

### Breakout Session 3: New Zealand Earthquake

- **What new questions raised by these events require basic research?**
  - What are **tolerable impacts**?
    - Who should be involved in decision making?
    - What should be the performance requirements?
  - Liquefaction – understanding, processes, effects on buildings and buried utilities (civil infrastructure); multiple occurrences at same site, multiple design-level events
  - How do we model probabilistically for ‘unlucky events’?
  - Effects of vertical accelerations (source, path and site effects), 3D shaking effects, implications for seismic isolation design, near fault effects



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### What new data are available as a result of these events?

- Data from events on multiple faults
- Attenuation relationships, stress drop, directionality, source depth
- Performance of URM and heritage buildings
  - technical issues, response of groups of buildings, neighbors retrofitting together, area-wide fixes
  - community perspectives of value and expectations regarding response
- Fragilities of all building types – most complete set of data yet collected
- Prevalence of precast concrete structures, 3D effects, diaphragm de-seating, lessons regarding detailing



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- **What unique aspects of these events require the development of a focused research program?**
  - Finish the validation of developing new structural systems for Chch rebuild. From lab to market
  - So long since last disaster that there was no existing community experience – how do you build latent capability?
  - What can be learnt from earthquake sequence effects? Stress loading
    - How to respond after first event and when to expect continuing sequence?
    - How to account for sequence effects when applying building placards?
  - Speed to reshape a recovery paradigm. Learning from Sept 2010 that was applied in Feb 2011
    - NZ's unique insurance penetration has slowed recovery and leads to questions of portability of experiences
    - EQC now broke, remove government insurance?
    - Political view to not retreat from insurance
    - Implications of being well insured on building standards



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- **What are the important lessons from these larger than expected events for the U.S., Japan and New Zealand?**
  - Deterministic – extreme conservatism?
  - Should there be a minimum/lower bound hazard level? M6.5 at 10 km?
  - Recovery issues – how to recover when major city loses its city center?
  - Land use planning, technical guidance, quantification of hazards



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### Why research collaborations with NZ?

- Major US research investment in Antarctica
- Similar built environment
- Similar code/design philosophies
- Tectonics very similar, soils/sands similar, analogies between Southern California and Canterbury plains
- Long standing successful collaborations, ease to quickly act
- Lots of face-to-face interactions previously that are now easy to leverage
- Free sharing of information, international researchers welcomed
- US researchers to be cognizant of NZ research Canterbury Earthquakes research plan

### Priorities

- Recovery for major urban earthquake
- Tolerable impacts
  - Acceptable performance
  - Defining Hazard levels
- Liquefaction processes and effects
- Gathering and analyzing databases:
  - Damaged buildings: URM, Precast, RC
  - Businesses, schools, tourism, rugby
  - Utilities
  - Performance of damaged structures