# IMOROVING THE RESILIENCE OF EXISTING HOUSING TO SEVERE WIND EVENTS

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**THIS PROJECT AIMS TO INVESTIGATE WINDSTORM RISK MITIGATION BY: (A) DEVELOPING VULNERABILITY MODELS FOR STRUCTURAL STRENGTH OF HOUSING FROM FIELD AND LABORATORY OBSERVATIONS AND (B) EVALUATING POTENTIAL UPGRADING AND RETROFITTING SOLUTIONS FOR RESIDENTIAL STRUCTURES.**

## POST-EVENT DAMAGE OBSERVATIONS

Significant structural damage of loss of roof cladding and roof structure to housing built prior the 1980s is a feature of many thunderstorm and cyclone damage investigations across Australia.

The recent Tropical Cyclone Debbie resulted in many cases of this type of severe damage.

There were cases of older housing with relatively new roof cladding installed to contemporary standards (i.e. screwed fixing as opposed to nailed) but lacking upgrades to batten/rafter or rafter/top-plate connections, loosing roof cladding with battens attached.

A contributing factor to this major structural damage is the failure of windward doors and windows. This breech leads to a large increase in internal pressure effectively doubling the load on the roof structure. Houses built since the mid-80s are designed for this contingency. Hence they are at a lower risk of failure.

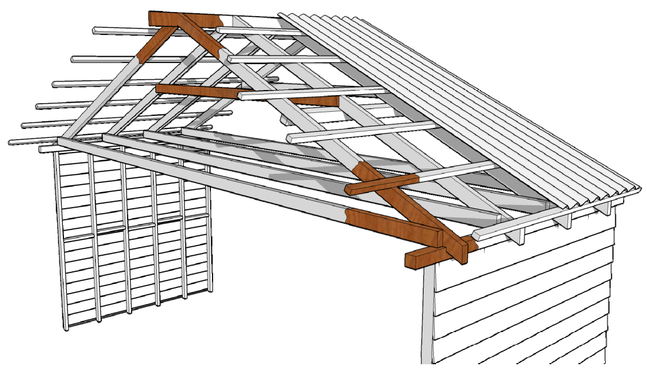
## HOUSE TYPES

To focus the analysis on vulnerable house types; surveys of houses, interviews with builders and inspectors, analysis of NEXIS building database across parts of cyclonic and non-cyclonic regions of Australia have resulted in three primary structural roof structure systems and associated subsets within them.

## STRUCTURAL ASSESSMENT

Load testing of components and structural analysis have been carried out as part of the investigation to determine the "strength of our houses to wind loads". In some cases this has involved harvesting components of older houses that were scheduled for demolition.

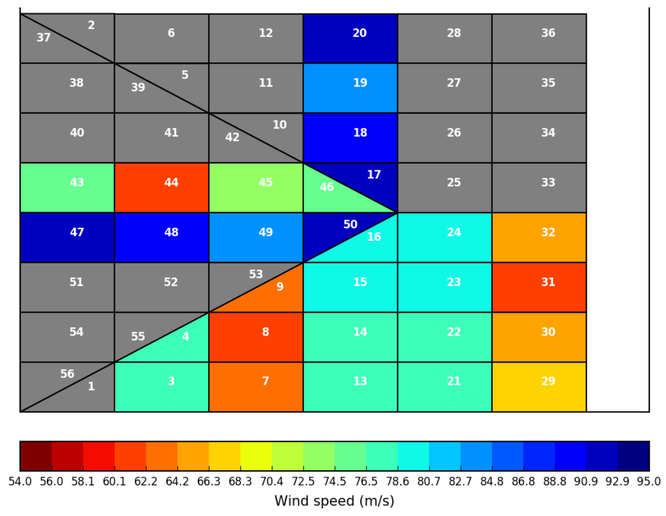
The primary structural components of a pitched roof frame include the rater to wall, ceiling joist to rafter, collar tie and rafter to ridge beam connections.



The structural testing and analysis provides input data for the vulnerability modelling to wind loads for different scenarios

## SOFTWARE MODEL - TOOL

The Vulnerability and Adaptation to Wind Simulation (VAWS) software tool is being developed to quantify the vulnerability of the pre-retrofitted house types as well as modelling the a range of mitigation actions to enable the calculation of a benefit / cost ratio for different retrofit strategies.




The model graphical outputs such as a view of hip roof showing the wind speeds for roof sheeting connection failures. The propagating failures at connections can be seen as lengths of unzipping roof sheeting. The cascade of connection failures stops at sheet ends at hips and the ridgeline. The model is able to assign varying connection strengths (based on test data) which instigates sheeting connection failures at a certain wind speed. This process allows the representation of poor construction practice (eg the roof sheeting screws at connections not engaging properly with the supporting battens) to be modeled and its consequences viewed. The model also provides a means of testing retrofit options.

## GOAL

The uptake of retrofitting and maintenance of house structure will increase community resilience and reduce the needs of response and recovery following severe wind events.

Incentives to encourage this action through insurance and government initiatives can be based on the economic modelling from this project

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