Hardening Building and Infrastructure Cluster

PROJECT A9: Cost-effective mitigation strategy development for building related earthquake risk

Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme
bnhcrc.com.au

Project Participants

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Swinburne University:

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Geoscience Australia:

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End Users:

WA DFES, York Shire Council, ABCB, Standards Australia, EMA, State/Local Governments

Aim: to develop evidence base to inform decision making for earthquake risk mitigation

- ✓ **Establish seismic vulnerability classes for representative building types in Australia**
- ✓ **Survey existing retrofit techniques for known performance in recent earthquakes**
- ✓ **Develop cost-effective Australia-specific retrofit solutions**
- **Develop decision-support and earthquake risk forecasting tools to support infrastructure managers**
- **Develop economic loss models that include business interruption and casualty costs**

End User Engagement

- WA Dept Fire & Emergency Services
- York Shire Council
- Standards Australia – AS 3826
- Other indirect
  - EMA
  - State & local governments
  - Bldg Code of Australia

Lessons from Christchurch

Christchurch corner shops

Adelaide corner shops

Christchurch theatre

Adelaide arcade

AERIAL VIEW OF CHRISTCHURCH SECONDS AFTER THE 22 FEBRUARY 2011 EARTHQUAKE (only M6.3 but ~ 10km from CBD)

Some statistics

- 39 of the 42 fatalities associated with unreinforced masonry buildings were ***outside*** the building
- NZ law has existed for several decades requiring ‘Earthquake Prone’ building owners to strengthen or demolish it.
- However, it was up to ‘local authorities’ to enforce it.
- Often, cost-benefit arguments were used to ‘avoid’ strengthening

NUMBER 3 RED BUS FROM SUMNER, ON COLOMBO STREET, 22 FEBRUARY 2011.

Earthquake Spectra, Vol 33 (4): 1241-1255.
(Photo supplied by J. Ingham; used with permission.)

More statistics

- 12 of 13 people on bus died; 13th had medical bills > $1million
- Cost to strengthen parapet ~ $20k; value of building ~ $100k; hence not justifiable to require strengthening
- Statistical value of 1 life ~ $3million

- Ann Brower successfully lobbied the NZ government to change law – 2016 Earthquake Prone Buildings Amendment Act (also referred to as the 'Brower Amendment'.

- Building owners in Wellington have 12 months to strengthen or remove unstrengthened masonry parapets and other 'falling hazards' from buildings

Out-of-plane wall bending failures in Christchurch (42 fatalities in URM buildings)

Parapet and out-of-plane wall failures

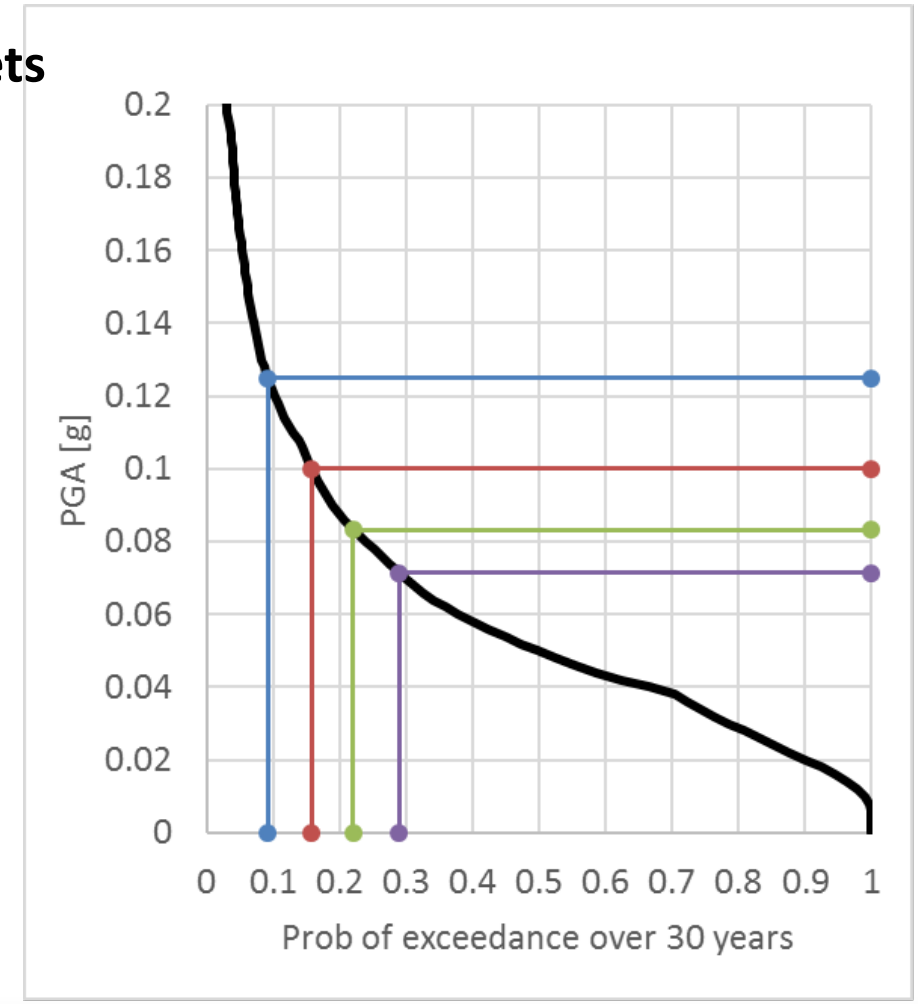
Typical building damage in M5.6 Newcastle Earthquake

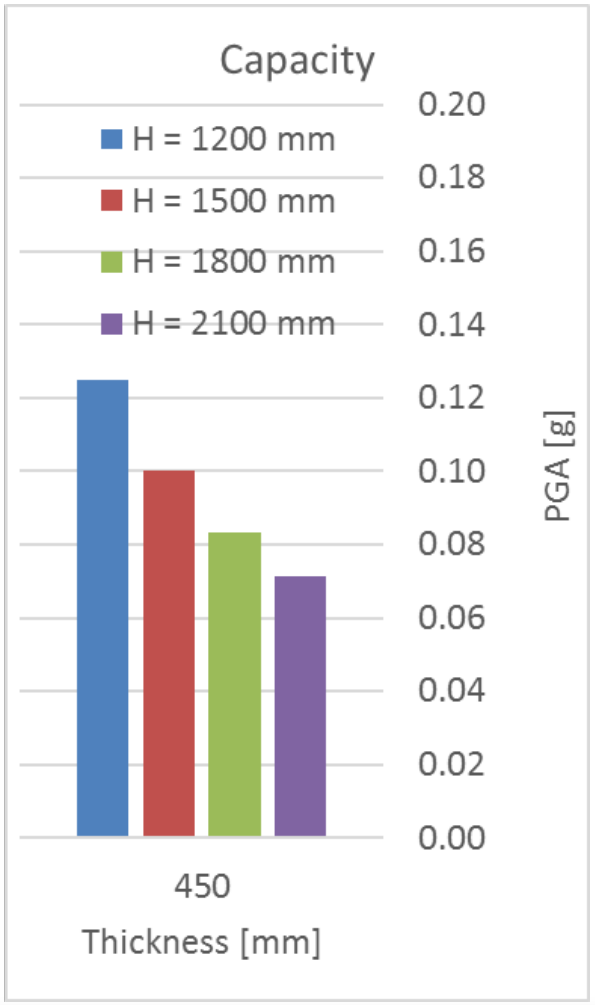
2010 Kalgoorlie Earthquake

Parapet/awning damage in URM buildings in M5.0 earthquake

PGA CAPACITIES AND PROBABILITY OF EXCEEDANCE OVER 30 YEAR TIME HORIZON

Parapets





Closing Remarks

- WA DFES and York Shire Council end user engagement has been fantastic:
  - Community engagement has been good;
  - Seismically vulnerable buildings have been identified;
  - Seismic strengthening options now being developed for typical York buildings;
  - DFES and York Shire application for a NDRP 2018-19 grant in preparation to support earthquake mitigation in York;
- Much of the assessment and retrofit solutions being developed for York will have national application
- Professor Griffith leading update of AS 3826 “Earthquake strengthening of existing buildings”