INTERNAL PRESSURE FLUCTUATIONS IN INDUSTRIAL BUILDINGS

Mitchell Humphreys[1], John Ginger[1], David Henderson[1], Peter Ridd [2]

[1] Cyclone Testing Station, College of Science and Engineering, James Cook University, QLD [2] College of Science and Engineering, James Cook University, QLD

INTERNAL PRESSURES CAN CONTRIBUTE TO A LARGE PORTION OF THE NET WIND LOAD ON A BUILDING. CURRENT KNOWLEDGE INTO INTERNAL PRESSURE DESIGN IS STILL DEBATED AMONG EXPERTS. THIS PROJECT AIMS TO PROVIDE MUCH NEEDED INFORMATION ON INTERNAL PRESSURE FLUCTUATIONS THAT WILL BE USED TO PROVIDE MORE ACCURATE DESIGN DATA FOR ENGINEERS TO INCREASE THE RESILIENCE AND SURVIVABILITY OF BUILDING STOCK AROUND AUSTRALIA.

IMPORTANCE

Internal pressure design in Australia is currently based on limited, simplistic analysis. The addition of limited design scenarios and lack of understanding by some engineers has lead to a range of internal pressures being used by many structural designers, with the temptation to use lower internal pressures, leading to cheaper design and the potential for greater market share.

Damaged Building in Northern WA during Cyclone Christine, 2013.

Recent studies have shown additional parameters such as the volume of the building, the sizes of openings and their locations, the characteristics of the unsteady flow through openings, and the flexibility of the envelope can have a significant influence on the peak internal pressure that is used in the structural design of buildings, with experts agreeing that additional testing is needed in this field.

This research will provide much needed experimental testing and analysis to provide a theoretical basis for the validation for calculation of design internal pressures, thus providing accurate overall net wind loads for a wide range of building types and sizes, bridging the gap in current wind induced internal pressure design knowledge.

AIM

To analyze internal pressure fluctuations, to formulate data for optimizing the design of net pressures for typical industrial type buildings. This will be accomplished by:

- Conducting full-scale and wind tunnel tests, recording internal pressure fluctuations to analyze the theoretical basis of air flow in and out of buildings in terms of non-dimensional parameters.
- Analyze the unsteady reversing flow characteristics through typical building openings, using state of the art technology in wind engineering research.
- Utilize these results to formulate peak internal pressures with the building volume, flexibility, porosity and size and shape of openings in the building envelope.

Damage to a shed in Tully from Cyclone Yasi, 2011.

The analysis of internal pressures in more simple structures, like that of industrial buildings will be analyzed in terms of non-dimensional parameters for ease of implementation in codes and standards. The information gathered can then be extended to the analysis of more complex structures such as housing and multi story type structures.

Wind Tunnel Testing of Internal Pressure Model.

PROGRESS

A 16m x 8m x 4.3m shed at the Cyclone Testing Station will be used for the full-scale testing. Internal and external pressures will be measured around the building envelope, with the flexibility of the building being measured during testing as well in approach wind conditions.

Equipment for the full-scale testing is currently being sourced with testing conducted to check if appropriate for testing.

Wind tunnel model tests have been conducted and analysis commenced. Validation of the wind tunnel testing is required from the full-scale experiments.

CONCLUSION

In conclusion, this study will provide more accurate internal pressure data for implementation into wind loading codes and standards, providing accurate data for designers to satisfy, thus allowing building regulators to have more confidence in the assessment of structural liability.

For more information please contact Mitchell Humphreys at: **mitchell.humphreys@my.jcu.edu.au**