MITIGATING WIND DAMAGE CAUSED BY INTERNAL PRESSURES

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End Users: Department of Housing and Public Works
Bushfire and Natural Hazards CRC, VIC

A broken door or window during a windstorm allows wind to enter the building and push on the roof and walls, increasing the load on the structure. This project is improving existing techniques which characterize these loads by analyzing internal pressures measured in a wind tunnel model and Full-Scale buildings with different types of openings, volumes, porosity etc. The results are incorporated into a central model which can predict internal pressures with more accuracy than ever before.

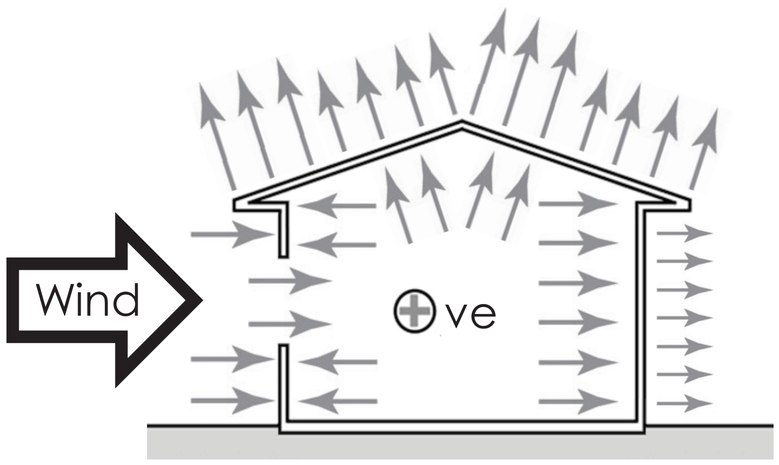
IMPORTANCE:

Inadequately designed buildings may lead to economic loss and human suffering, where excessive safety margins lead to wastage of materials and valuable resources. The optimal design relies on a sound understanding of the loads and probability of occurrence.

A failure of a door or window is very common during a windstorm, generating large pressures inside the building, significantly increasing the overall loads.

This research shows that the design internal pressure is a function of several additional parameters of the building, which are not considered in current design practice, with the intention that the results will be implemented into wind loading codes.

The research will also highlight modifications which can be integrated into the design to reduce these loads.



Large Internal Pressure

THE PROBLEM:

- Windows and doors are usually overlooked during design, leading to failures.
- If no "large opening" is considered during design, the building has a much higher potential to fail.

END USER STATEMENT:

The end user for the project, the QLD Department of Housing and Public Works believe "This research has the potential to increase our understanding of the impacts of wind loads on commercial buildings" and "anticipates that the data obtained from this research could be used to inform future Australian Standards for wind loading."

RESEARCH METHODS:

Three separate studies measured internal and external pressures, 1. A 1:200 geometric scale building in a wind tunnel, 2. An Idealized Full-Scale Enclosure, 3. A Typical Full-Scale Shed.

As very few Full-scale studies have ever been conducted these experiments provide critical information to describe numerical methods and validate model-scale wind tunnel results.

Results show internal pressures are lower when the building has greater permeability, (e.g. many smaller openings distributed around the building, i.e. gaps around doors windows, etc.), a larger building volume, greater envelope flexibility.

Internal Pressure Damage
Tully Heads, Cyclone Yasi (2011)

Full-Scale test building

TAKE HOME MESSAGE:

- Ensure all external windows and doors are secured if there is potential for a severe storm.
- Investing in adequate locks and door jams for external doors will significantly reduce your vulnerability.
- Results show internal pressures are just as great as the external pressures even from a small opening (i.e. like that of a bathroom window), if there are no other openings.
- The outcomes of this project will better inform engineers to design buildings and increase confidence in structural liability models.
- The optimization of building design will increase the resilience, survivability of communities and improve vulnerability modeling of all building stock around Australia, providing more reliable and potentially more affordable buildings.

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