

WIND INDUCES INTERNAL PRESSURES IN INDUSTRIAL BUILDINGS



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INTERNAL PRESSURES ARE GENERATED INSIDE A BUILDING DURING A WIND STORM FROM OPENINGS IN THE ENVELOPE. INTERNAL PRESSURES CONTRIBUTE TO A LARGE PORTION OF THE LOADS ON A BUILDING, FAILURES DUE TO INTERNAL PRESSURES ARE OFTEN SEEN POST EVENTS. THIS PROJECT AIMS TO PROVIDE MORE ACCURATE INTERNAL PRESSURE DESIGN CRITERION FOR WIND LOADING STANDARDS, THUS INCREASING RESILIENCE, SURVIVABILITY AND IMPROVE VULNERABILITY MODELING OF ALL BUILDING STOCK AROUND AUSTRALIA.

PROBLEM:

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 led 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.

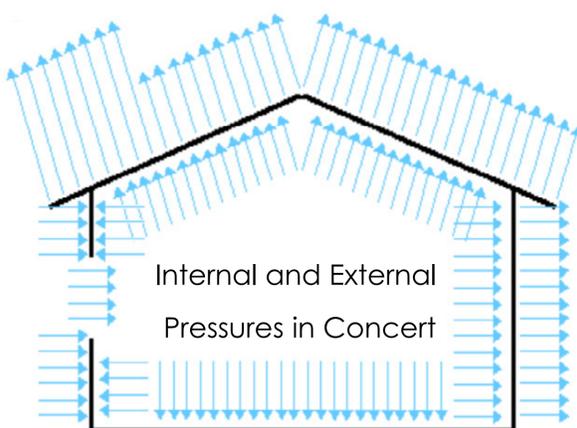
RESEARCH QUESTION:

This project is investigating internal pressure fluctuations induced by atmospheric wind flow by means of flow through building openings. The aim is to define more accurate internal pressure design criterion for a range of typical industrial type buildings.

Our End User the **QLD Department of Housing and Public Works** believes "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."



Wind Tunnel Set-up of Scale Model



PROJECT TO DATE:

The project has three sub sections, a) conduct wind tunnel tests on a typical industrial building, b) analyze flow characteristics through typical building openings from experimental tests, and c) to measure internal and external pressures on a full-scale building.

As a whole, this will provide a theoretical basis and experimental validation of numerical methods that describe internal pressures, thus improving internal pressure assessment during design.

The wind tunnel tests are complete, with the analysis having been presented as a paper submitted to the 9th Asia-Pacific Conference on Wind Engineering.

The next stage of the project involves setting up experimental tests to examine the flow characteristics through building openings, to more accurately describe ill-defined parameters in numerical methods used to determine internal pressures.

WIND TUNNEL TESTS:

- ▶ The wind tunnel study was undertaken on a 1:200 scale model of a 80m x 40m x 20m building. The building was tested for two main design scenarios. 1) The building nominally sealed with a range of leakage levels, (no large openings), 2) Similar leakage levels, but with several large opening scenarios.

- ▶ Results showed that the Australian wind loading standard slightly underestimates the positive internal pressure in the nominally sealed buildings, but over-estimates the internal suction pressure by 90%, usually the critical design case for nominally sealed buildings.
- ▶ The longer external pressure fluctuations are shown to penetrate the nominally sealed building up to 7 to 17Hz.
- ▶ The Australian wind loading standard overestimated the internal suction pressure with a large opening by 5%, while underestimated the positive internal pressure by 20%, this is the most critical design scenario as the positive pressures act in concert with the suction pressures on the roof.
- ▶ The internal pressures in a building with a large opening follow the external pressure on the large opening, when increasing the background leakage, the mean and fluctuating internal pressures are reduced.

CONCLUSION

This study will provide more accurate internal pressure data for implementation into wind loading codes and standards, this will allow building regulators to have more confidence in the assessment of structural liability, increase the resilience and survivability of all building stock around Australia.

From the preliminary wind tunnel tests the Australian standard overestimates and underestimates some internal pressures. The further steps in the project will evaluate internal pressures at full-scale to provide more accurate data for internal pressure design.

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