UNDERSTANDING PROGRESSIVE FAILURES TO WIND LOADS

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THIS STUDY WILL DETERMINE THE LOAD REDISTRIBUTION AND PROGRESSIVE FAILURE MECHANISMS OF HOUSES TO SEVERE WIND EVENTS. OUTCOMES WILL ENABLE THE DESIGN AND CONSTRUCTION OF MORE RESILIENT STRUCTURAL SYSTEMS AND TECHNIQUES FOR RETROFITTING EXISTING STRUCTURES.

BACKGROUND:

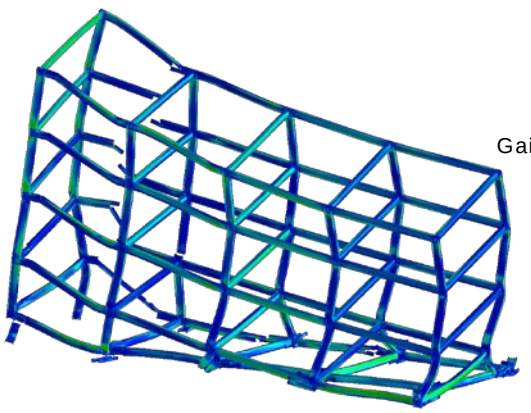
The overall structural response of light framed houses to wind loads is still poorly understood. Light framed construction is difficult to analyse due to the myriad of connection types and load sharing between structural and non-structural members. This study will determine the non-linear behavior and progressive failure mechanisms of the structure to extreme loads through structural analysis, computer simulation and physical testing.

CURRENT GAPS IN RESEARCH:

- Limited work using realistic time history wind loads
- Limited work on progressive or cascading failures.
- Nonlinear behavior of connections are not modelled past the point of complete failure.
- Little work on individual connection tests for Australian connections subject to realistic time-history loads.

RESEARCH QUESTIONS:

- How are loads shared and redistributed through a roof structure during a severe wind event?
- What is a typical failure cascade caused due to failure of cladding/batten/truss connections?
  - How can this be prevented?
- How much energy is absorbed in roof connections during a high wind event?
  - Does this energy give a measure of accumulated damage in the structure?



METHODOLOGY:

1. **Physical testing** of individual connections to determine their non-linear behaviour to fluctuating wind loads.
   - Properties such as stress strain curves and hysteresis models will be defined.
2. **Numerical Simulation** using physical test results will be used to test the effects of accumulated damage, construction defects and examine progressive collapse mechanisms.
   - Full scale testing will be required to calibrate numerical models.

PROJECT OUTCOMES:

Determine progressive failure mechanisms caused by:

- Construction defects.
- Accumulated damage from past events.

Provide design data for:

- The development of building standards.
- Retrofitting strategies for older structures.
- Vulnerability and catastrophe modelling.

Gain an in-depth understanding of:

- The response of Australian roofing connections to fluctuating wind loads.