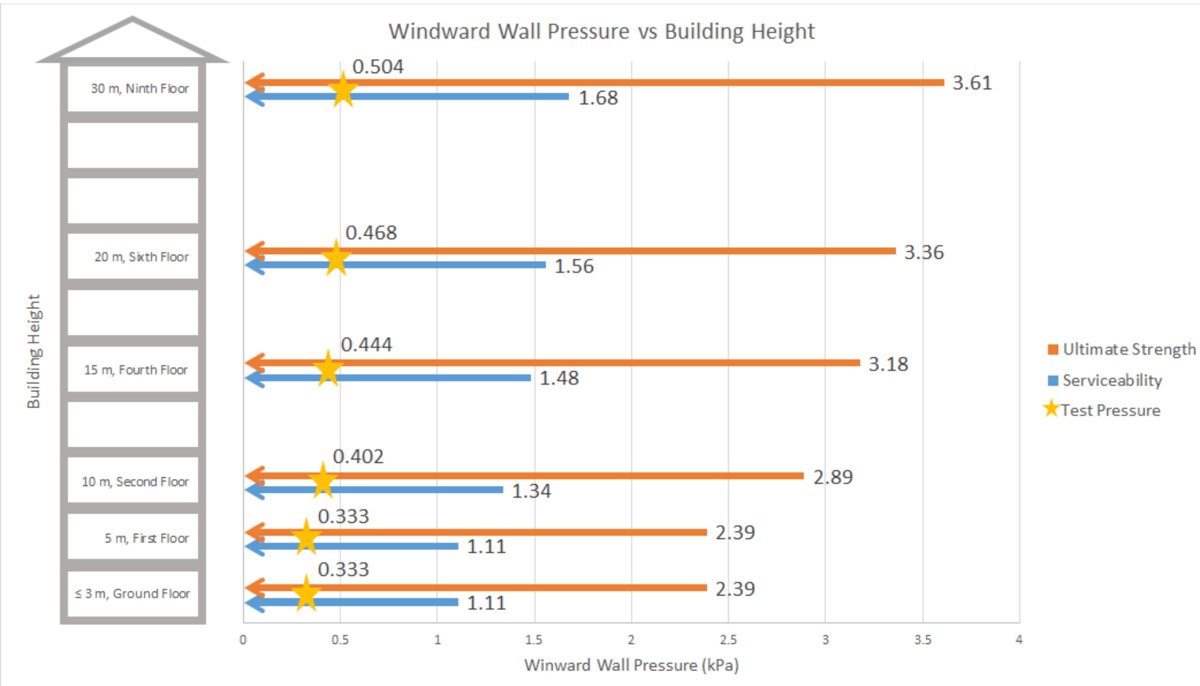

Figure 2 Relationship between ultimate strength design pressure, serviceability design pressure and the test pressure for the Australian Standard water penetration test showing how small the test pressure is in relation to the Serviceability design.

Weep holes in windows or glass sliding doors (Figure 3) are designed to allow condensation and minor leakage around seals to pass from the inside to the outside of the building. However, in high winds, differential pressure forces horizontally driven rain on windward walls through weep holes (i.e. in the opposite direction intended in design) and through other gaps in the building envelope.

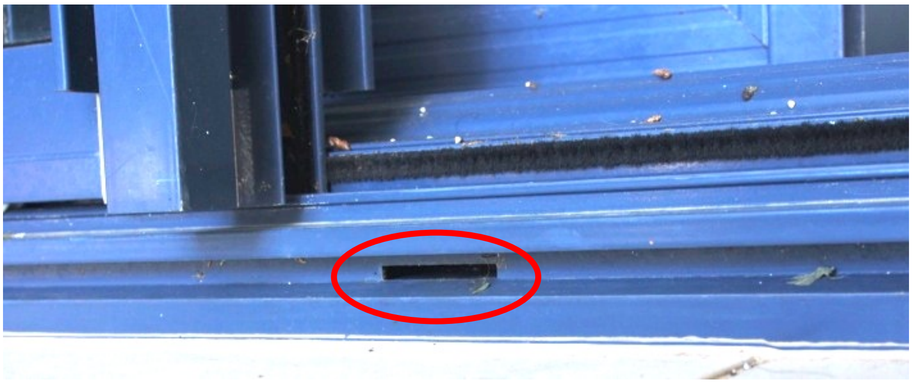

Figure 3 Weephole in glass sliding door frame

Residents of strata properties and detached houses reported that water entered apartments and houses through windows and glass sliding doors or under swinging doors or bi-fold doors. Some said they were able to manage the small amounts of rainwater that came in with a few towels placed in front of windward windows. Others reported that they were unable to keep up with positioning and then wringing out saturated towels that produced up to 8 buckets full per hour during the cyclone. The long period of high intensity wind and rain during TC Debbie meant that occupants had to manage water ingress for many hours.

However some people mentioned, who were in either apartments or houses, they had no water or only a small amount of water enter through their sliding windows during TC Debbie. Typically, the windows without significant water ingress had weep holes that were covered by external rubber strips. Figure 3 (a) shows a window from a house and another in a larger apartment building with rubber seals over the weepholes that performed well. The windows and glass sliding doors in another apartment building, Figure 3 (b), had an external baffle that concealed the weepholes; only a small amount of water leaked through them. This door also had a step that would have assisted in reducing water into the unit from water that pooled on the balcony near the bottom of the door.

(a) Sliding windows with rubber flaps over weepholes

(b) Sliding glass doors with baffle that concealed the weepholes on an apartment balcony

Figure 4 Windows and glass sliding doors that prevented wind-driven rain entering the building

Reducing water ingress for existing windows and doors

With the support of the project partners, a pressure chamber was constructed to explore the performance of contemporary windows and doors during fluctuating wind loads and rain and to test proposed mitigation measures to reduce water ingress.

The Wind Driven Rain Simulator (WDRS) comprised of an open air-pressure-chamber equipped with two ‘spray bars’ to simulate rain. To generate the highly turbulent fluctuating wind loads on the wall the chamber, was powered by a Pressure Loading Actuator (PLA).

The tests specimens were set up on the WDRS with their outdoor side facing the inside of the WDRS. This simulates ‘real life’ conditions since the rain and pressure are applied in the inside of the WDRS.

Figure 5 shows the WDRS with the wall sample including a window fitted to its open face.

During the testing, all the modern window and door specimens tested were compliant with the AS 2047 rain flow rate and static test pressure of approximately 300 Pa standard, and did not let uncontrolled water into the inside of the building. However, for the fluctuating pressures encountered during wind storms the windows and door leaked, a lot.

Various mitigation strategies such as taping over the weep holes were trialled. The only configuration that greatly reduced the amount of water ingress was by using a strip of plastic sheet taped on the inside of the window sill (i.e. outside of WDRS). This strip of thin plastic increased the height of the window sill, caught the water and allowed it to drain back out of the house via the weep holes. Figure 6 shows results side by side during a pressure peak of a fluctuating pressure trace. A significant amount of water is being pushed through the seals and over the sill of the window on the left side, while the water is constrained by the plastic lining on the right side. This was a similar result for the sliding door tests.

Figure 5: WDRS with Wall and Window Test Sample

https://www.youtube.com/watch?v=prn0kBCXRkk&t=46s

Figure 6 Side by side views of normal window and window with the Plastic sheet sill extension during a pressure peak

Conclusion

Water damage is a significant cause of loss. In many ways, water damage is well disguised from outside the house. Many homes and buildings that are built correctly and do not suffer major structural damage still incur heavy losses, driven largely by serious internal water damage

Water can enter the buildings through failure of the envelope (roof, windows, doors, flashings, etc.) as well as through ingress through sound windows and doors.

This project has demonstrated that although our current Standard AS2047 for windows and doors provides wind pressures and rainfall rates that are complied with, these pressures are not adequate to prevent water ingress during cyclonic events.

It is recommended that the insurance, and window and door industries work together to promote the importance of having secure weather resistant openings for cyclonic regions. This will result in less stress for the occupants during the cyclone, lower damage costs, quicker recovery, and help lower premiums due to reduced risk of loss.

Simple measures such as storm shutters on the exterior or the plastic sheet sill extension on the inside face of the window can greatly reduce the amount of driven rain entering our homes.

Note:
This is a summary of report TS1124. Report TS1124 is confidential to the project partners as it contains description of damage and photos that could be used by third parties to identify properties and their associated damage claim