BUILDING PERFORMANCE

Improving structural engineering and resiliency in New Zealand

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US-Japan-NZ Workshop
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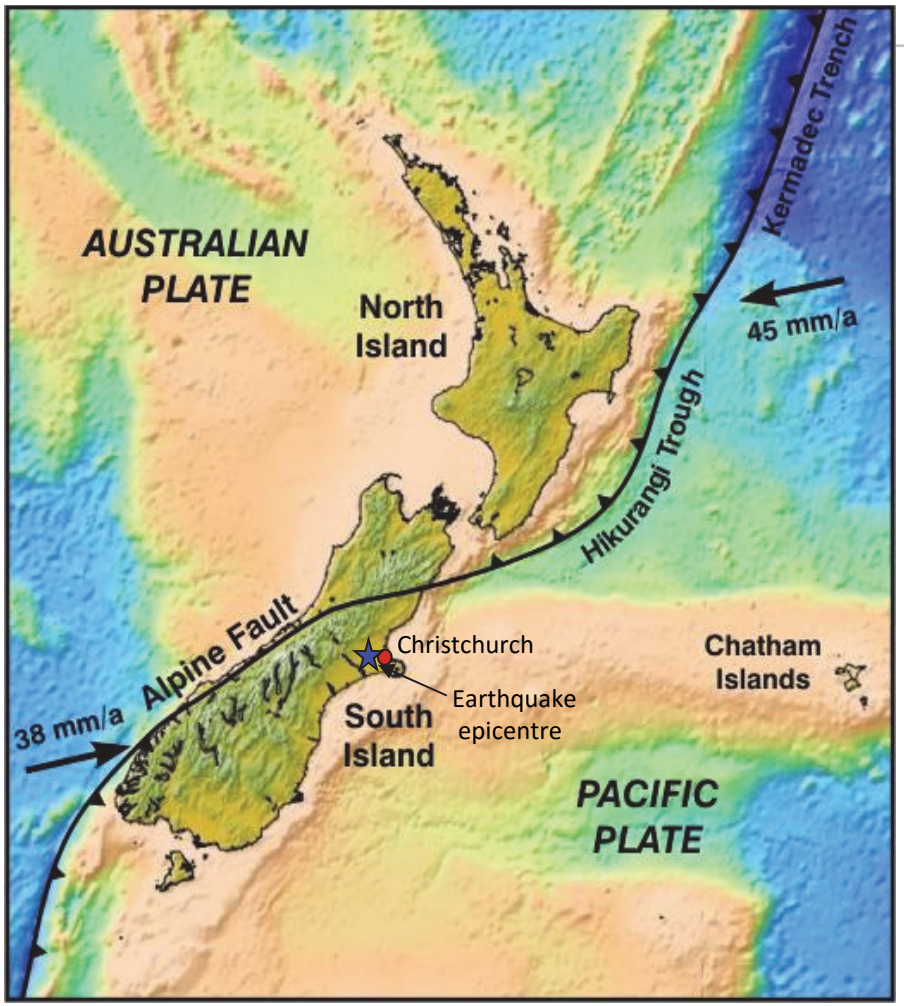
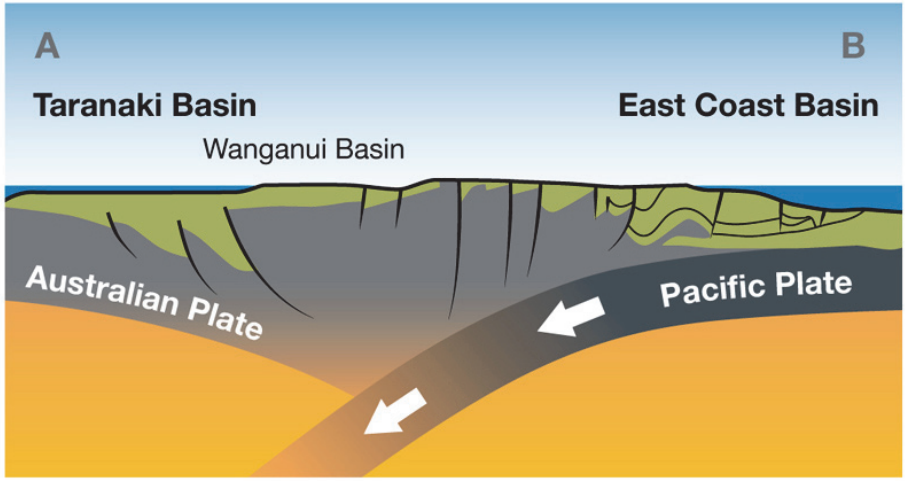
July 2016

New Zealand is vulnerable





23 January 1855

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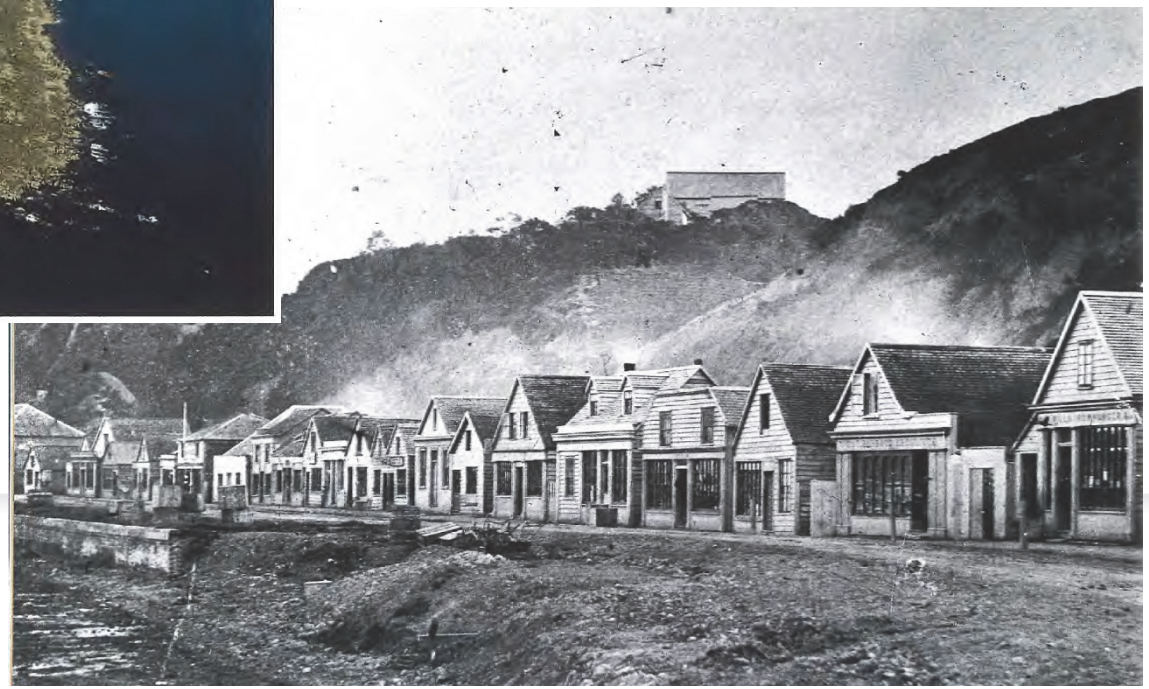
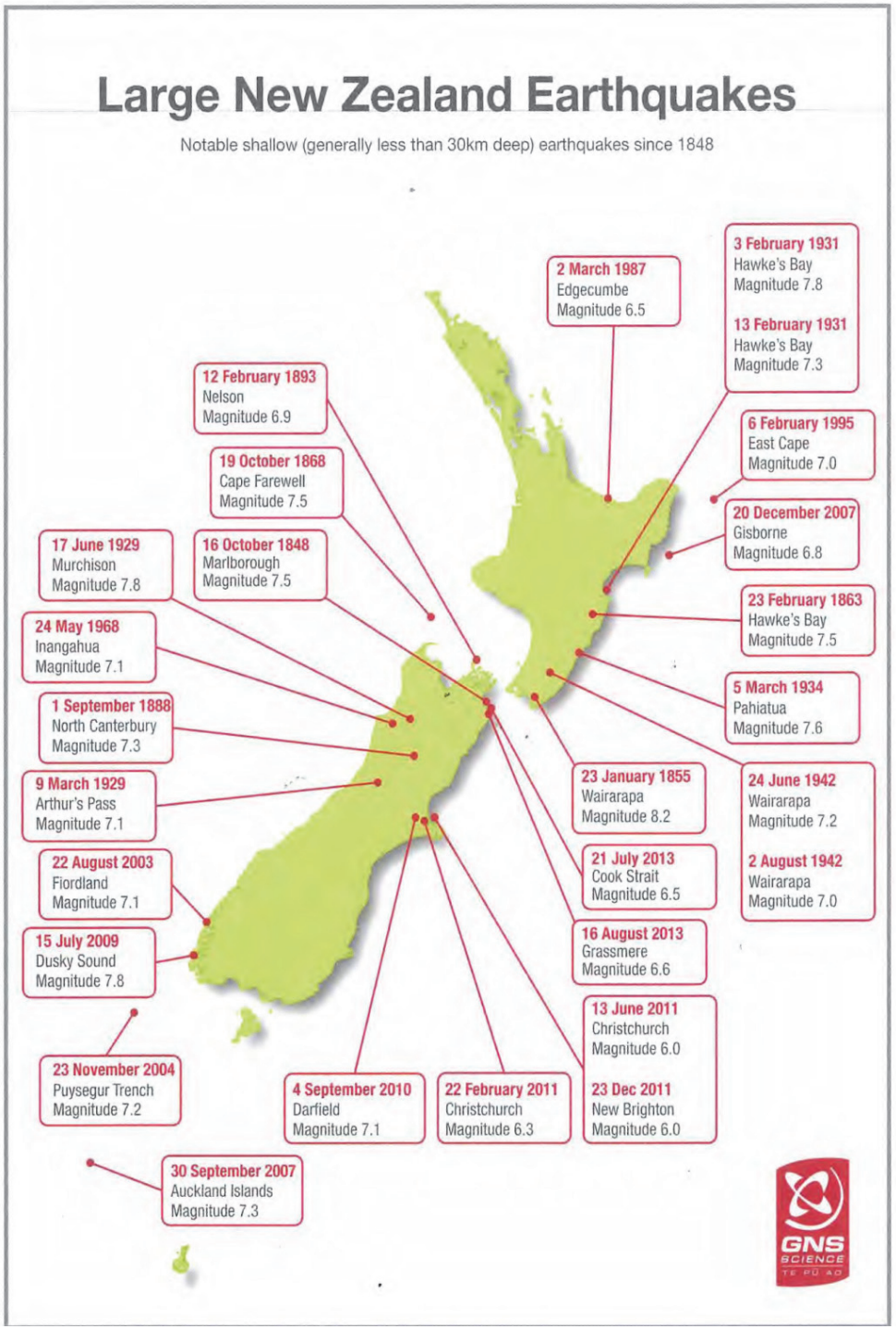


NZ Earthquakes

Murchison 1929

Napier Nurses Home 1931

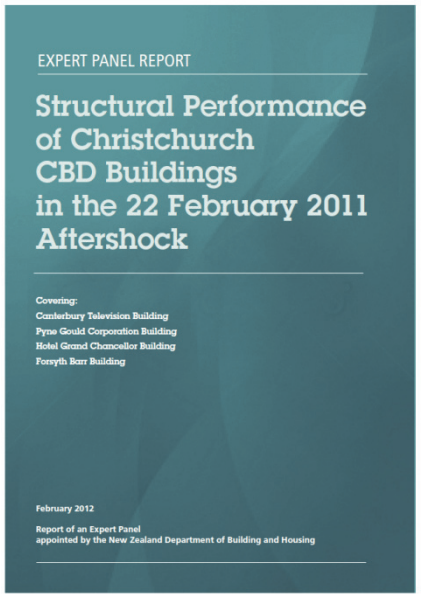


The Canterbury experience

Fatalities – 185 (11,000 injured) **Cost** – ≈ $NZ40 billion ≈ 20% GDP

Christchurch – 2 major collapses, 1700 commercial buildings demolished, 170k residential properties damaged, 8,000 red zoned

Canterbury - Many lessons



- Importance of:
  - resilience
  - knowledge of existing building stock (earthquake-prone)
  - integrated design process and monitoring
  - collaboration
  - engineering – 'engineering matters'
    - structural design
    - ground conditions & geotech design
  - preparedness – 4Rs

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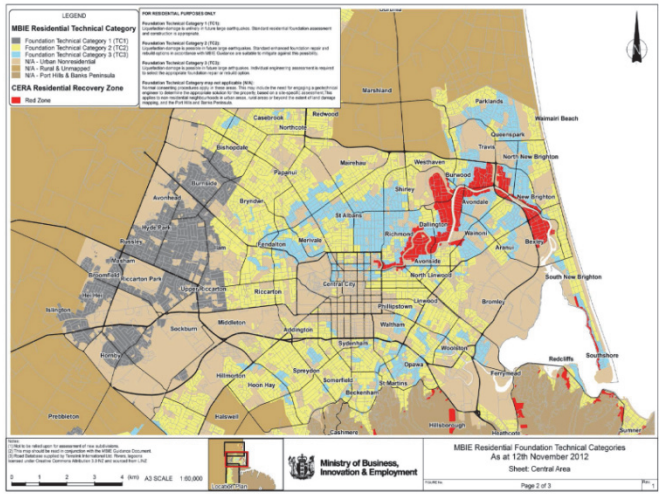
Canterbury repair and rebuild

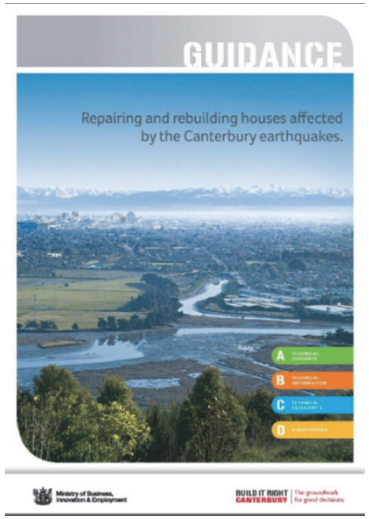
Residential guidance

Liquefaction

Slope stability

Risk approach – available resources

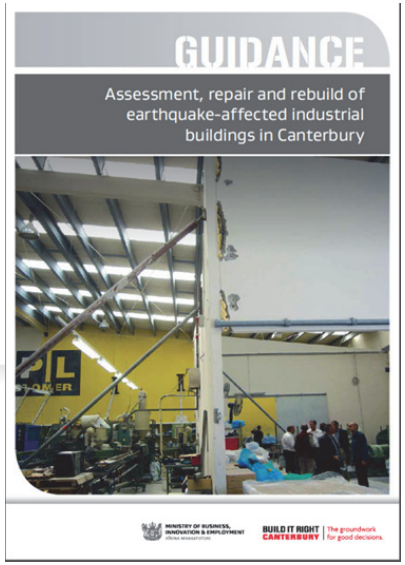




Industrial guidance

Keeping businesses operating

Foundation design



Seismicity review

Time varying hazard

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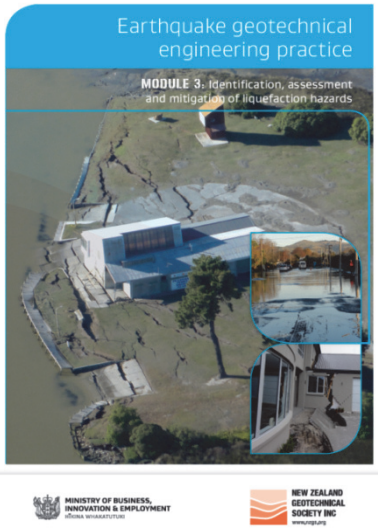
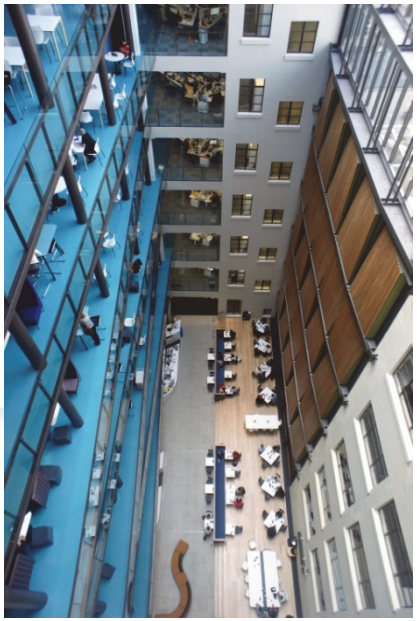
Learning from Canterbury – geotechnical



- planning and building guidance – areas subject to liquefaction
- earthquake geotechnical engineering modules on:
  - geotechnical investigation for liquefaction assessment
  - foundation and retaining wall design
  - ground improvement methods and specifications
  - rockfall protection structures
  - slope stability
- National Geotechnical Database
  - Successful Canterbury database
  - Capture data once, reuse many times
  - Much better understanding of land and likely behaviour

Learning from Canterbury – structure

- review of structural provisions in Building Code – specificity of performance requirements & what is tolerable to society
- structural design standards reviews – design actions, concrete, steel, timber
- non-structural building elements (eg ceilings)
- low damage building technologies (eg base isolation)



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Existing buildings – safer & more resilient earthquake-prone buildings legislation

- New legislation – the Building (Earthquake-Prone Buildings) Amendment Act 2016
- Balance of life safety, costs, heritage, resources
- Previously local govt policies, now national requirements
- varies the timetable for strengthening buildings relative to earthquake risk
- review of building assessment guidelines – displacement methods preferred

Seismic risk area	TAs identify potentially EQP	
	Priority	Other
High	2 ½ years	5 years
Medium	5 years	10 years
Low	n/a	15 years

Owners strengthen/ demolish EQP	
Priority	Other
7 ½ years	15 years
12 ½ years	25 years
n/a	35 years

Better management of buildings in an emergency

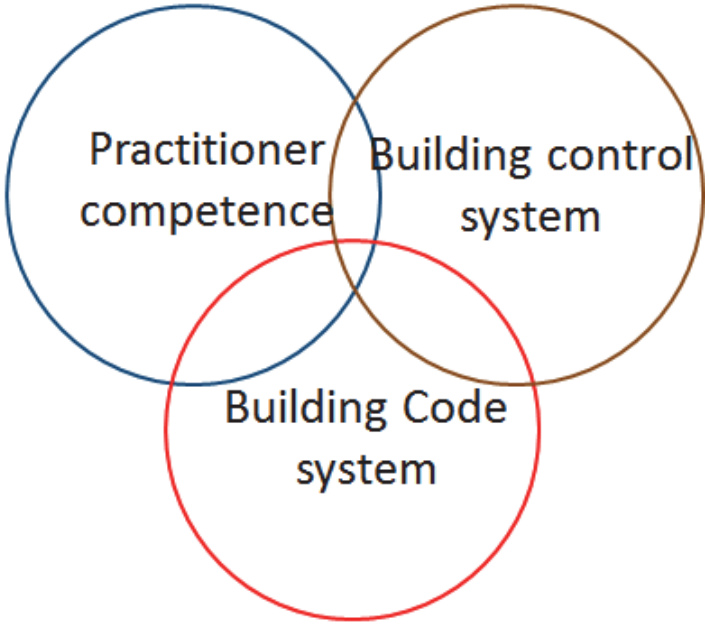
- MBIE has new functions around building management in an emergency
- preparing guidance for councils on the rapid building assessment process for emergencies (assessment and demolition protocols)
- training building assessors in rapid building assessment (400 trained nationally)
- guidelines for building failure investigations
- Detailed Damage Evaluation guidance

Research to improve building performance

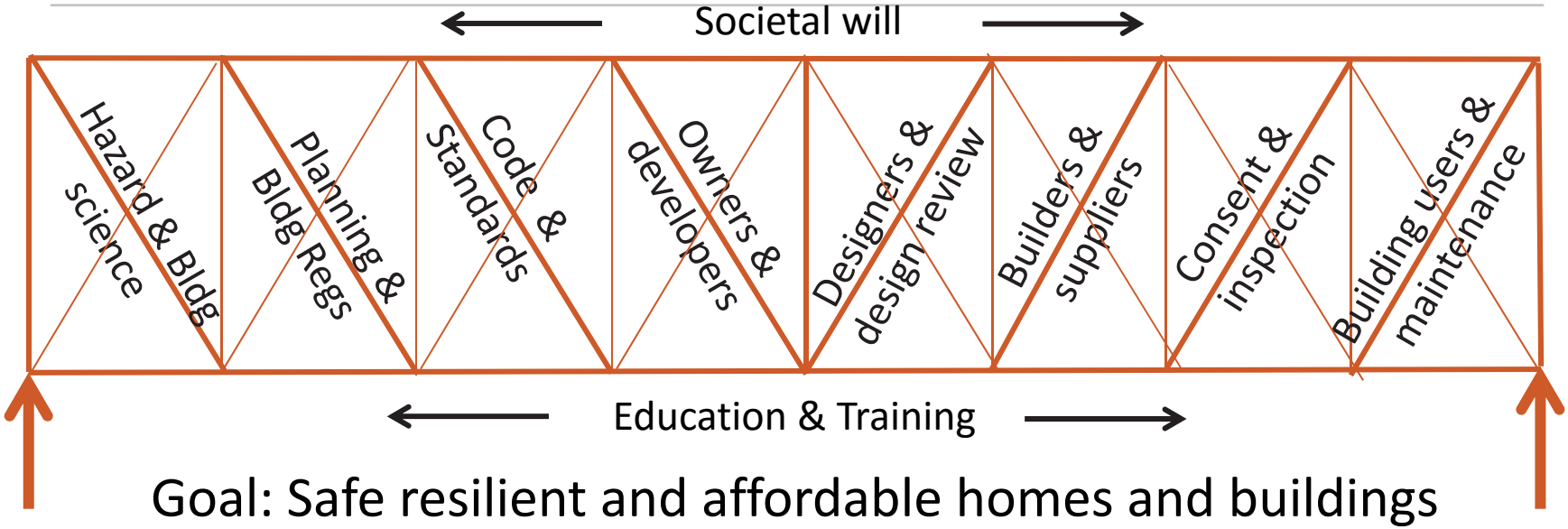
- MBIE, Natural Hazards Research Platform, QuakeCoRE, QuakeCentre, National Science Challenges
- research projects on the performance and resilience of buildings:
  - residual capacity of buildings
  - performance of concrete walls
  - geotechnical (liquefaction and slope stability of Wellington hillsides)
  - economic research into the costs and benefits of increasing the structural performance requirements in the Building Code
- international collaboration
  - MBIE Chair in Earthquake Engineering
  - International Wall Institute
  - Joint Laboratory of Earthquake Engineering, Tongji

Designer competence and occupational regulation

- building failures in Canterbury - increased accountability of engineers
- upskilling engineers
- Code of Ethics review
- Body of Knowledge
- occupational regulation of engineers
- Liability

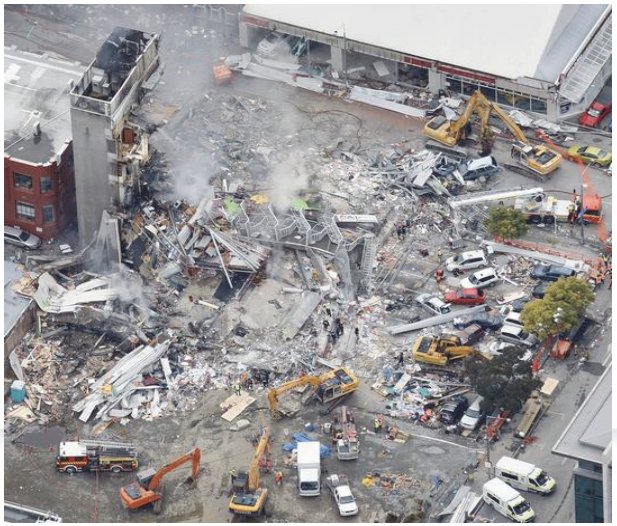


Integrated Construction System



Goal: Safe resilient and affordable homes and buildings

Southland Stadium
September 2010



CTV Collapse Feb 2011

Weathertightness issues

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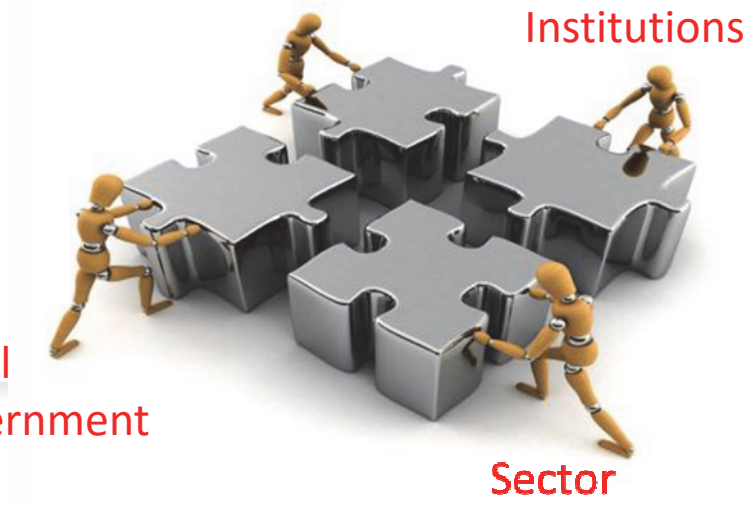
Southland Government

Sustaining collaboration

- interdisciplinary collaboration to recognise and mitigate hazards
  - occurs naturally during disasters
  - needs mechanisms to encourage in peacetime
- helps with political process – support
- co-operation needed in crisis – trust
- Engineering Advisory Group
- memoranda of understanding with professional societies



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Built Environment Leaders Forum 2015 & Action Plan

- Key government & private sector decision makers reflecting on lessons from Canterbury
- Develop Action plan for improving resilience on NZ built environment – five recommended areas
  - governance and leadership
  - decision-making frameworks
  - incentives and tools
  - Public engagement and communication
  - Information: data and evidence

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Future challenges for improving structural engineering and resiliency in NZ

- identifying and protecting critical infrastructure
- adapting our buildings and infrastructure to climate change, sea level rise, coastal erosion and storm surges
- globalisation of supply chains – compliance and quality assurance
- better integrating regulations and design of buildings, land use and infrastructure

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Leonard Cohen's Anthem:

Ring the bells for those that ring, forget your perfect offering, there is a crack, a crack in everything. That's how the light gets in.

Japanese practice of kintsukuroi 'to repair with gold'