QuakeCoRE
NZ Centre for Earthquake Resilience
Te Hiranga Rū

QuakeCoRE Research Accomplishments
Annual Meeting 2023

Brendon Bradley
on behalf of the QuakeCoRE community

30 August 2023

Research Programme

Technology Megatrend Capability Areas

coordination mechanism

- **TM1** Computational Science
- **TM2** Machine Learning
- **TM3** Sensing and Monitoring
- **TM4** Materials Science and Manufacturing

Disciplinary Themes

- **DT1** Integrated Seismic Geohazards
- **DT2** Whole-of-Building Seismic Performance
- **DT3** Law, Planning, Economics
- **DT4** Cultural and Social Factors Shaping Resilience
- **DT5** Mātauranga Māori and Earthquake Resilience

Inter-disciplinary Programmes

- **IP1** Functional Recovery with Repairable Multi-storey Buildings
- **IP2** Thriving Residential Communities
- **IP3** A Resilient Aotearoa New Zealand Transport System
- **IP4** Harnessing Disruptive Technologies for Earthquake Resilience

Regional Network Areas

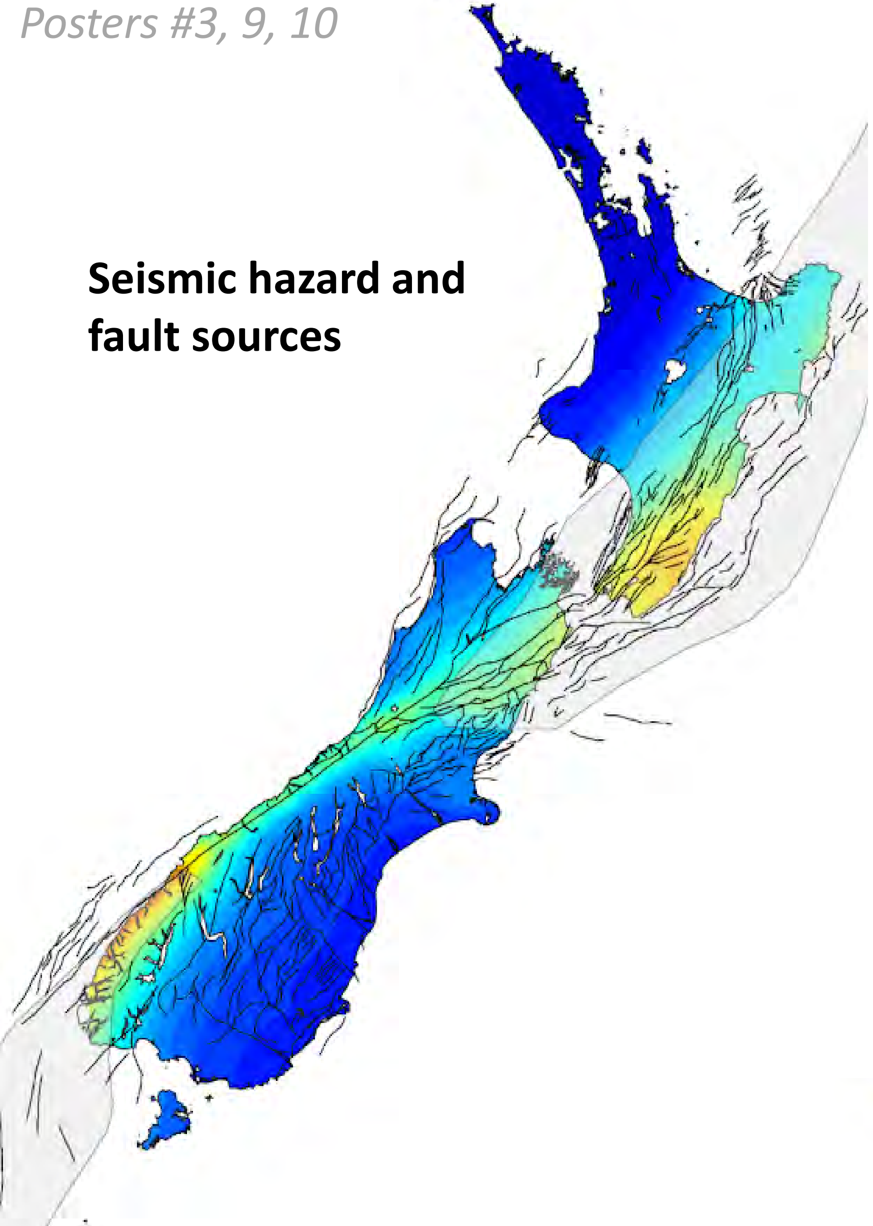
coordination mechanism

- **RN1** Alpine Fault *South Island-wide*
- **RN2** Wellington
- **RN3** Hikurangi subduction zone *North Island-wide*
- **RN4** Auckland
- **RN5** South Pacific

2022 Aotearoa NZ National Seismic Hazard Model

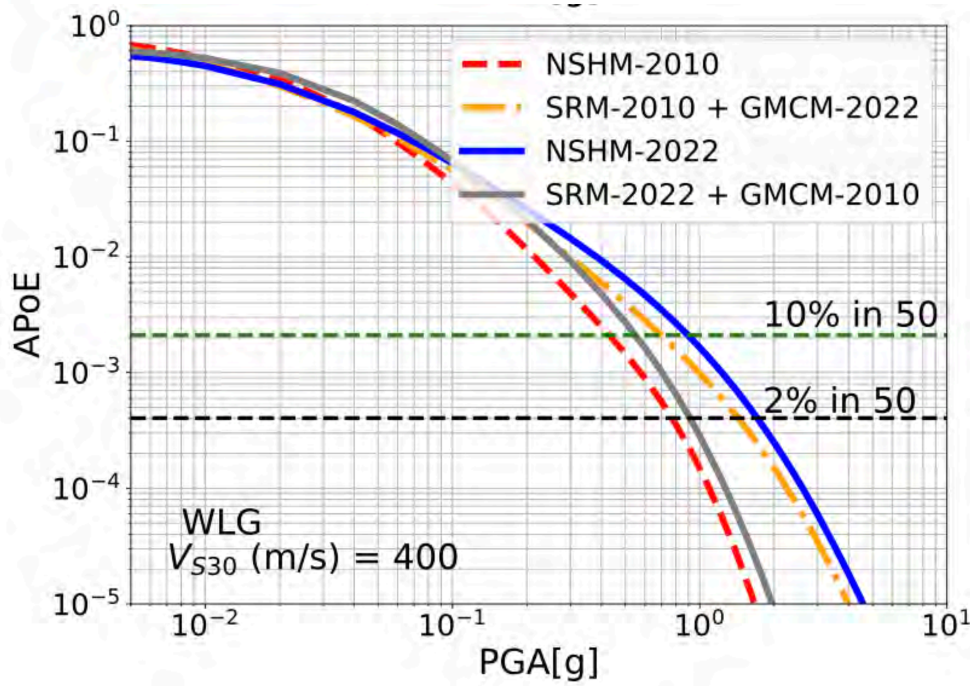
Gerstenberger et al.
Posters #3, 9, 10

Seismic hazard and fault sources



Ratio with 2010 hazard model

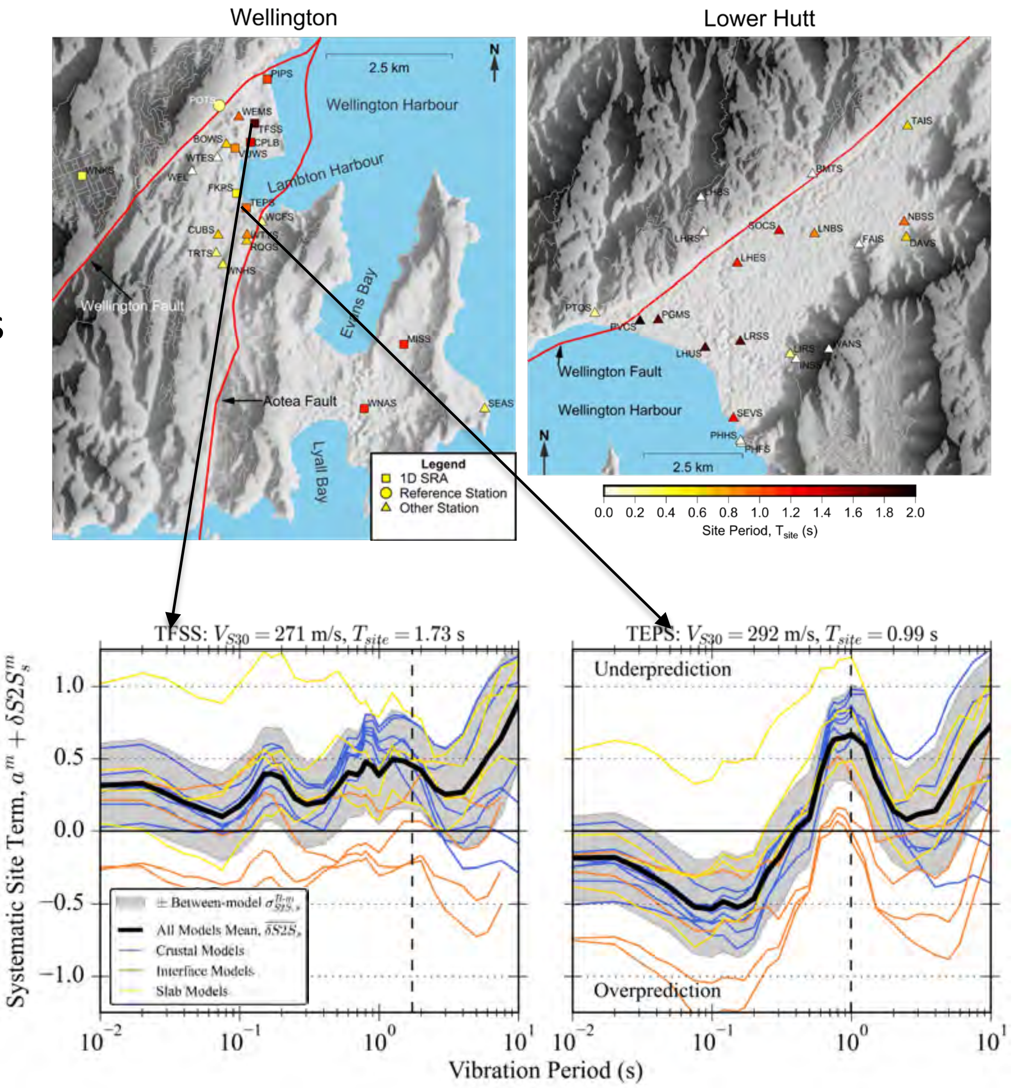
Hazard curves illustrating source vs. ground motion sensitivity



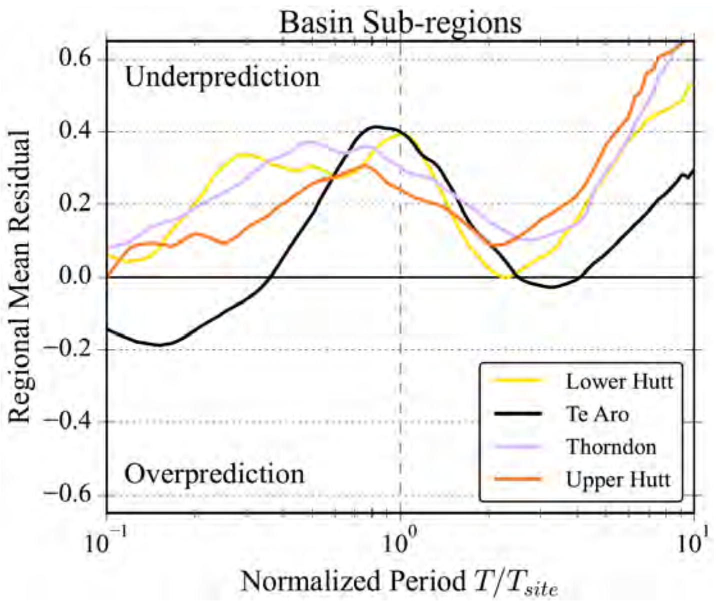
Site-Response Adjustments to Account for Basin Effects in Wellington

de la Torre et al.
Poster #08

- Prediction residuals for sites in Wellington and Lower Hutt
- 4 basin and 3 valley sub-regions



- Ground motion models from 2022 NZ NSHM
- Model-to-model variability
- Underprediction at site period for basins and valleys



- Similar shape for basin regions (and valley regions)
- Centred around T_{site}
- Max underprediction: factor of ~1.5
- Option for regional adjustment

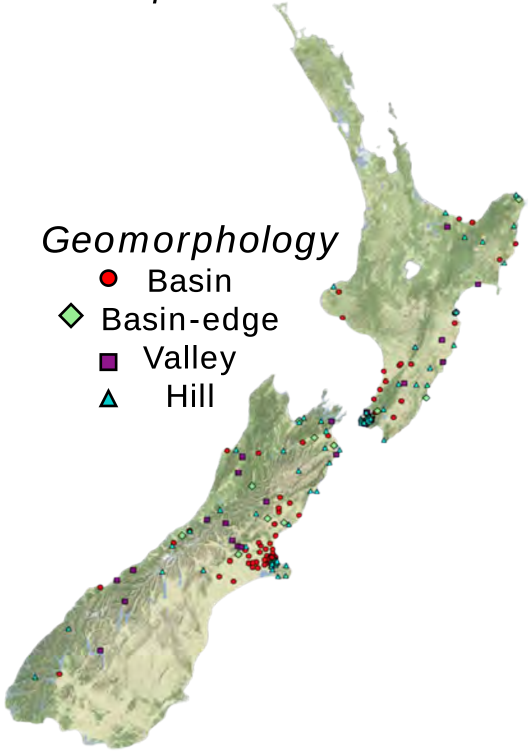
Site effect residual analysis of physics-based ground motion simulations

Tiwari et al.
Poster #19

Objective: Nationwide investigation of *strong systematic site effects* to determine the attributes influencing these effects for advancing ground motion simulations

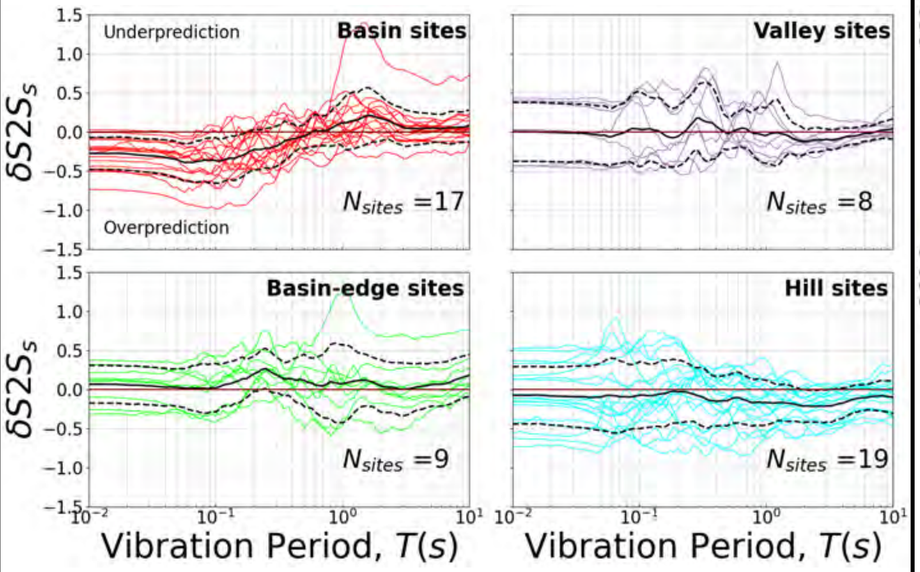
Approaches: Geomorphology, V_{S30}, T_0, $Z_{1.0}$, topo parameters etc. ⟷ Understanding of systematic site effects ⟷ Clustering of site-to-site residuals

Geomorphic classification of sites

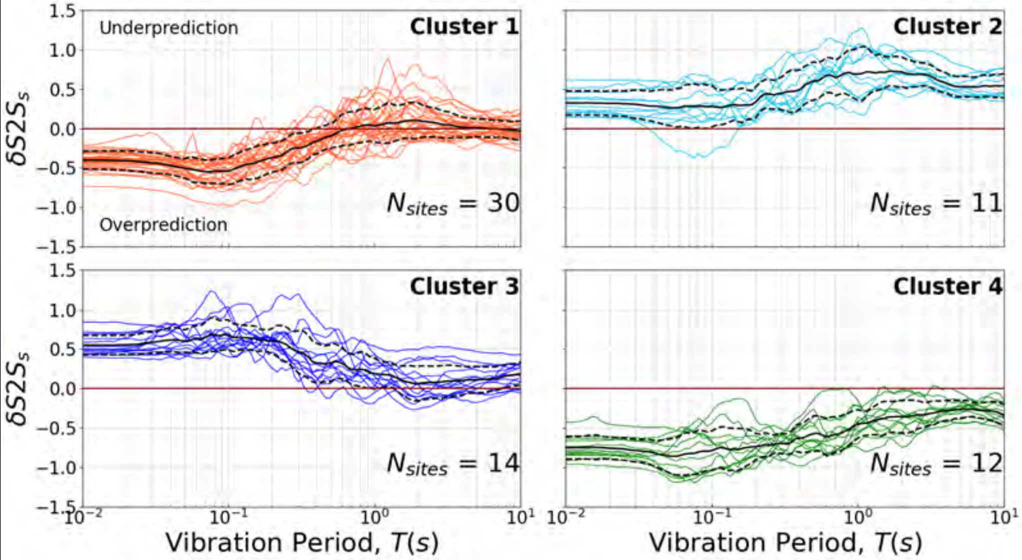


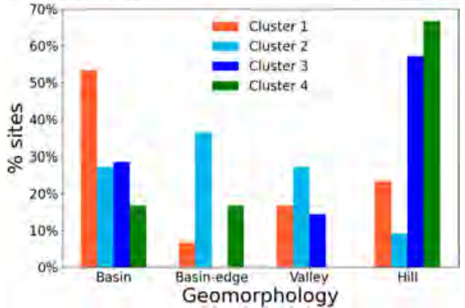
Trends with geomorphology

Wellington region



Trends with clustering

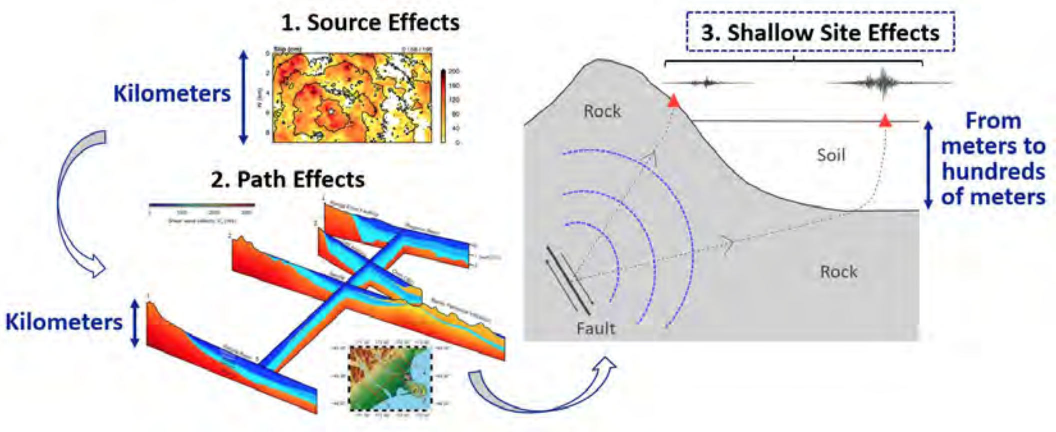




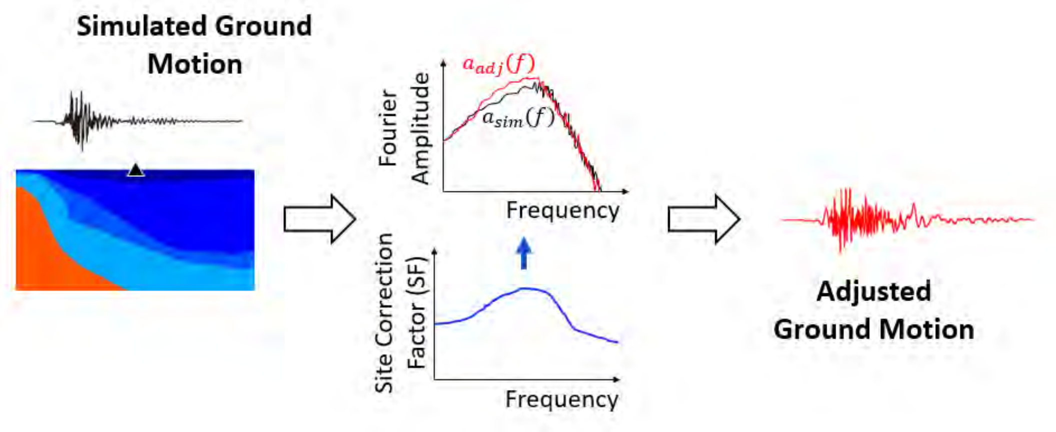
Frequency-domain Methods to Account for Shallow Site Effects in Hybrid Broadband Ground-Motion Simulations

Kuncar et al.
Poster #13

1. Problem



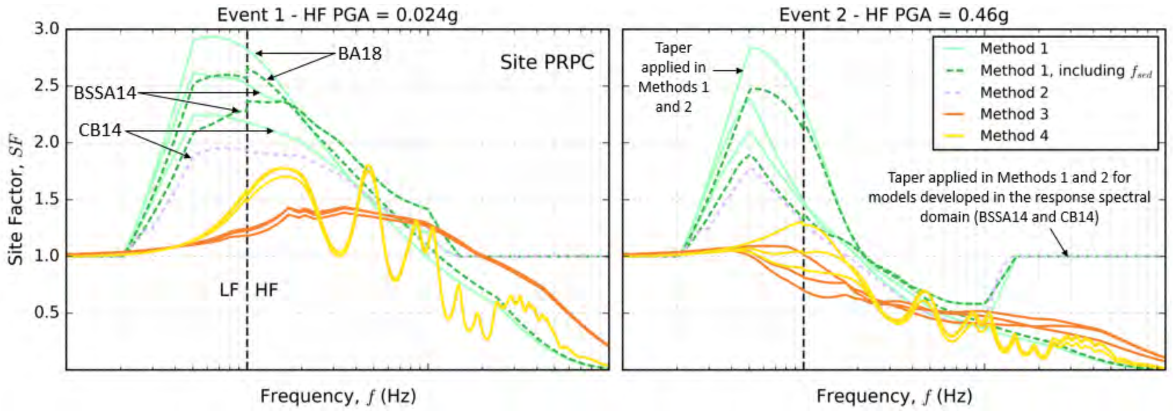
2. Approach



3. Methods

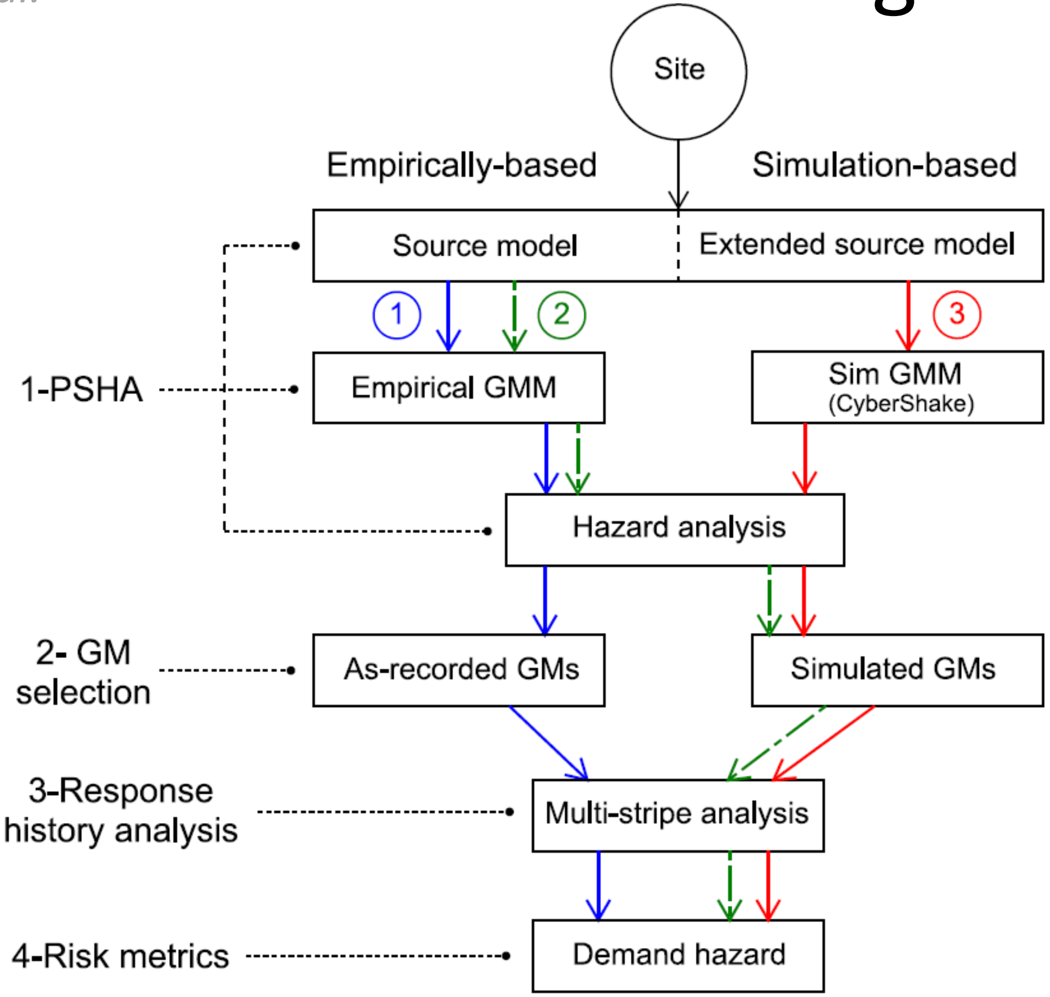
Method	Concept	Site-Characterization Data	
1	Based on the site-response component of a semi-empirical ground-motion model	V_{s30} (and Z_1)	Suitable for regional applications
2	Similar to Method 1 but includes a host-to-target adjustment to the simulated Vs profile	V_{s30} (and Z_1)	
3	Combines the SRI method with the nonlinear component of Method 1	V_s and ρ profiles, and k_0	Applicable with only a Vs profile
4	Combines the theoretical 1D transfer function with the nonlinear component of Method 1	V_s, ρ, and D_{min} profiles	

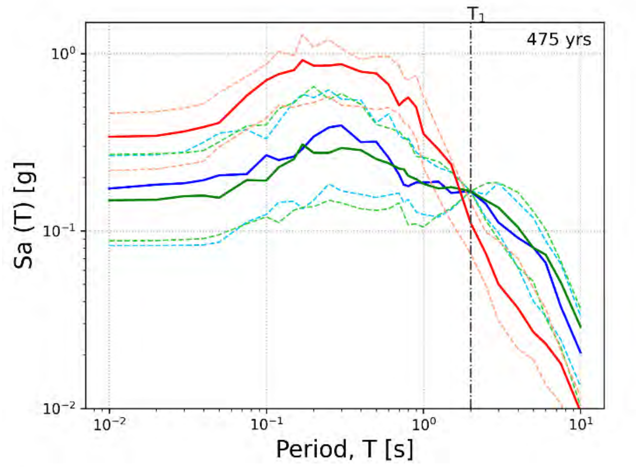
4. Application to a Site in Christchurch

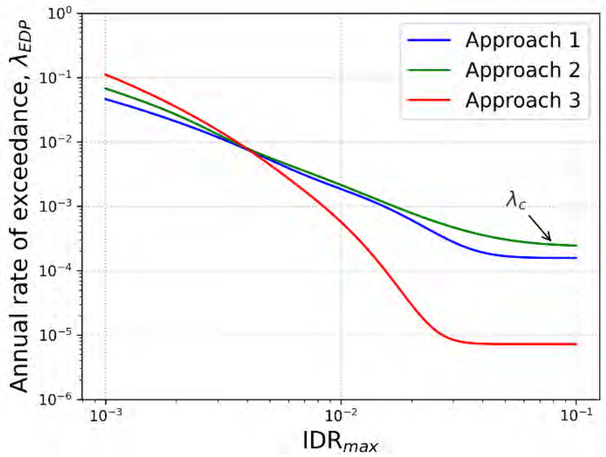


Seismic performance assessment using observed or simulated ground motions

Loghman et al.
Poster #14







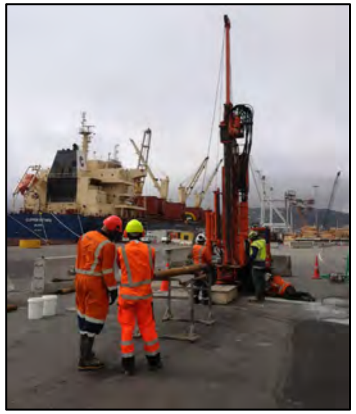
Outcomes:
Different approaches in using observed and simulated ground motions in seismic hazard analysis as well as response history analysis and their subsequent application in seismic risk assessment are illustrated.

Liquefaction Hazard of Wellington Reclamations

Dhakal et al.

1. Soil and site characterization using CPT (2016-2021) ✓

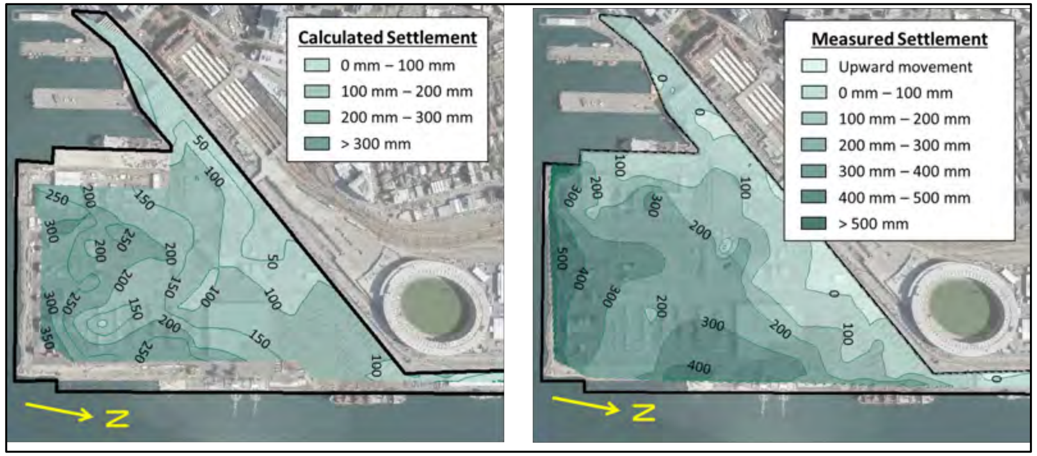
→ Port and waterfront areas



2. Simplified liquefaction evaluations (2016-2022) ✓

→ Predictions VS Observed EQ damage

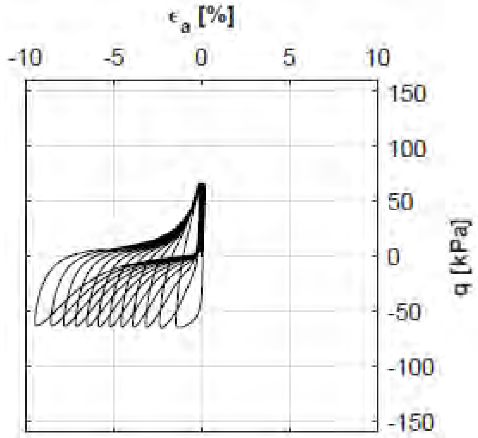
→ Scenario-based assessment



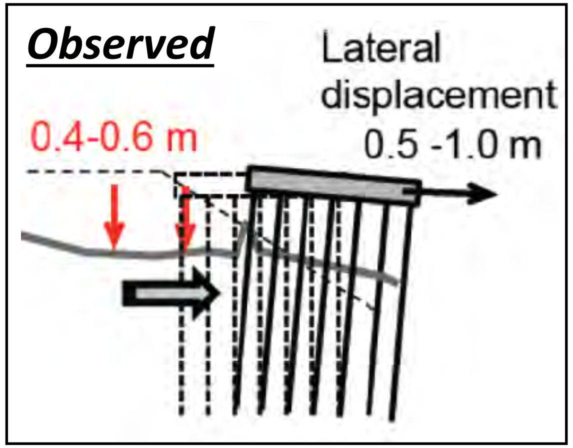
3. "Undisturbed" soil sampling & laboratory testing (2021-2023)

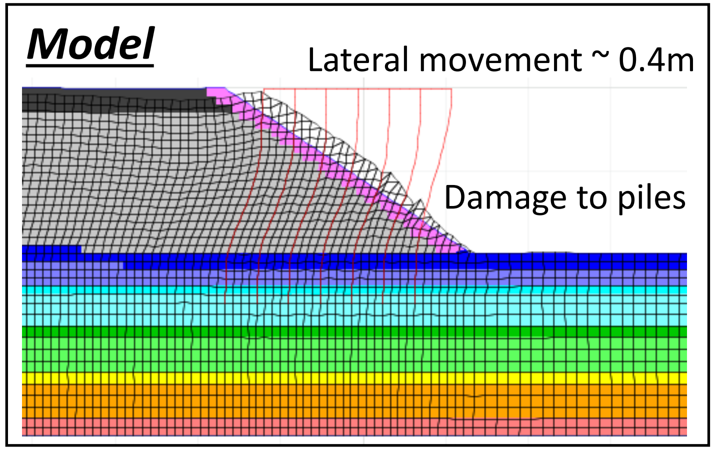
→ Compare against CPT characterization

→ Inform numerical analyses



4. Advanced dynamic numerical analyses (2021-in progress)

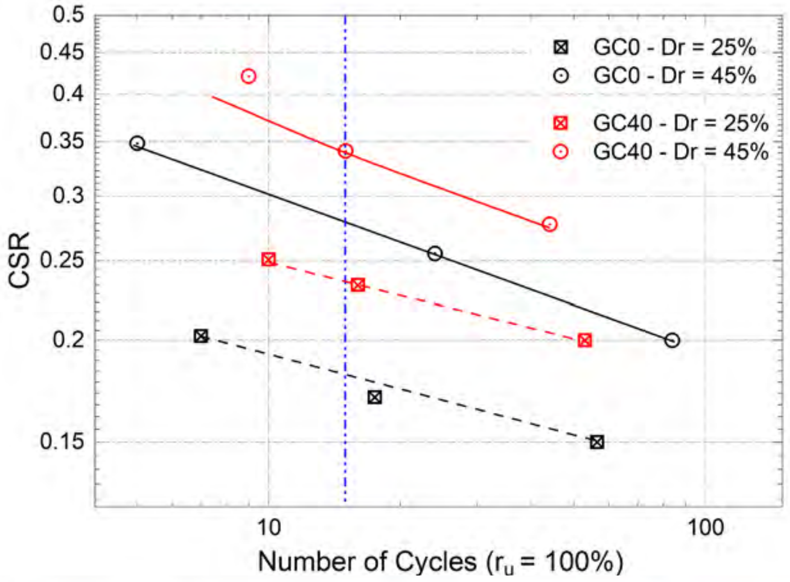




Liquefaction of Gravelly soils

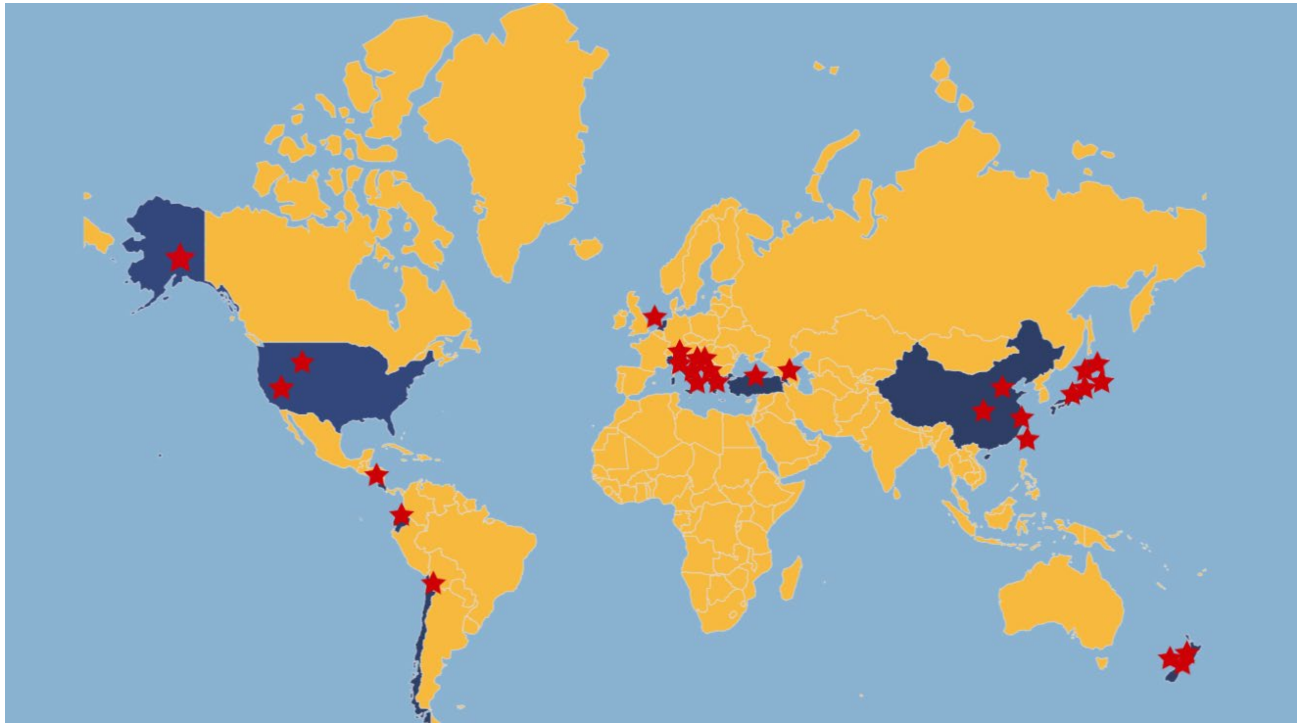
Pokhrel et al.

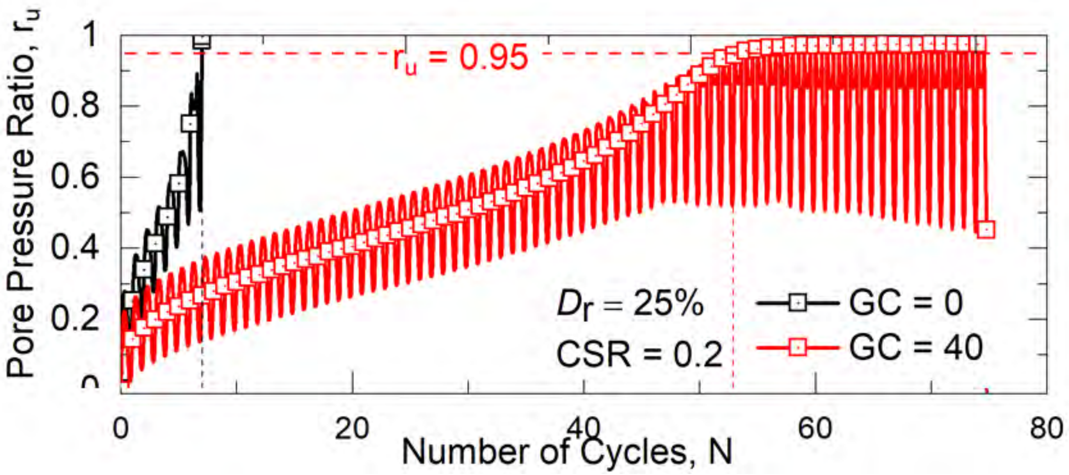
Effect of gravel content and relative density on CRR



Gravelly soil liquefaction case histories

- At least 28 earthquakes from 15 countries





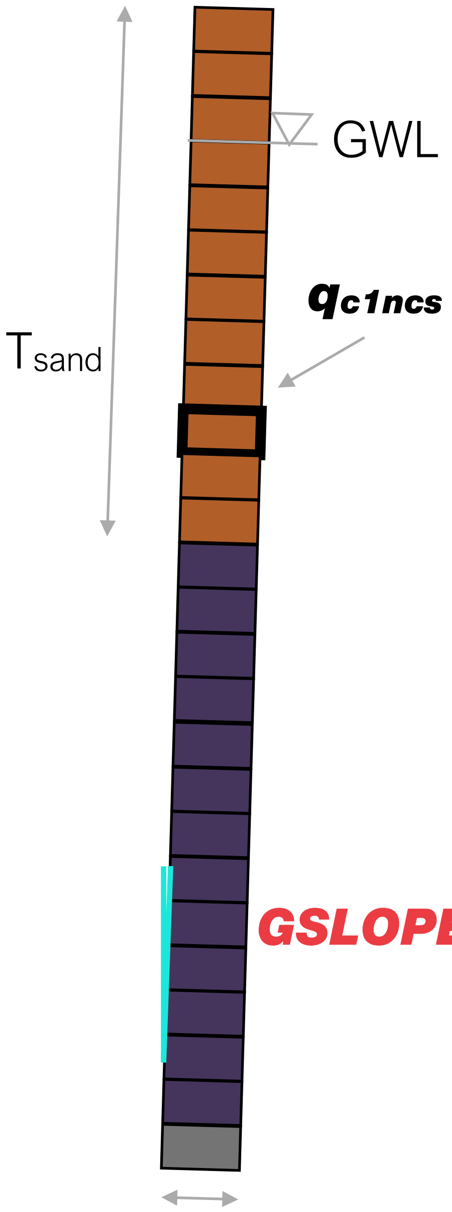
- Well graded gravelly with mixtures of silt, sand and gravel

- Gravel content ranges from 5 – 85%

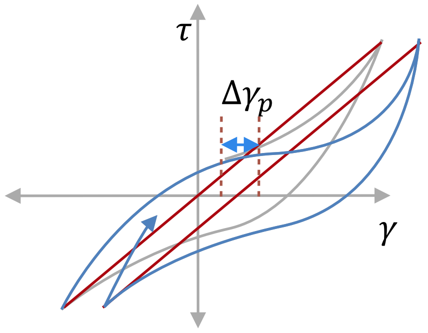
***Result:** Significantly affected by gravel content and relative density*

Estimation of Lateral Spreading

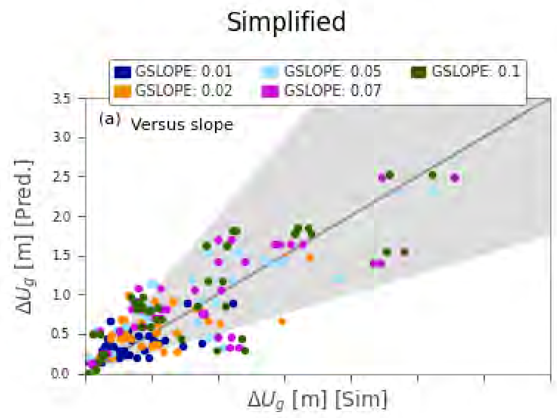
Millen et al.



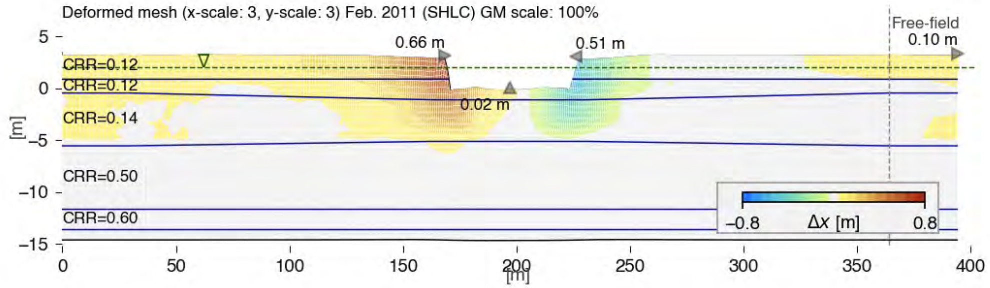
1) Isolated the complex role of static shear on lateral spreading.



2) Developed estimation procedure for infinite slopes



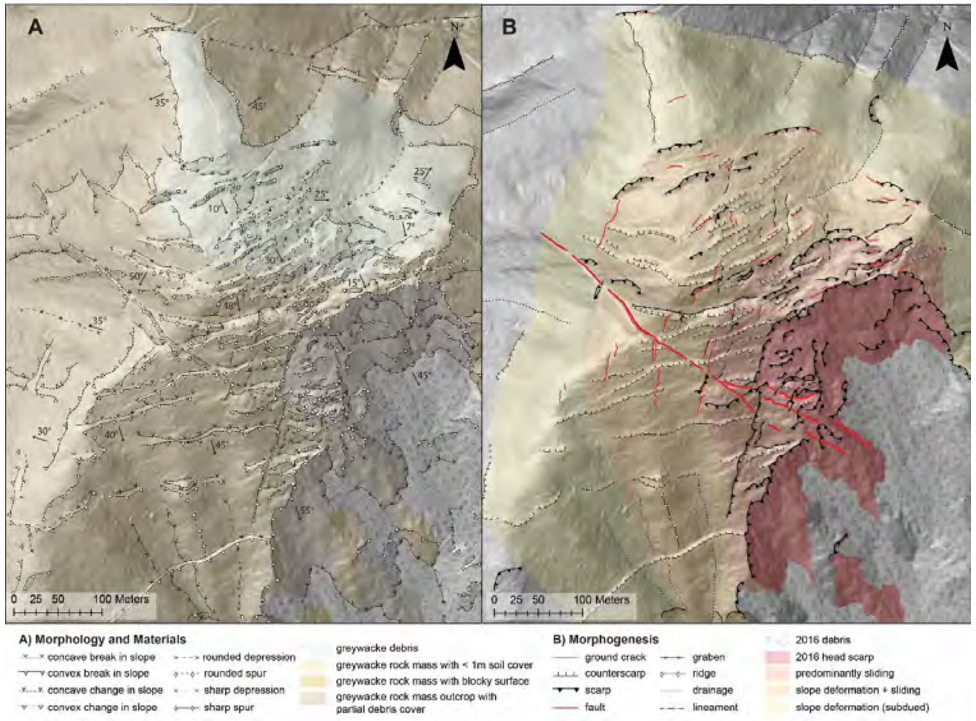
3) Extending estimation for free face geometry



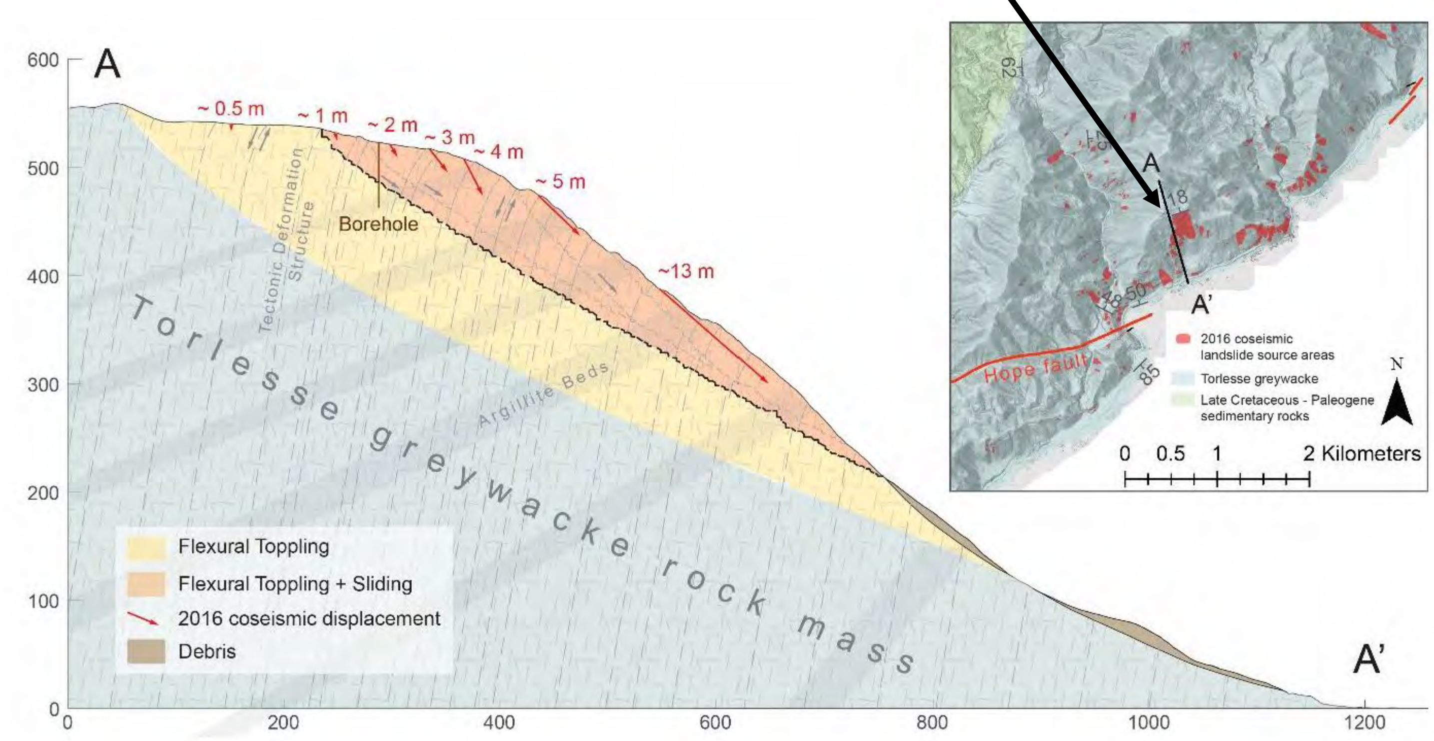
Relationship of reactivated, secondary fault planes to coseismic slope failure

Singeisen et al.

Landslide location in hanging wall of Hope fault



Detailed mapping and site investigations

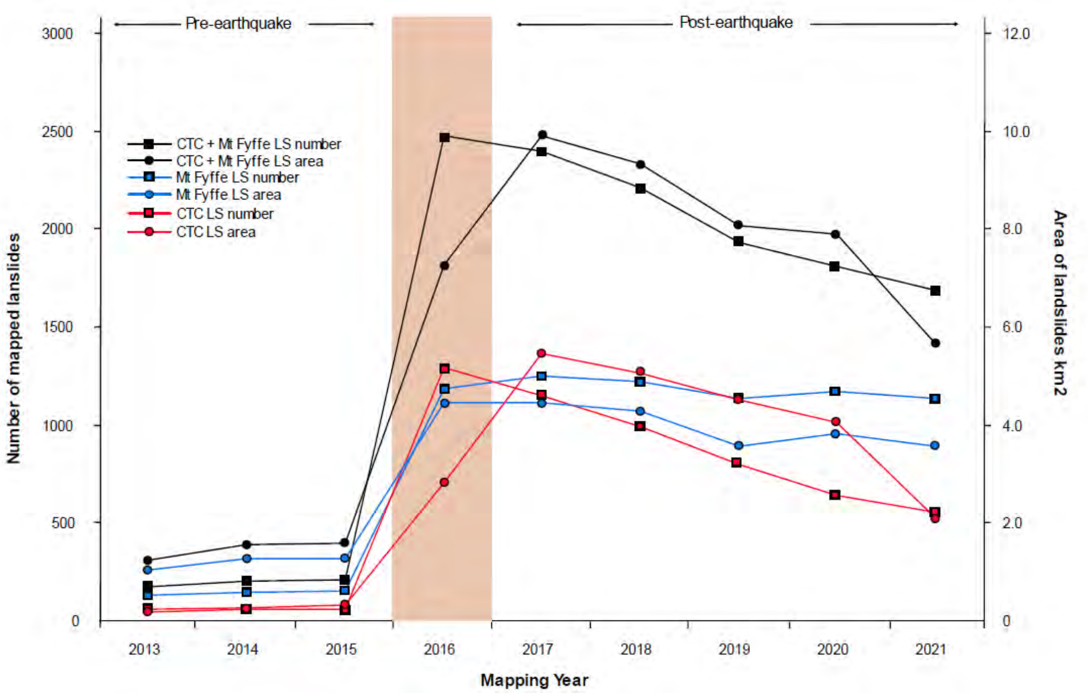


Ground model based on numerical models, field investigations, and remote sensing displacements

Post-earthquake Changes in Landslide Activity

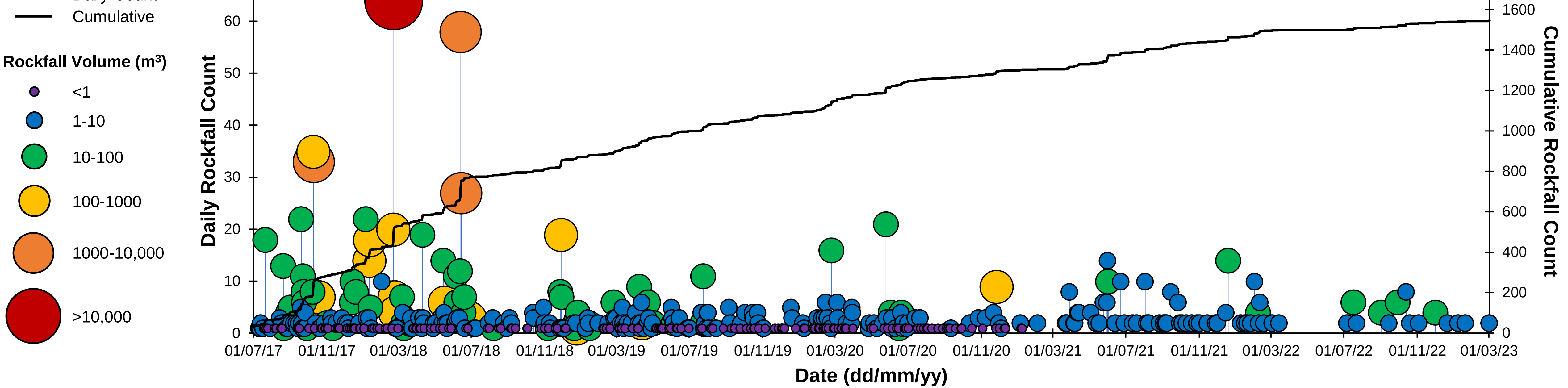
Polwart et al.. Posters #7, #78

- As of 2022, landslide rates throughout Kaikōura Region remain significantly above pre-earthquake rates, but declining at steady rates
- ‘Recovery’ is most significant adjacent to the Coastal Transport Network – rates are expected to be back to pre-EQ levels by c. 2024-2026
- In Mt Fyffe, landslide rates have barely changed since the earthquake – at current rates it will take until c. 2066 to return to pre-EQ rates
- Areas with ‘active’ post-EQ mitigation (e.g. sluicing) are recovering fastest – **effective remediation can dramatically speed up landscape recovery**



▲Temporal changes in landslide number and area across the Kaikōura Region

▼Temporal changes in rockfall number and volume along Coastal Transport Corridor



IMPACT OF COSEISMIC LANDSLIDES ON INFRASTRUCTURE SYSTEMS IN WELLINGTON

Harvey et al., Poster #11

KEY FINDINGS:

- High susceptibility (90th percentile) across all five districts in a M_W 7.5 Wellington Fault Rupture Scenario
- Plausible estimates of slope failure over an area between 3 and 138km^2
- ~1500 buildings situated within 90th percentile of values, with ~1000 of these situated in Wellington City
- Areas susceptible to slope failure across key transport routes, including the connection between Wellington City and the Hutt Valley on SH 2

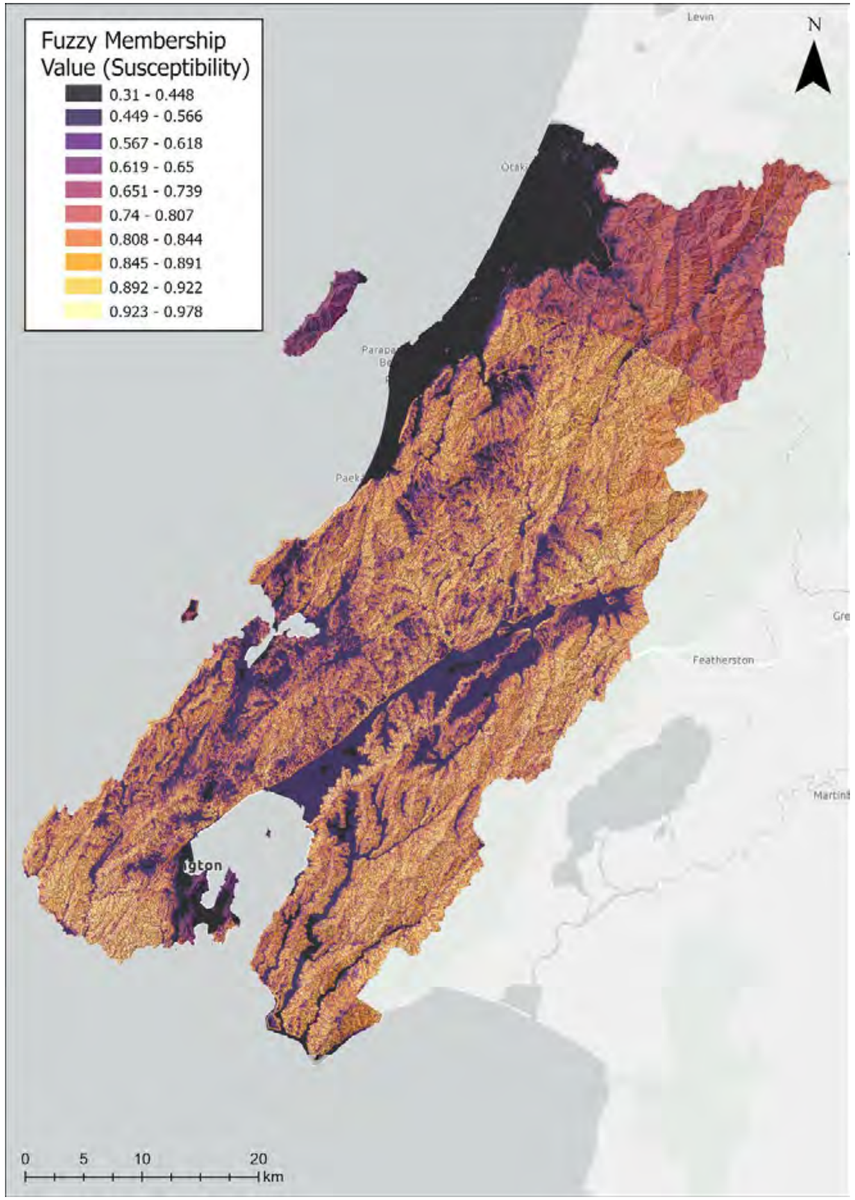


Figure 1. Coseismic landslide susceptibility of research area, as determined by fuzzy membership.

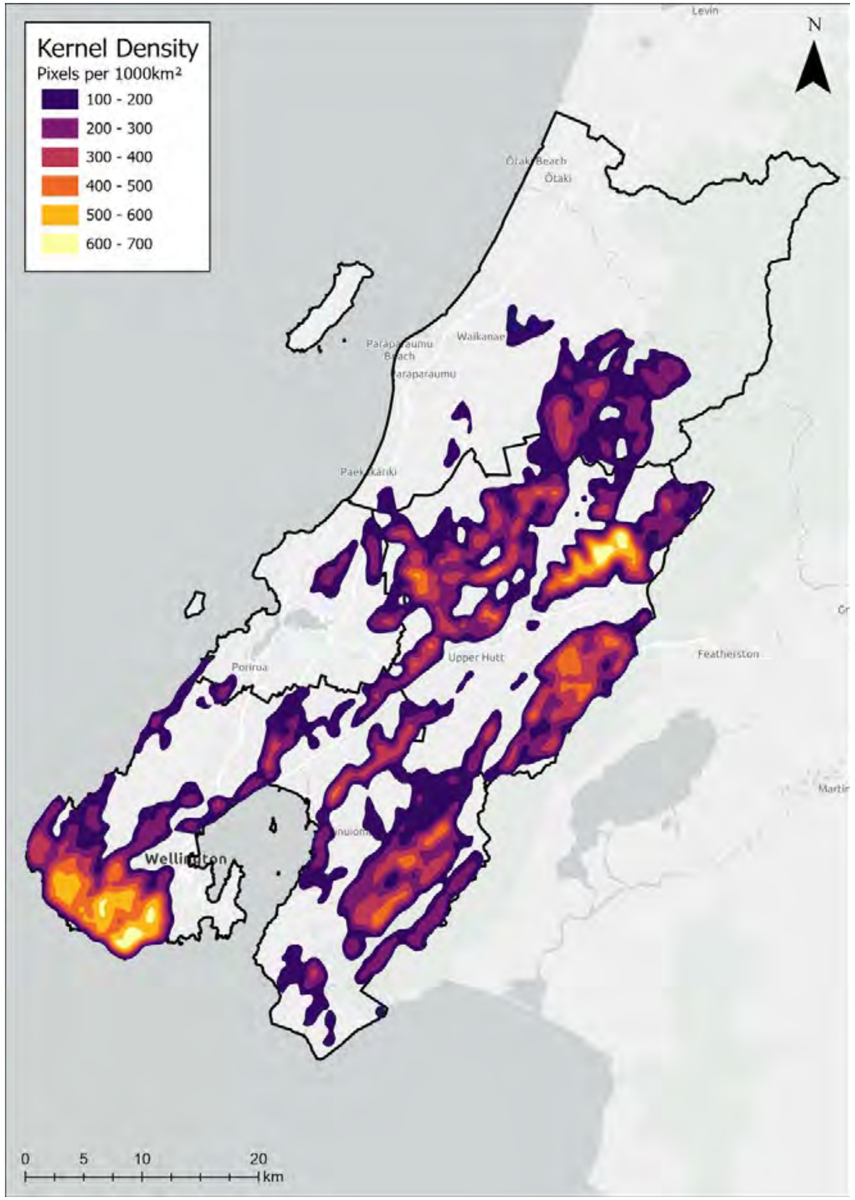


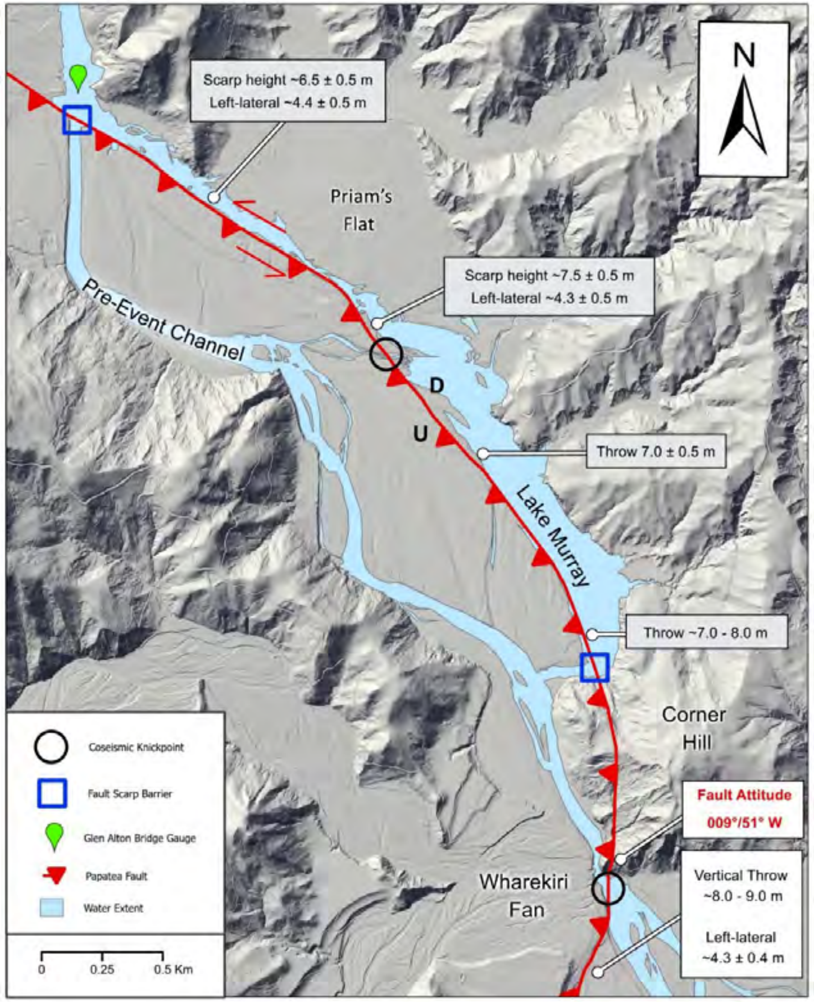
Figure 2. Kernel density map of 90th percentile of susceptibility values, that is > 0.933.

QuakeCoRE NZ Centre for Earthquake Resilience
UC University of Canterbury Te Whare Wānanga o Waitaha Christchurch New Zealand
New Zealand Geotechnical Society

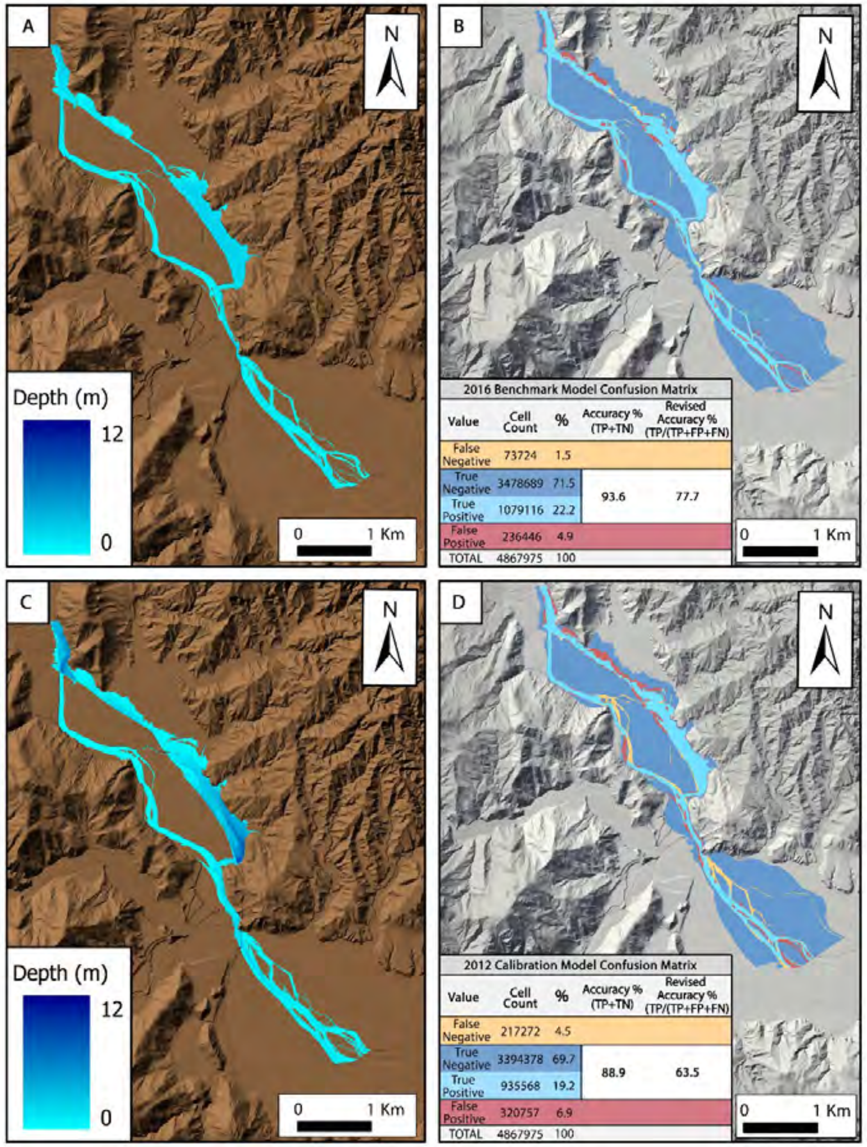
Coseismic flooding and avulsion along surface rupturing faults

McEwan et al.
Poster #16

Oblique aerial photo of Clarence River avulsion



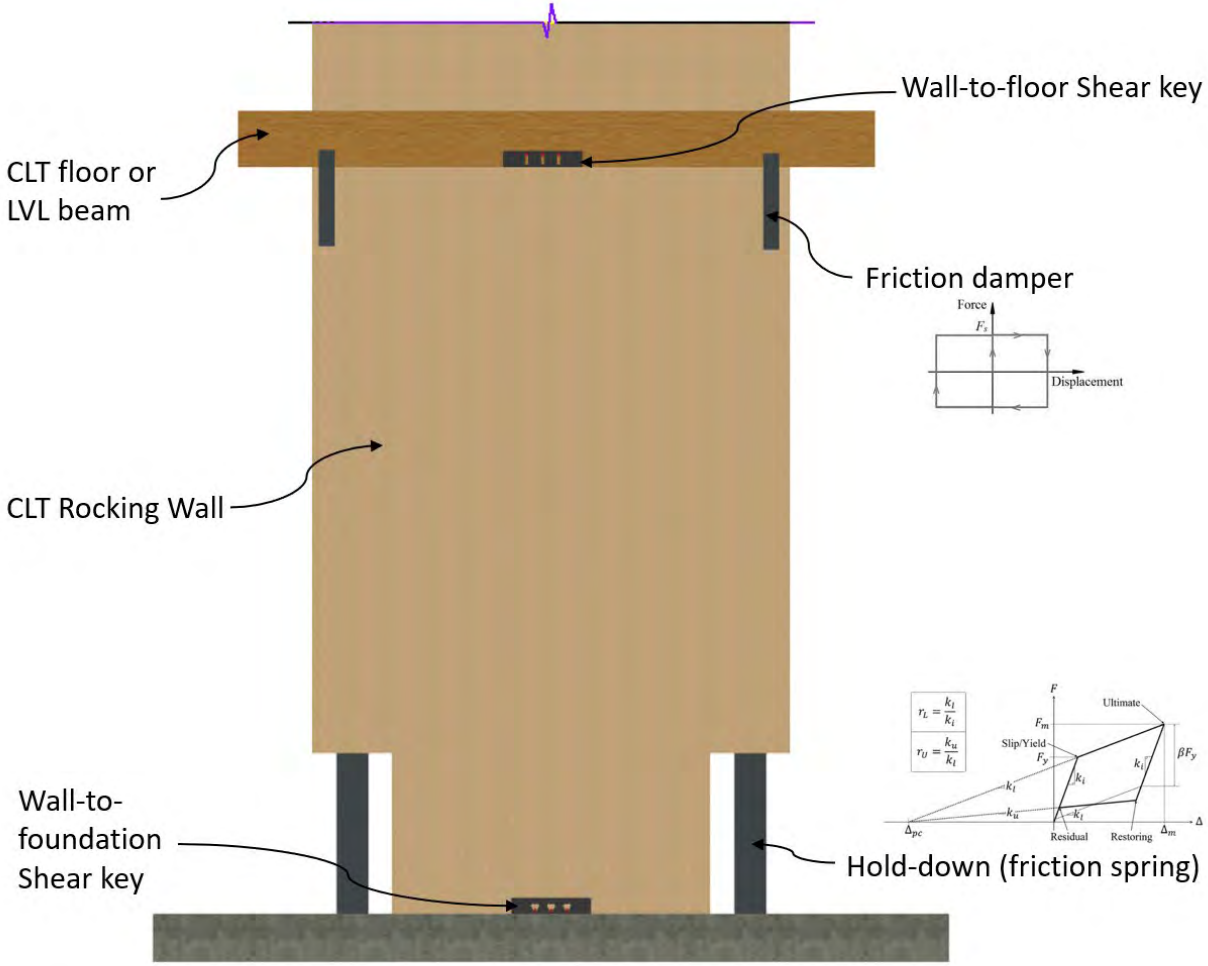
Mapped flood extent

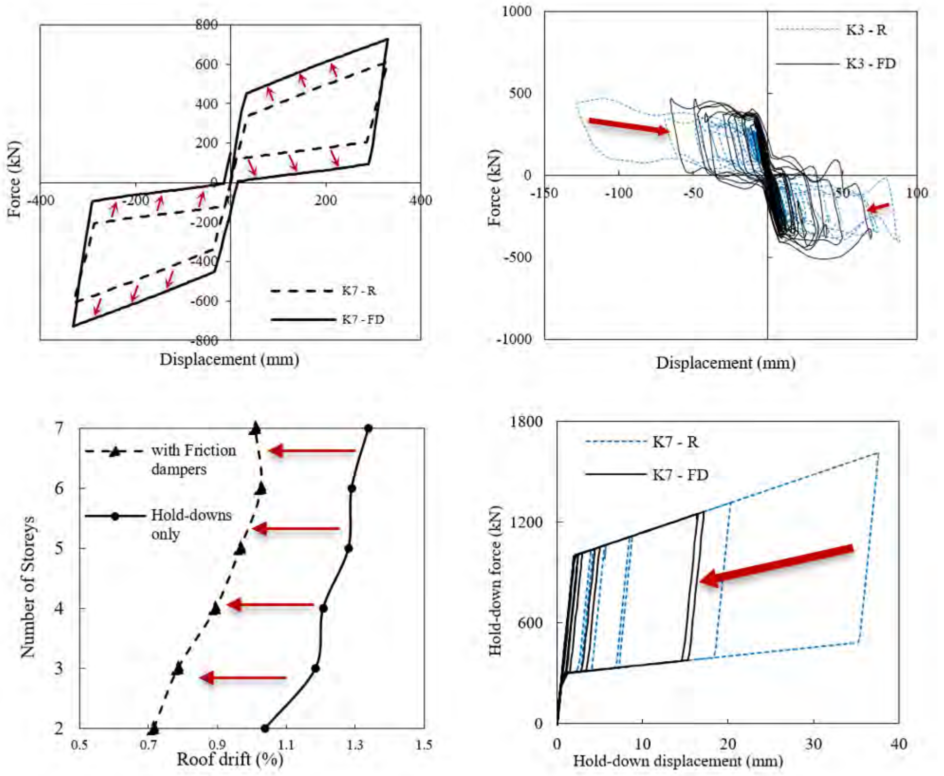


Accuracy of hydrodynamic model on post-quake lidar (top) and pre-quake lidar with synthetic fault (bottom)

Low Damage Wall To Floor Connections For Seismic Resilient Timber Structures

Assadi et al.
Poster #25



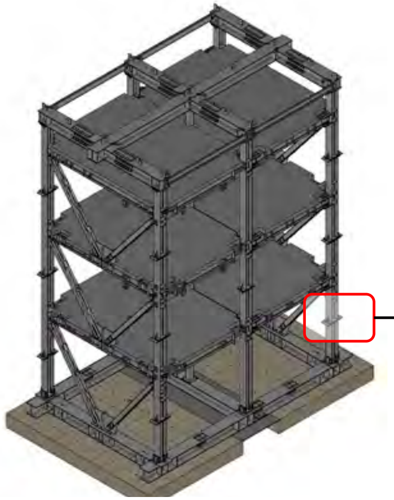


Results:

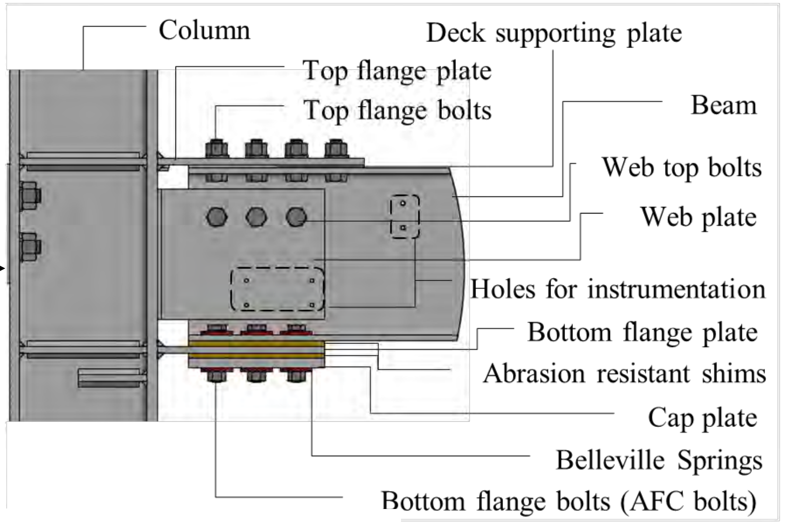
- ➢ Complete self-centring
- ➢ Substantial mitigation of structural drift demands
- ➢ Significant reduced wall hold-downs demands
- ➢ No yielding or damage to any of the joints or structural parts
- ➢ Repeatable and pinching free flag-shaped force deformation behavior (hysteresis)
- ➢ High damping ratio system (energy dissipation) 20%~25%
- ➢ highly cost-effective and competitive timber structure and construction
- ➢ Immediate occupancy

Numerical Modelling of Moment Resisting Frame (MRF) Incorporating Optimised Sliding Hinge Joint (OSHJ)

Yan et al.



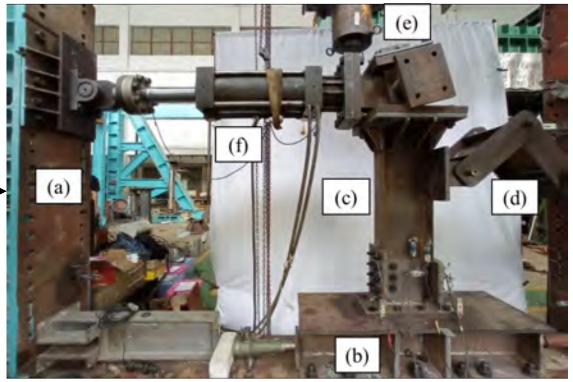
Prototype Structure



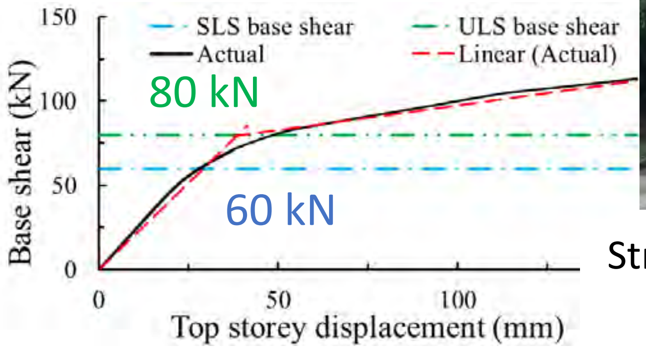
Layout of the OSHJ

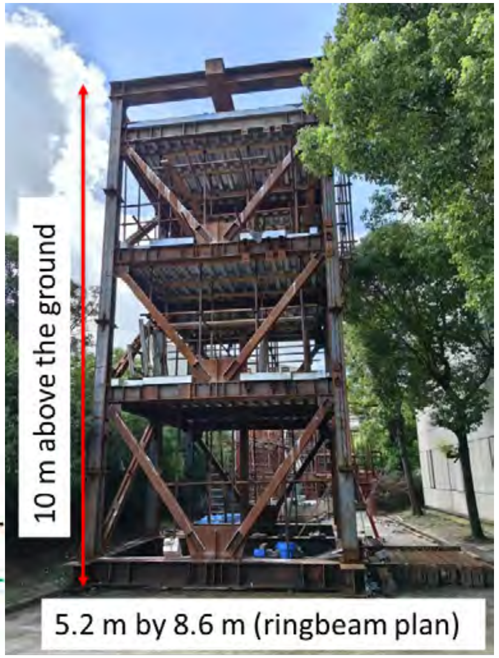
- Rigid under SLS conditions
- Stable hysteretic response under ULS
- Become rigid again and ready for next

Full-scale Component Test

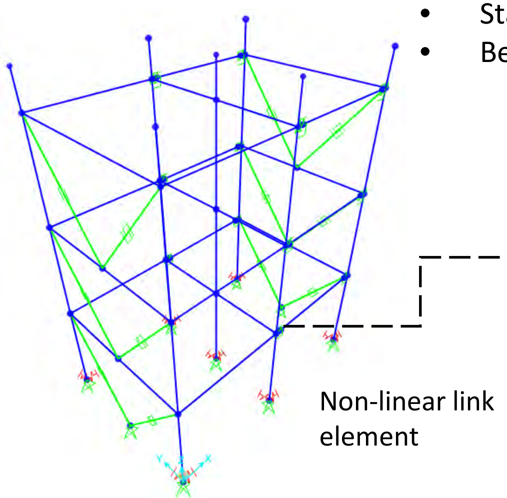


Pushover Analysis

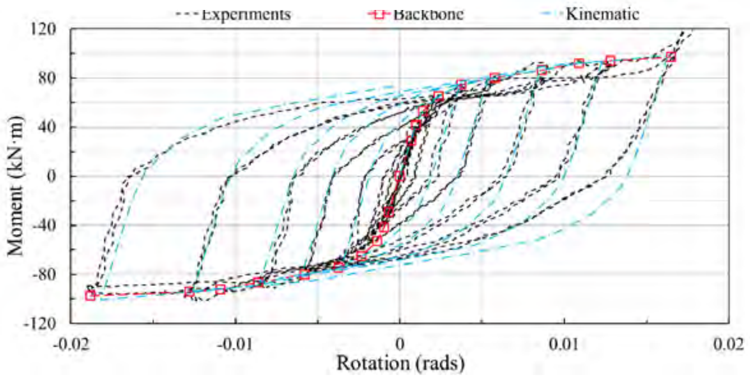




Structure erected on 16th July at Jiading Campus, Tongji University, Shanghai, China

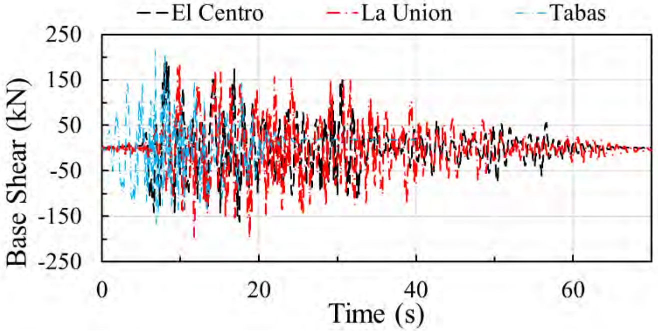


Simplified Model



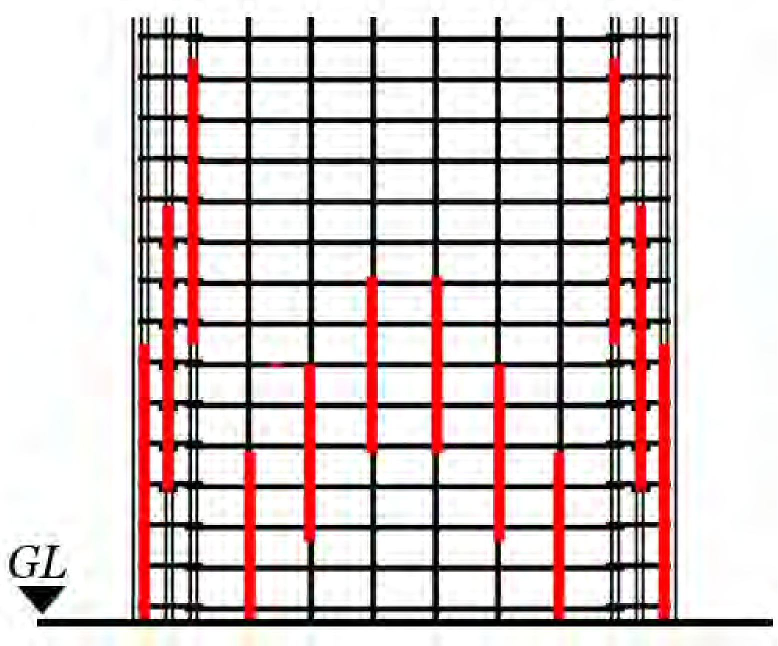
Comparison with Experimental Results

Non-linear Time History Analysis



DEFORMABILITY OF RC WALLS WITH STAGGERED LAP SPLICES

Kerby et al.



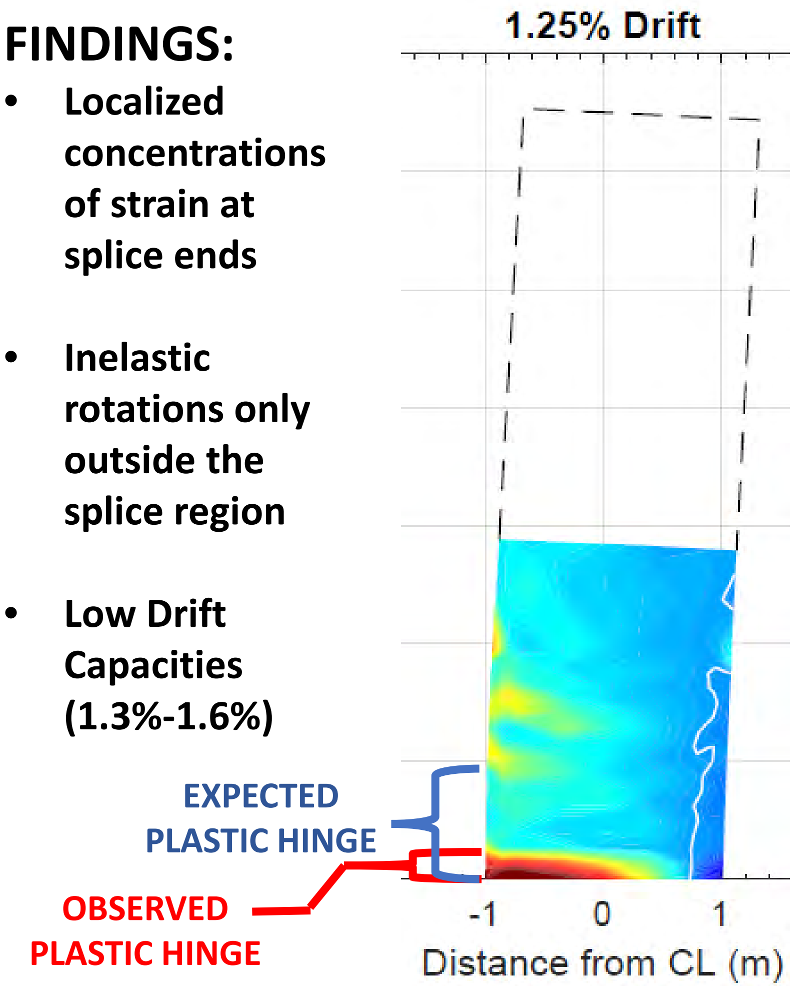
LARGE-SCALE EXPERIMENTS:

- 8.1m tall, 13000 kg walls
- 4.0m wide, 20000 kg foundations

- 2/6 walls tested
- In-plane, cyclic loading
- Detailed to the highest modern standards

FINDINGS:

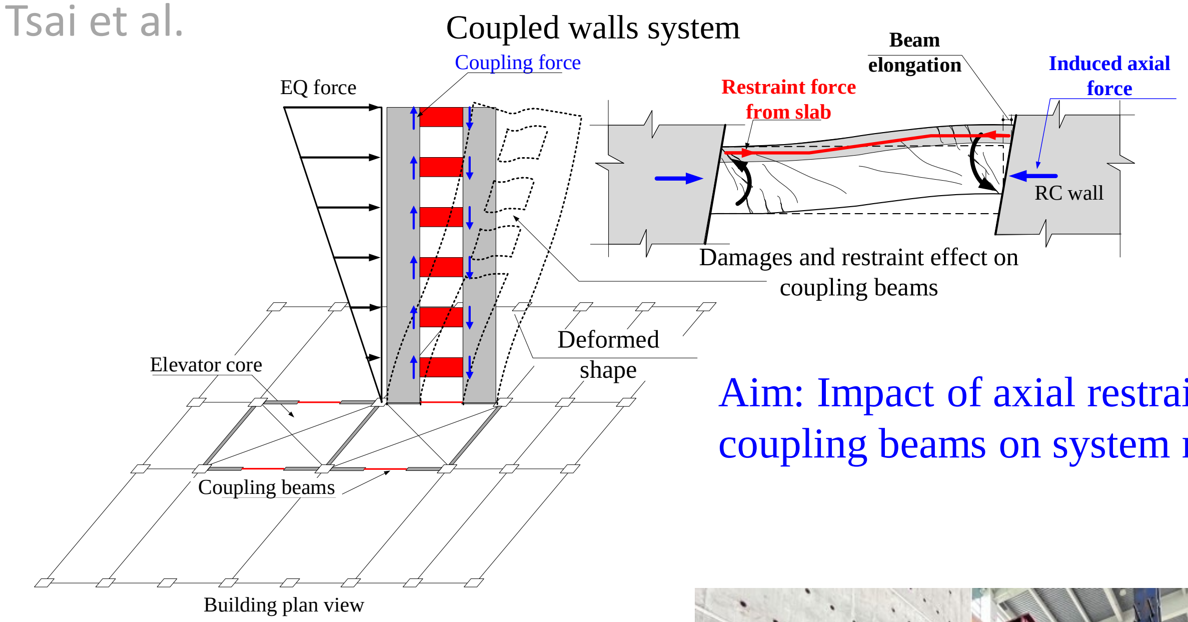
- Localized concentrations of strain at splice ends
- Inelastic rotations only outside the splice region
- Low Drift Capacities (1.3%-1.6%)



Toka Tū Ake EQC | QuakeCoRE NZ Centre for Earthquake Resilience Te Hiranga Rū | UC University of Canterbury

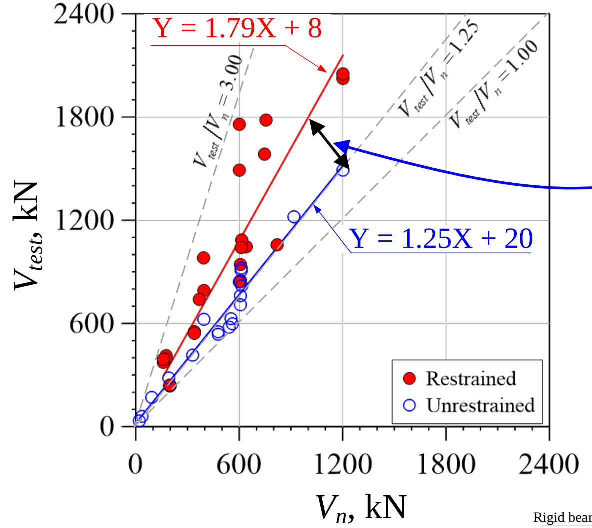
Design of Coupled Walls Systems

Tsai et al.



Aim: Impact of axial restraint of coupling beams on system response

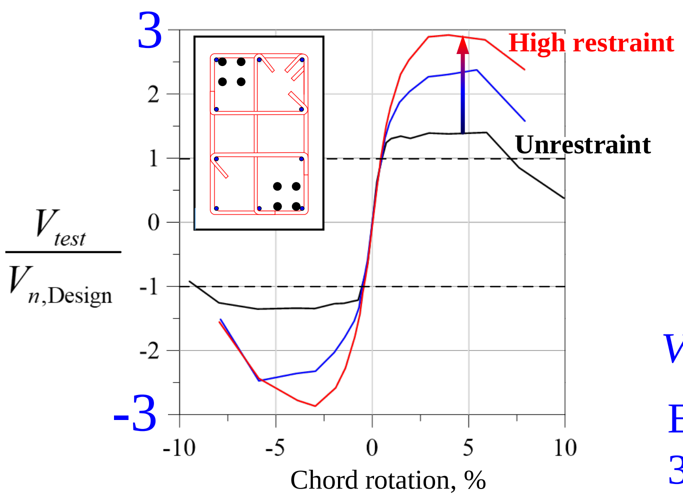
2) Coupling beam Database



Enhancement caused by axial restraint

1) Component responses:

Collaborative test – NTUST, Taiwan

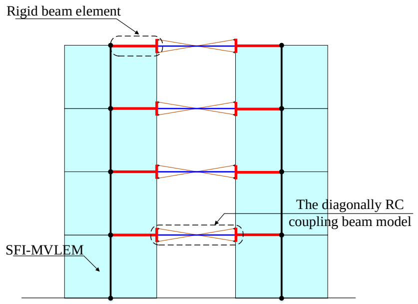


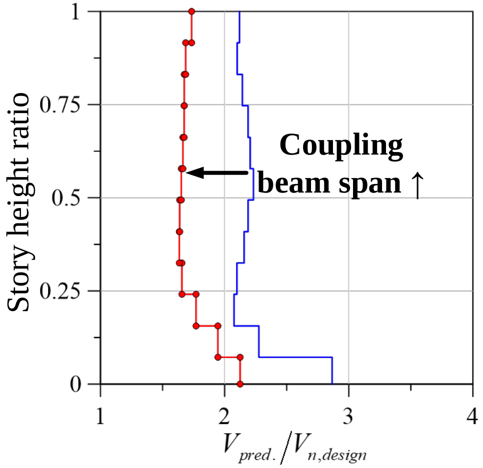
$$V_n = 2A_{vd} f_{yd} \sin\alpha$$

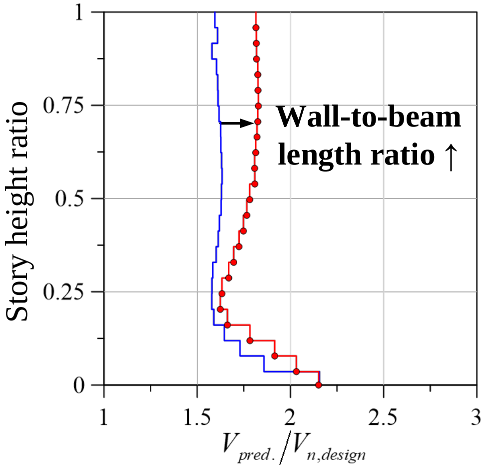
Enhanced strength can reach up to 3 times of design strength

3) Numerical model of coupled wall system

Identify the factors that influence enhancement



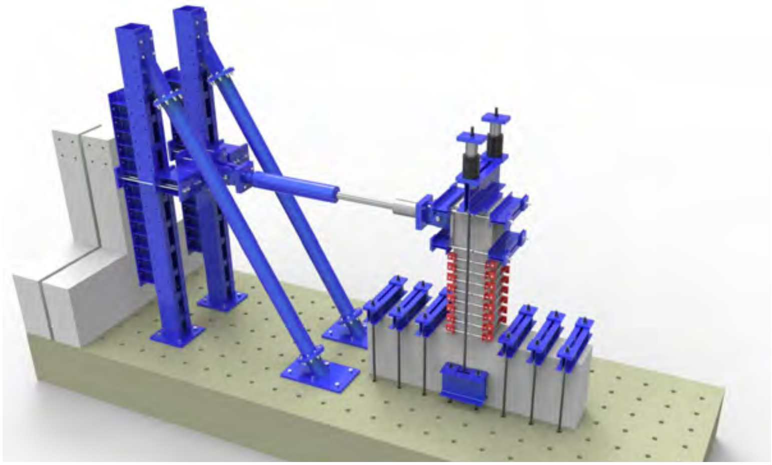




Retrofit and repair of RC columns with post-tensioned clamps

Rincon et al.
Poster #32

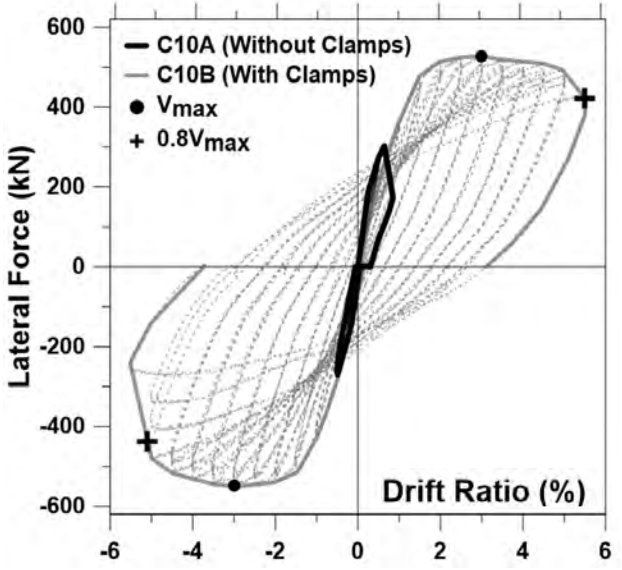
Damage after 2023 Turkey EQs



Experimental Programme on full-scale RC columns

Proposed P.T. Clamps for retrofit and repair

How to retrofit and/or repair RC columns in large building inventories or in developing countries ?

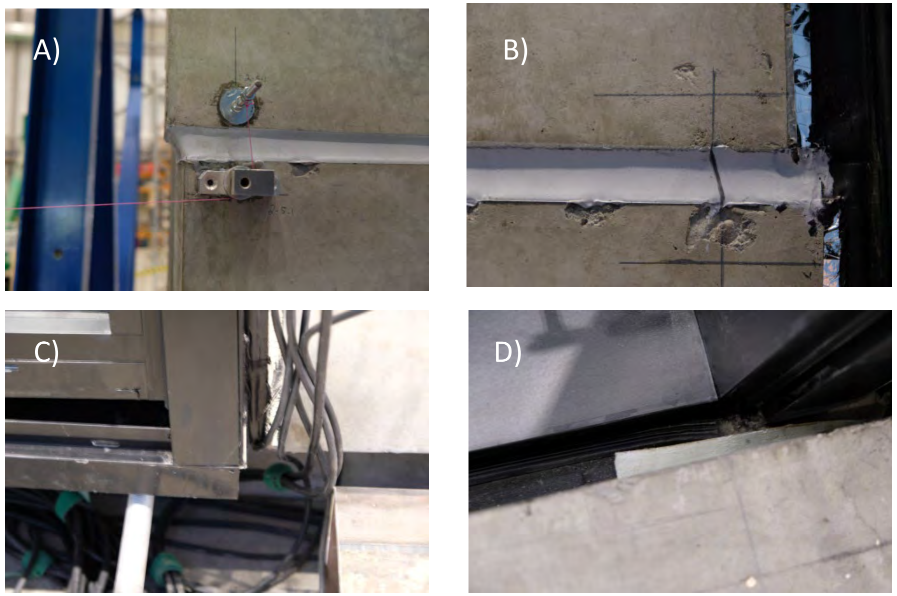


✓ Increase in Lateral-load Resistance

✓ Increase in Drift Capacity

Non-Structural Element (NSE) Interaction Testing

Photos from the experimental setup just before the testing.



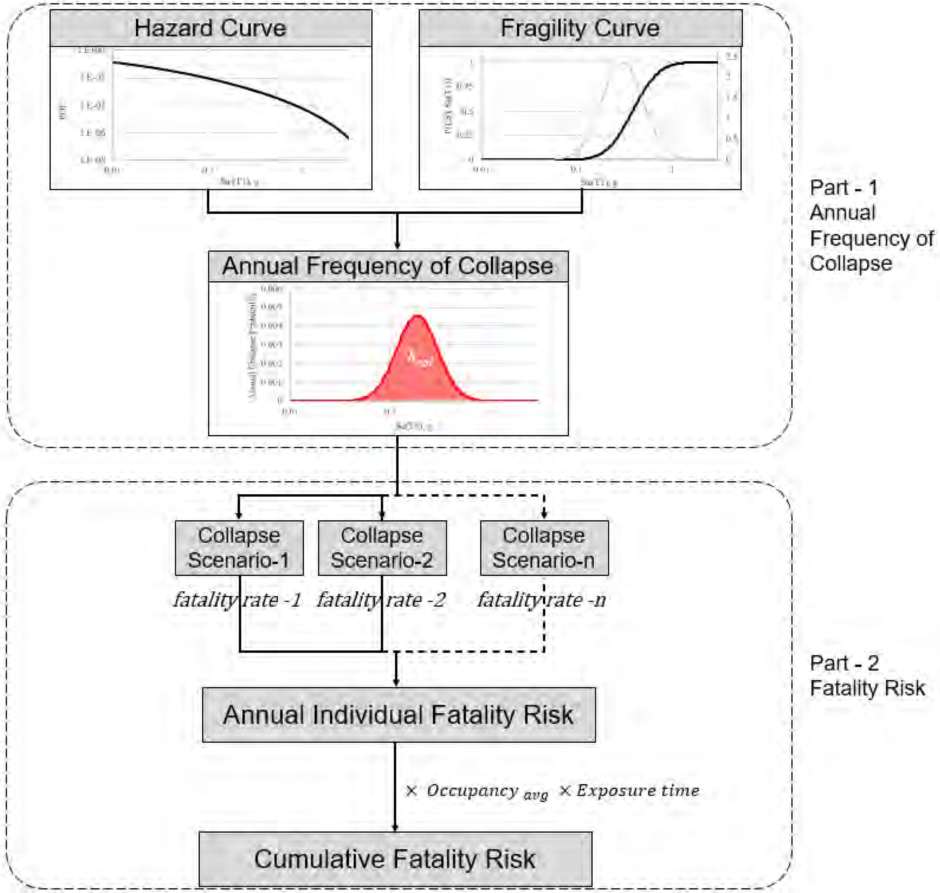
Displacements and damage observed at 2.5% drift: A) Rotation at the corner of the panels B) Dispalcement in the Sealant C) Uplift of the internal glazing frame D) Damage to the Gasket of the External Glazing Frame.

- Testing of interaction between Precast Rocking Panels and Seismic Frame Glazing
- Experimental Rig tested up to ± 2.5% Interstorey Drift
- No oberved damage to the precast panels, which was expected
- Minor damage to the sealant was observed at the interestion between the stacked panels and the Glazing Frame
- Damage to the Glazing system was limited only to the external frame, glass and internal frame unaffected
- Data processing still in progress

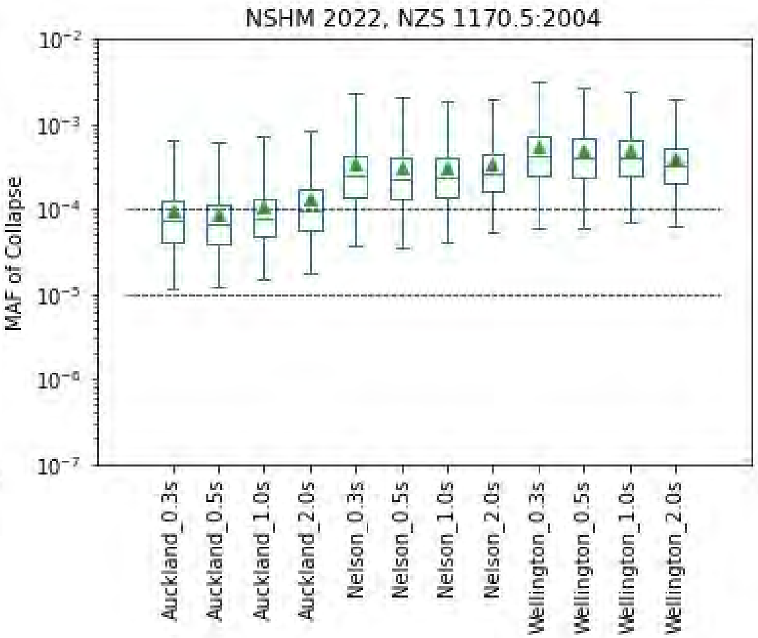
Seismic Assessment of Reinforced Concrete Buildings based on Fatality Risk

Zaidi et al.

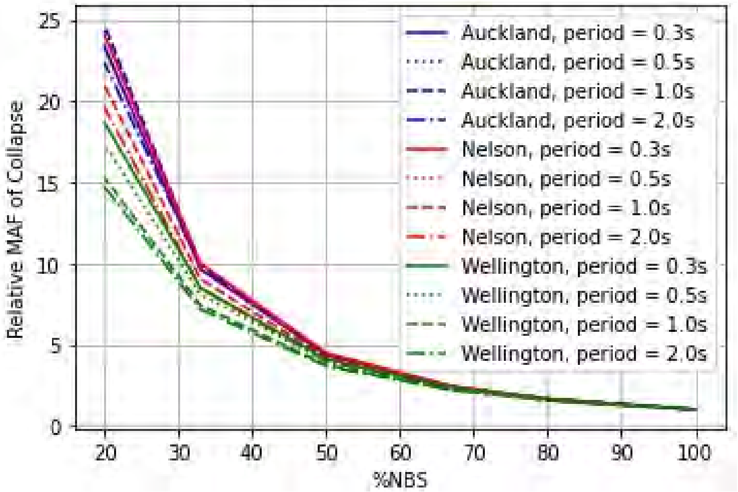
- Fatality Risk Based Seismic Assessment
- Probabilistic Framework – Accounts for Uncertainties
- Augmenting %*NBS* with a Life Safety Risk Metric



Linking %*NBS* to Collapse Risk



Mean Annual Frequency (MAF) of Collapse of a 100%*NBS* building (Vs(30 = 400 m/s)



Relative MAF of Collapse vs %*NBS* (Vs(30 = 400 m/s) – Mean Values

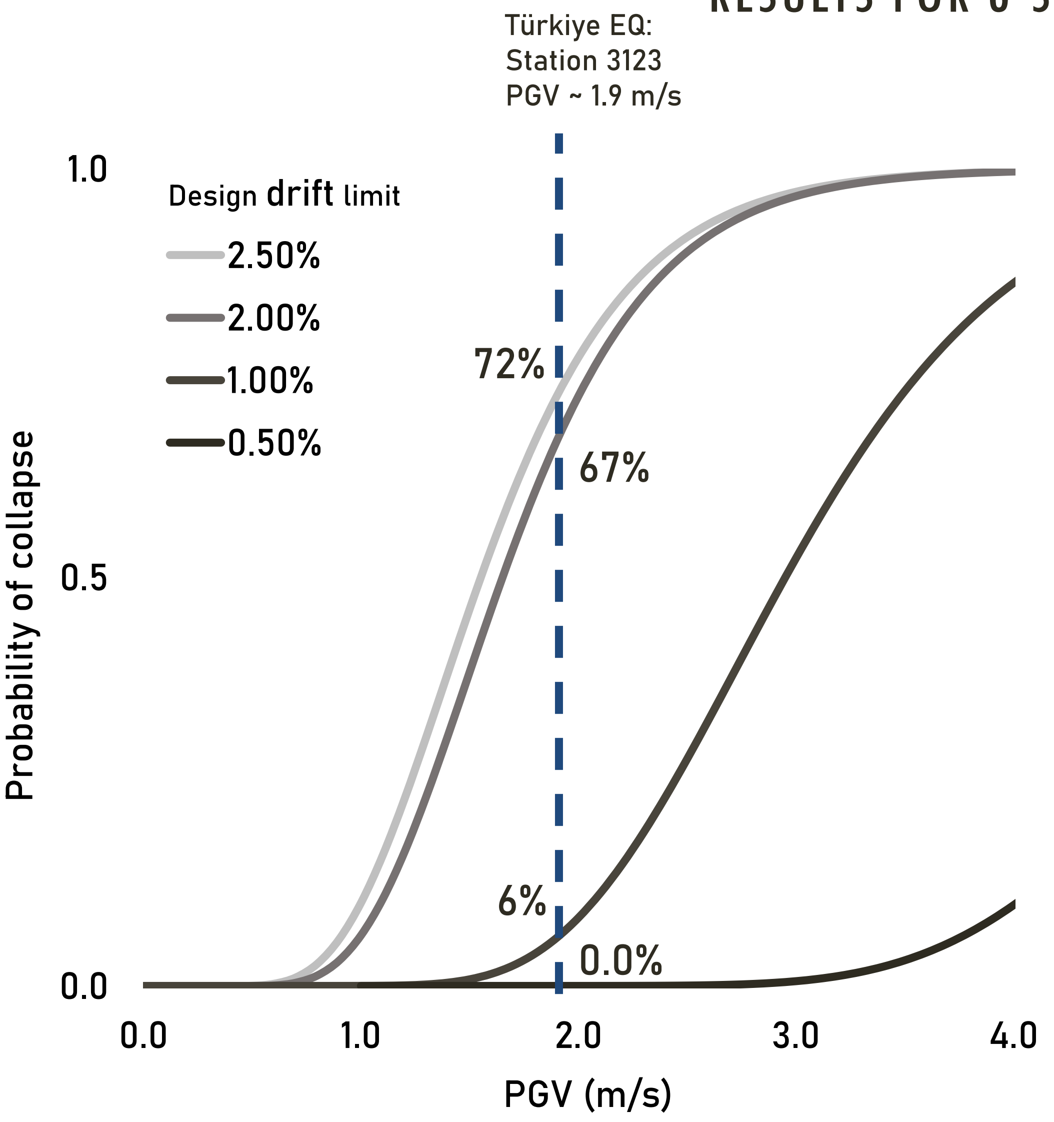
Fatality Risk Assessment

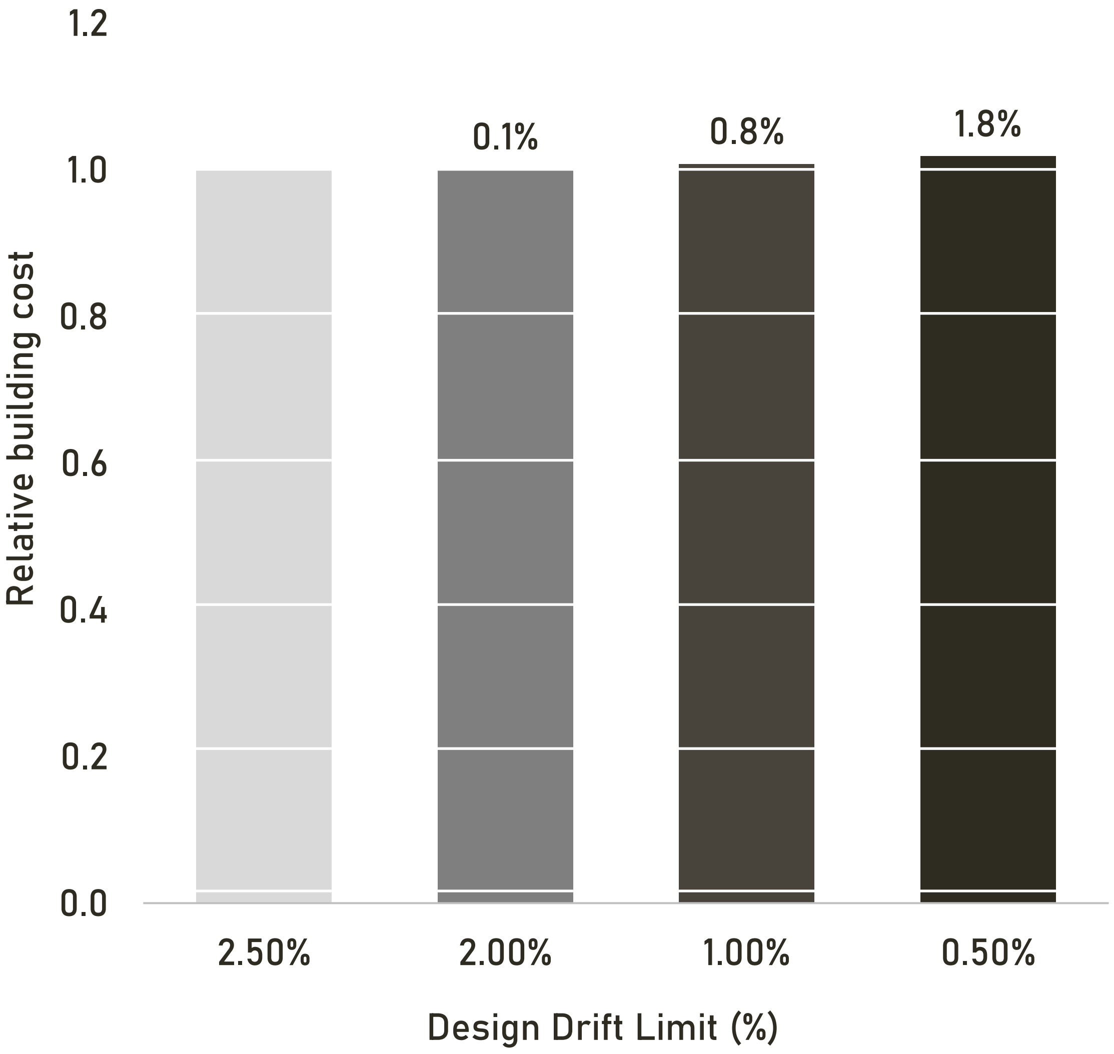
- Fragility estimation from %*NBS*
- Fatality rate from expected collapse scenarios
- Fatality risk estimation
- Relative comparison w.r.t. a new building
- Useful in post assessment decision making and planning retrofit.

Quantifying the effect of reducing seismic drift limits

Pledger et al.

RESULTS FOR 6-STOREY RC FRAME STRUCTURES





A Socio-Legal Analysis of Seismic Building Regulation in Aotearoa New Zealand

Hopkins

The Project

A Socio-Legal examination of the EPB Elements of the Building Act and their operation.

Project Findings

The EPB Sections of the Building Act apply to buildings based not upon life safety but age and ownership.

The project argued that this outcome is not obvious due to inappropriate use of secondary legislation and deemed regulations (particularly the EPB methodology) .

Project Intended Impact:

Increased awareness of the impact of the EPB elements of the Building Act and potential reform of the legal framework.

Hopkins W.J., "Safe as Houses? The Limits of Seismic Building Regulation in Aotearoa New Zealand" NZLR, 2023, (Forthcoming)

LEAD Institute of Law, Emergencies & Disasters

QuakeCoRE NZ Centre for Earthquake Resilience Te Hiranga Rū

UC LAW Te Kura Ture

An Investigation of the Effective Reuse of Heritage Buildings to Achieve Resilience in New Zealand Small Towns

Inal Kaynar et al.
Poster #69

SUSTAINABLE DEVELOPMENT GOALS

8 DECENT WORK AND ECONOMIC GROWTH

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

CULTURE GOAL

Research Question:

How to effectively reuse heritage buildings to create resilient small town centres in New Zealand?

The literature review focusing on UNESCO Sustainable Development Goals and adaptive reuse in small towns revealed five themes:

- Economics- SDG 8,
- Seismic Risk - SDG 11,
- Obsolescence- SDG 11,
- Heritage Conservation- SDG 11, Culture Goal,
- Environmental Sustainability- SDG 12.

Further Research:

What design strategies contribute to the effective seismically resilient adaptive reuse of mixed-use heritage buildings?

Focusing on Whanganui, New Zealand, as a case study.

- Defining the existing situation of the buildings in Whanganui CBD: construction types, conservation status, Earthquake-prone status, occupancy.
- Develop case studies.
- Develop effective adaptive reuse strategies for different construction and building types that may be applied to all small towns in New Zealand.

Christchurch Lichfield St 2008

Christchurch Lichfield St 2015

Whanganui, Earthquake Prone Building Map 2016

Source: Whanganui District Council, (2016) Making Whanganui Visible Regeneration Strategy for The Whanganui Town Centre, Whanganui District Council.

QuakeCoRE
NZ Centre for Earthquake Resilience
Te Hiranga Rū

1897
VICTORIA UNIVERSITY OF WELLINGTON
TE HERENGA WAKA

Post-Disaster Dispute Resolution

The Canterbury Earthquake Insurance Tribunal
the 'fors' and the 'flaws'

2010 → 2011 2012 → 2013 → 2018 → 2019 on

2010

Ongoing seismic activity

Mapping of a timeline for post CES dispute resolution – to establishment of CEIT

2011 2012

High Court List established

Little progress on reinstatements – discontent and mistrust grow.

Identification of obstacles and **impediments** to the resolution of insurance claims

2013

RAS established

Slow progress with claims

Residents needed advice!
Decisive action needed!
Issues included:
Red/land zoning, policy entitlements, geotech, lack of resources and lack of collaboration between agencies including national and local govt

2018

GCCRS established

Stalled claims
New issues arose such as failed/ inadequate repairs

Utilising experts effectively - critical to resolution

2019 on

CEIT established

CEIT – established 8 years after CES!
How could early barriers to resolution of claims/ disputes and reinstatement of homes have been overcome???

Post-earthquake Reconstruction of Christchurch City Center- Housing Challenges

Fatourehchishabestari et al.
Poster #45

What is the issue?

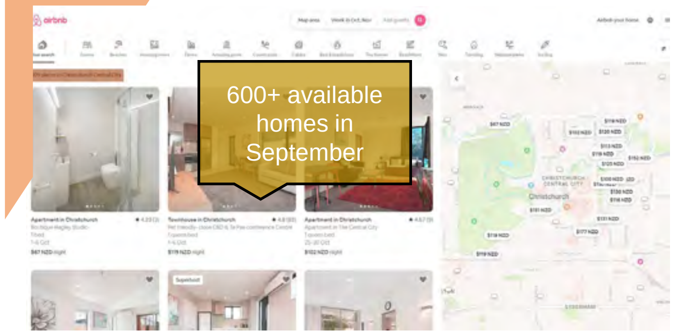
- ✓ Despite efforts like the Greater Christchurch Urban Development Strategy to encourage central city living and 2018 Christchurch central housing program (Project 8011) aiming to attract 20,000 people or 8,000 households to the city center by 2028, the post-earthquake residential reconstruction has not met the population target.
- ✓ The city center's attraction for speculative investments and Short-Term Rentals (**STR**) like Airbnb has created challenges for achieving permanent residency in the area

Why is the issue important?

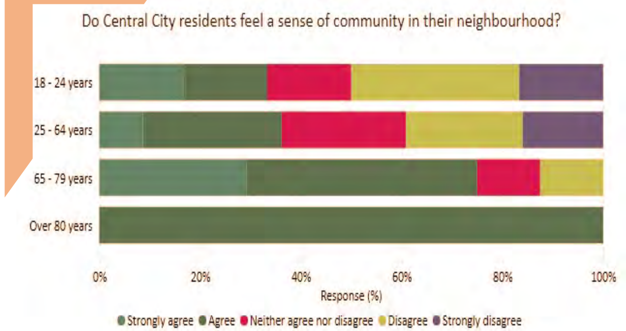
- ✓ By using gentrification, rent gap, and financialization of housing theories, the study aims to investigate how STR disrupt the long-term success of residential rebuilt in the city center.
- ✓ Assessing the impact on housing affordability, social cohesion and community resilience will help policymakers and planners make informed decisions about future residential development in the city center.

Research Approach

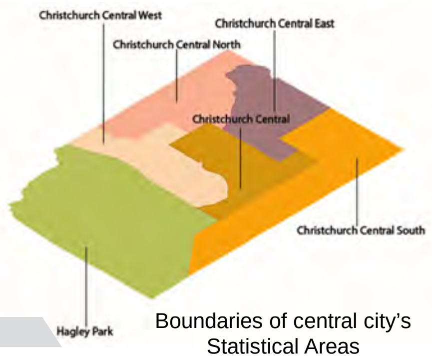
- ✓ The research will employ secondary datasets and interviews to explore how current planning policies affect the long-term success of residential rebuilt in the city center.
- ✓ Through quantitative and qualitative analysis, the research will examine the relationship between housing financialization and population displacement, as well as the impacts on social cohesion, sense of attachment, and community resilience.



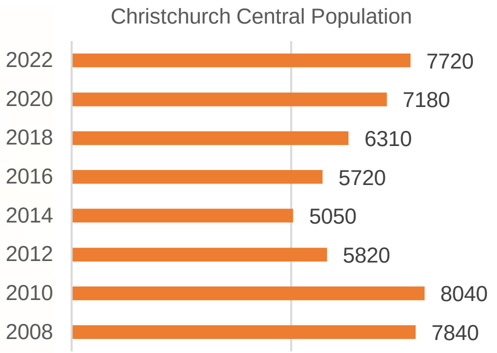
High number of available Airbnb homes in Christchurch Central

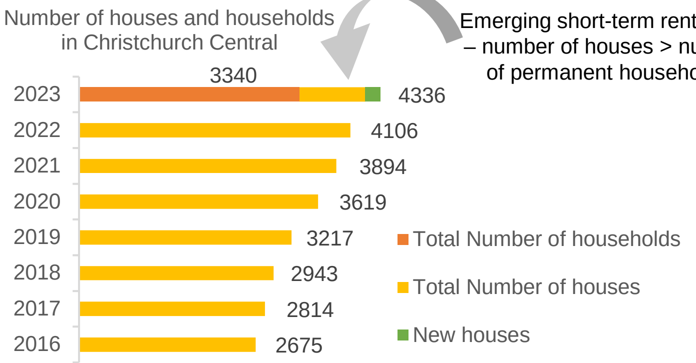


Sense of Community Disparity: A Comparison of City Center Living Across Age Groups from the 2022 Life in Christchurch Survey

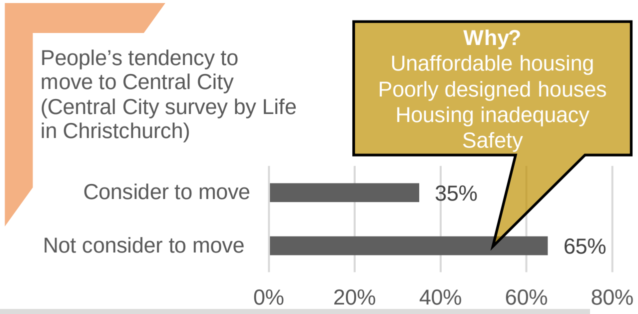


Boundaries of central city's Statistical Areas





Emerging short-term rental gap – number of houses > number of permanent households



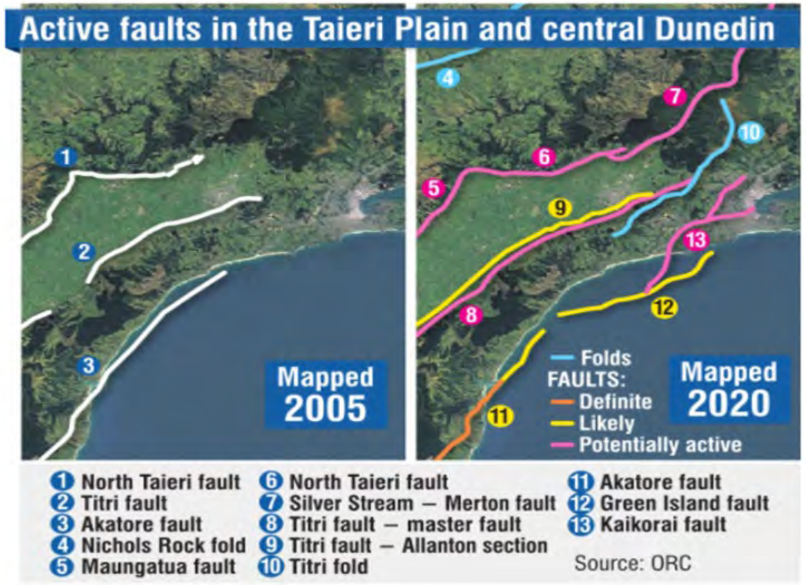
Te Hiranga Rū | QuakeCoRE
Aotearoa New Zealand Centre for Earthquake Resilience

Low seismic hazard zones in Dunedin and Oamaru

Akther et al.

Understanding how local government stakeholders and building owners make sense of, and apply, the Building Act for earthquake risk reduction

Timeframes for reducing risk

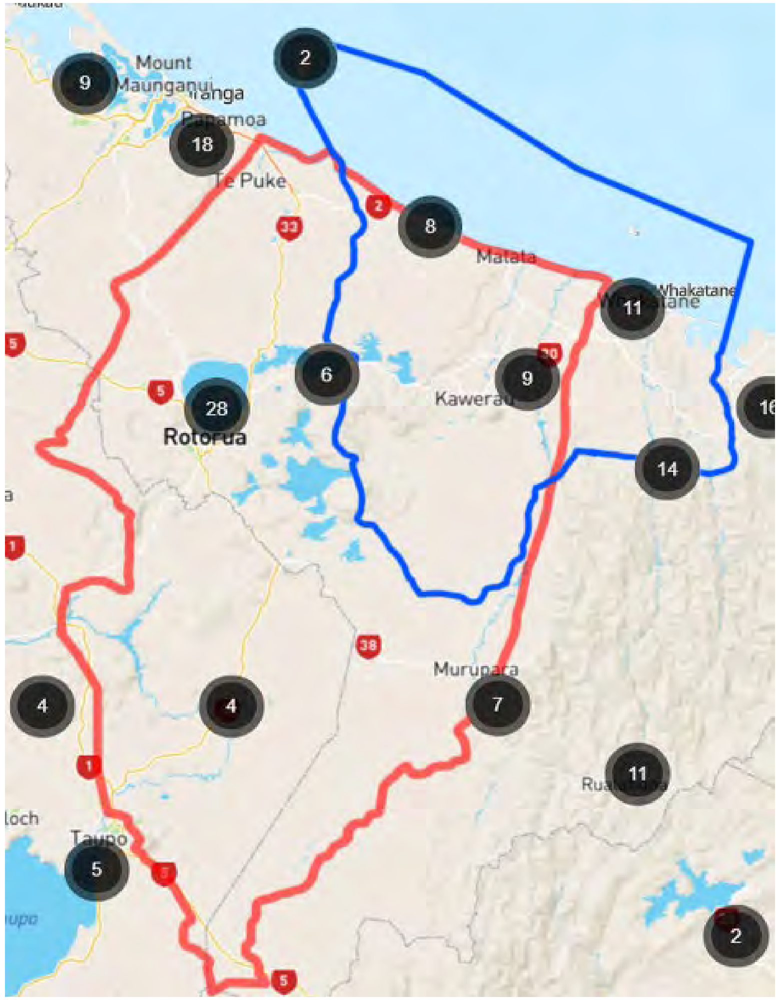


Christchurch

Dunedin

Faaui and Hoete

Atlas of Marae Resilience



Regional stocktake of marae in Te Arawa and Ngāti Awa rohe

GIS assessment of marae (infrastructure, hazard exposure), LIDAR

+

Engagement with marae, identifying key vulnerabilities

Planned output:

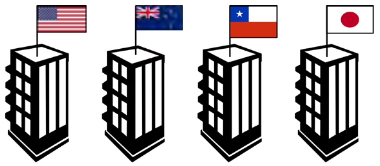
- *Development of Atlas resource for marae*
  - *Access to site and regional scale maps*
  - *Hazard vulnerability*
  - *Direct marae input into online curation*
  - *Physical and online resource for marae and CDEM*

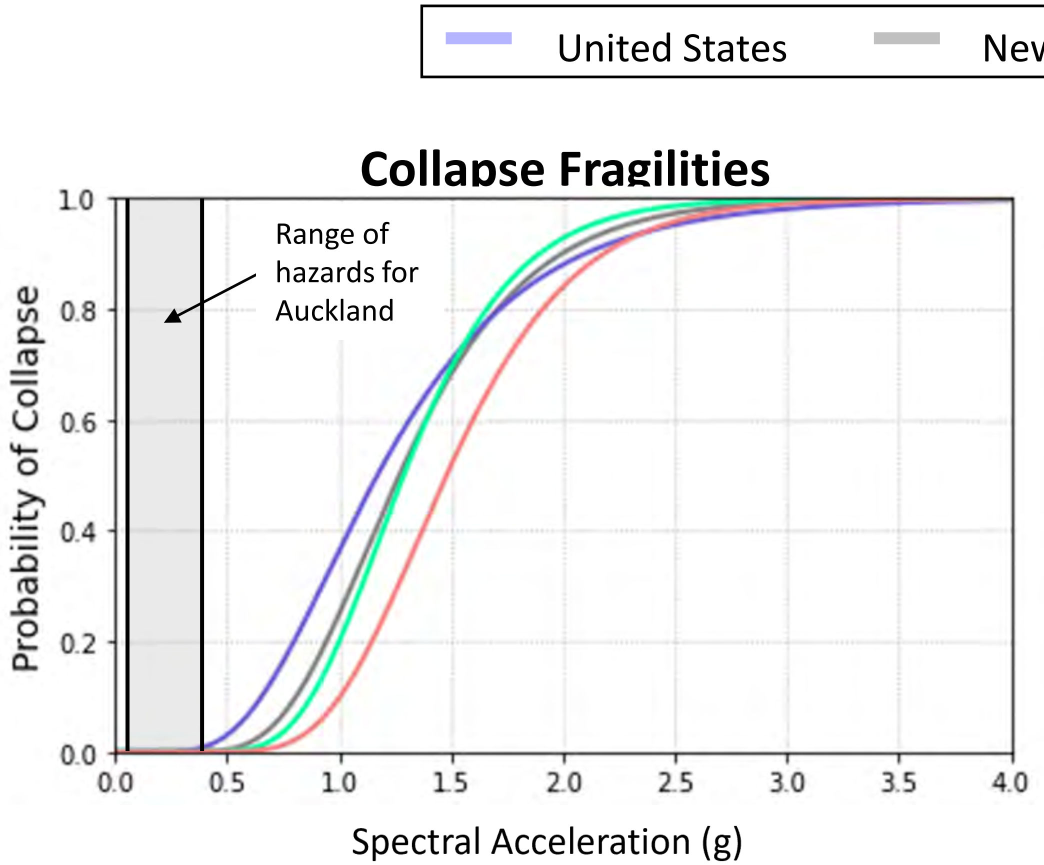
National Science Challenges
Resilience to Nature's Challenges

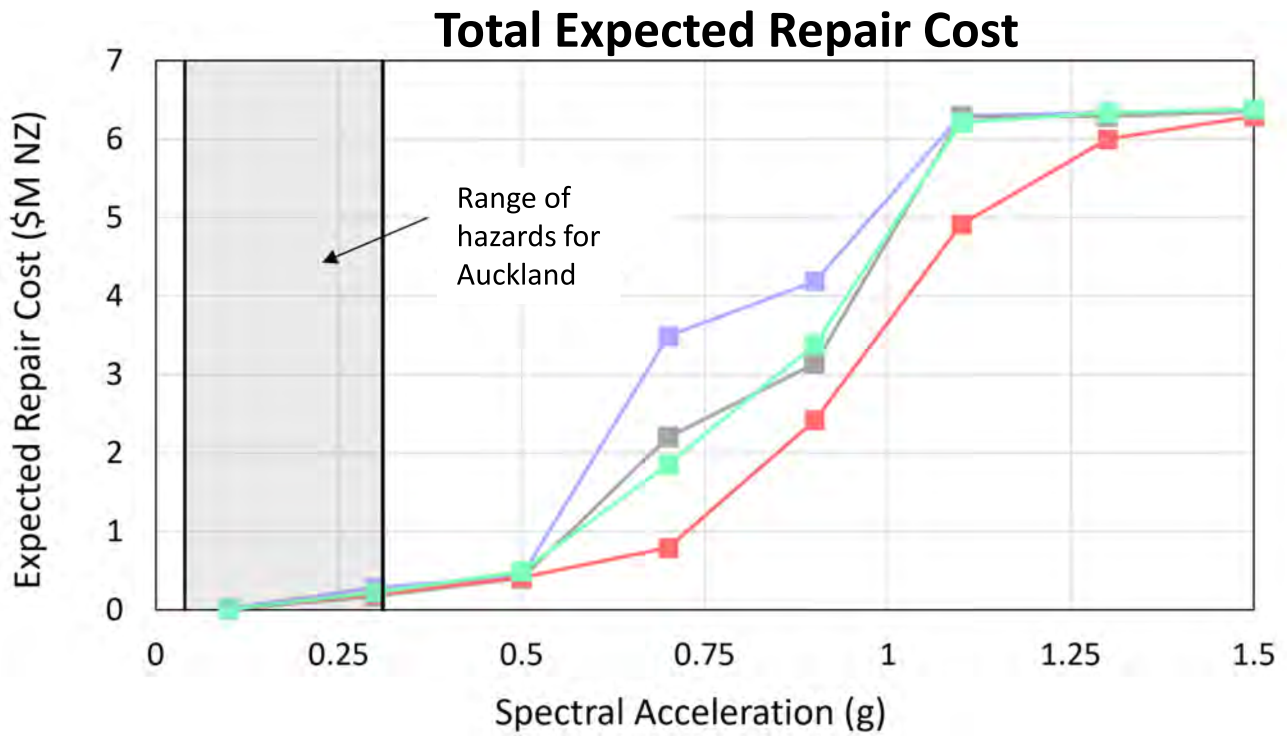
University of Auckland
Waipapa Taumata Rau
New Zealand

Performance of Concrete Moment Frames Designed to Different Standards

Buck et al.
Poster #60







Result: ***Different design methodologies <u>do not drastically influence</u> the relative* Seismic Performance *and* Expected Annual Losses *of moment frames in* LOW *seismic regions***

Building the Carbon Case for Resilient Design

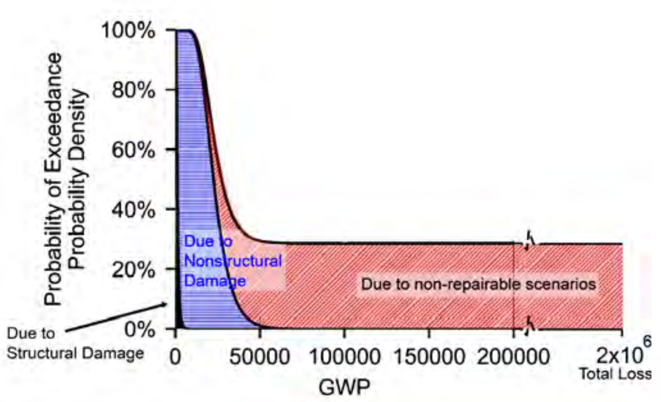
Gonzalez *et al.*

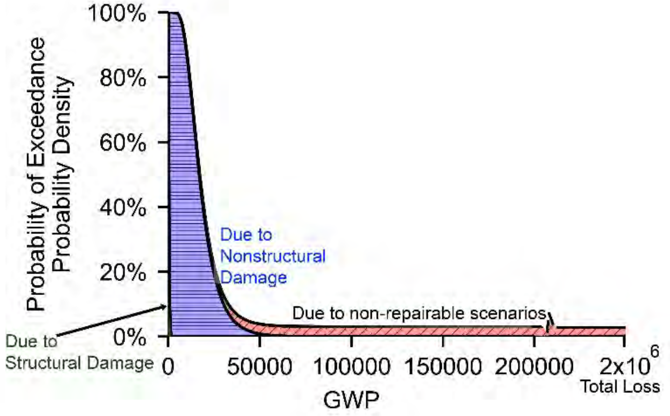
Goals and Scope of Study

This research aims to provide valuable insight into the **carbon cost of designing** seismically resilient buildings in New Zealand.

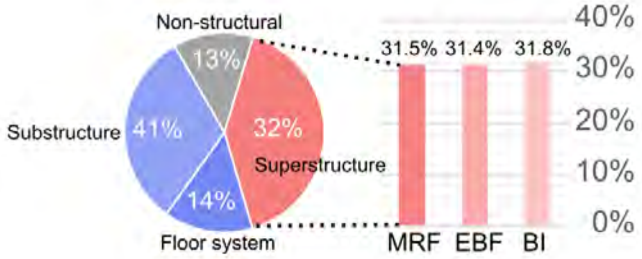
Methodology

Results

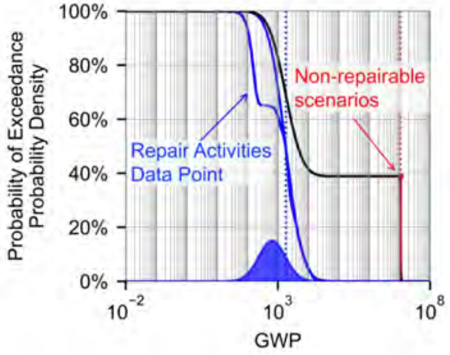




Code-Minimum Building **Stronger-stiffer Building**



Initial Embodied Carbon across building designs
-MRF Moment Resistant Frame (Code Minimum)
-EBF Eccentrical Braced Frame (Stronger-Stiffer)
-BI Base Isolated building (Low Damage design)



MCE earthquake response

A Computational Framework for Estimating Functional Recovery Downtime

Li et al., Poster #64

Systematic review findings

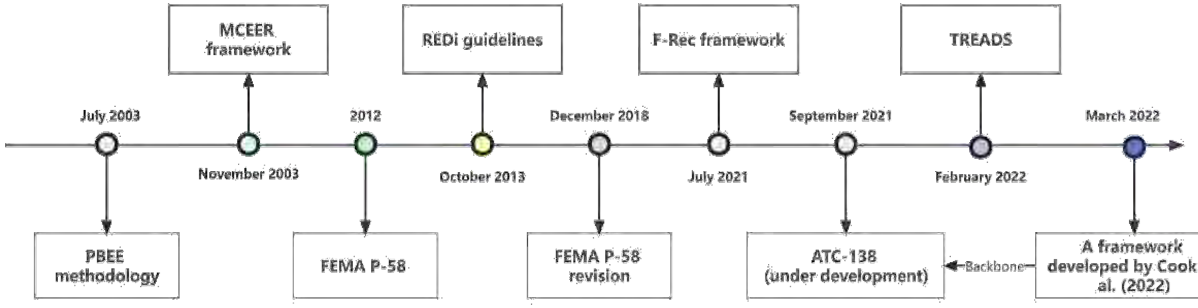


Figure 1. Timeline of paradigm shifts from seismic resilience to functional recovery

Table 3
Summarised details of extracted tools.

Identified tools	Usage in the quantification of functional recovery	Studies (n)
Monte Carlo simulation	Used to address uncertainties in the quantification of functional recovery.	26
HAZUS	Estimates physical damage, economic loss, social impacts, and cost-effectiveness in post-hazard scenarios.	19
FTA	Links the functionality of a complex system to the state of its subsystem.	14
Markov chain	Can dynamically capture changes in the functionality state during the restoration process.	7
OpenSees	Can create a 3D nonlinear model to evaluate structural performance.	5
Critical path method (CPM)	Used to determine resource scheduling and resource allocation.	4
Hydraulic simulation	Can assess hydraulic system performance for a wide range of loading.	4
EPANET	Used to perform an extended period simulation of hydraulic and water quality behaviours within pressurised pipe networks.	4
Probabilistic seismic hazard analysis (PSHA)	Used to measure the probability of exceeding various ground-motion levels at a given site (or a map of sites) given all possible earthquakes.	4

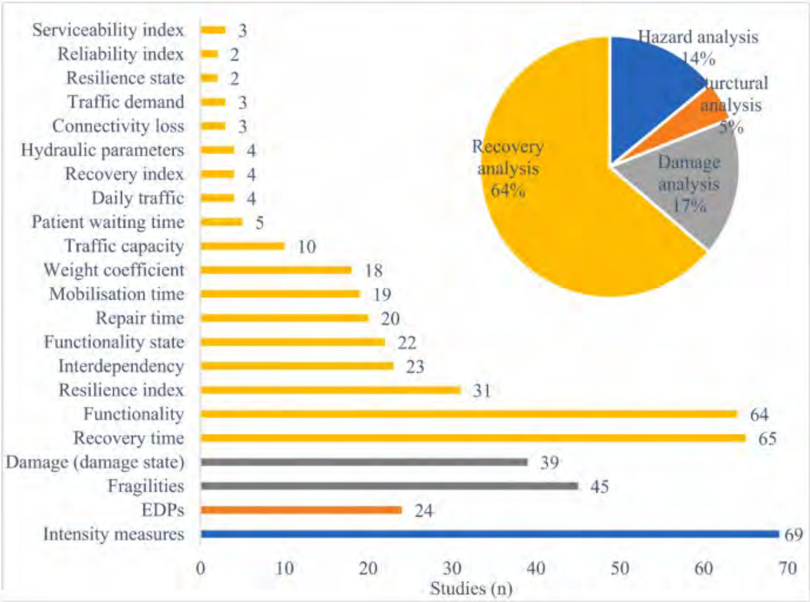


Figure 2. Indicator distribution for functional recovery analysis

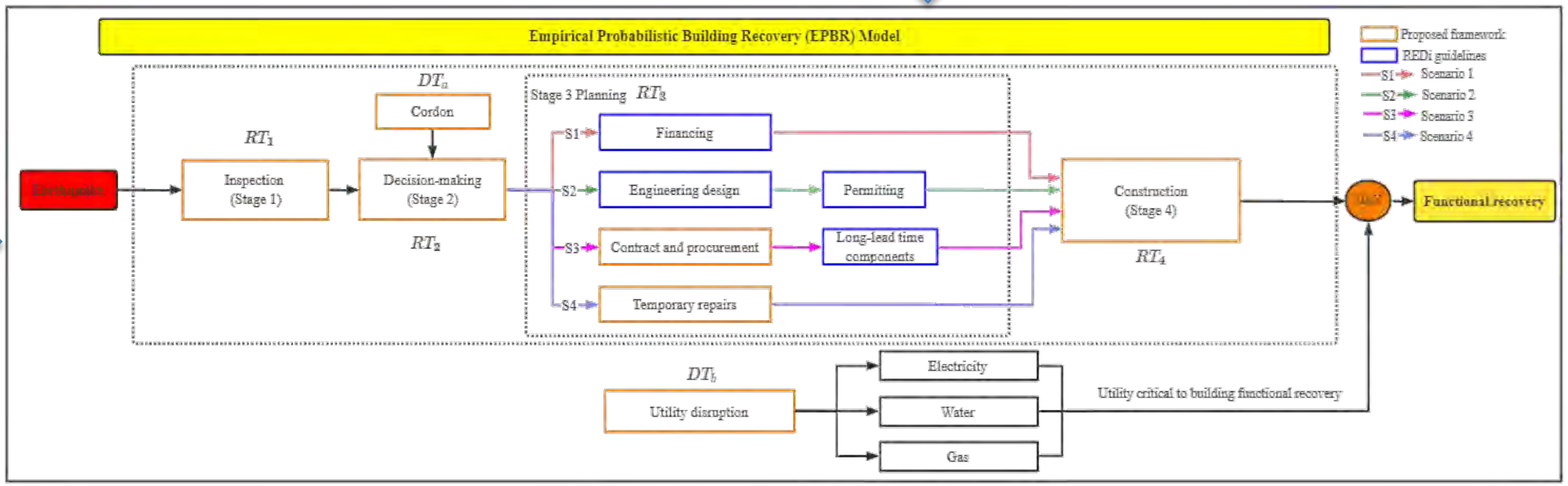


Figure 3. Overall computational framework for downtime estimation

Planned results

- ***Downtime distribution curves*** for different recovery stages
- ***A data-driven computational framework***, provides the basis for effective decision-making during a crisis

Publication: Li, L., Chang-Richards, A., Boston M., Elwood, K., Hutt, C. M. (2023). **Post-disaster functional recovery of the built environment: A systematic review and directions for future research.** International Journal of Disaster Risk Reduction. doi: https://doi.org/10.1016/j.ijdrr.2023.103899

Post-disaster building functionality: A systematic review

Mayer et al.
Poster #59

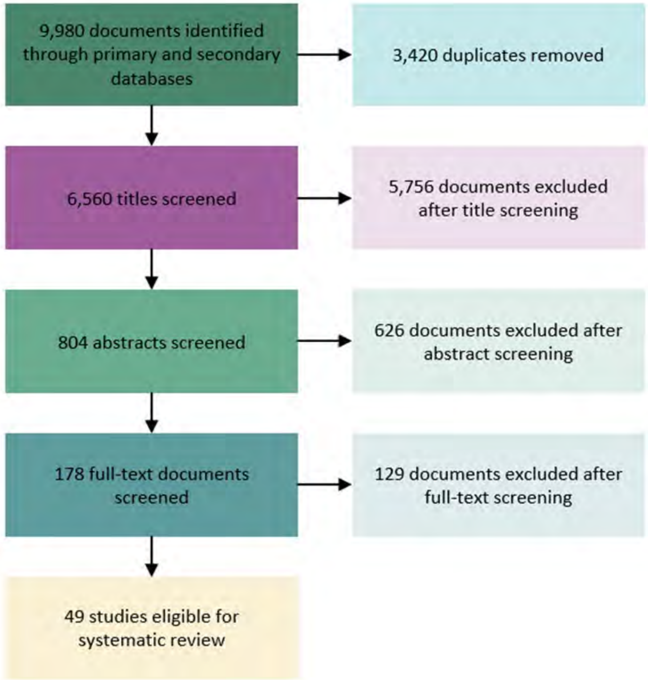


Fig. 1 Systematic Review of Functionality and Occupancy

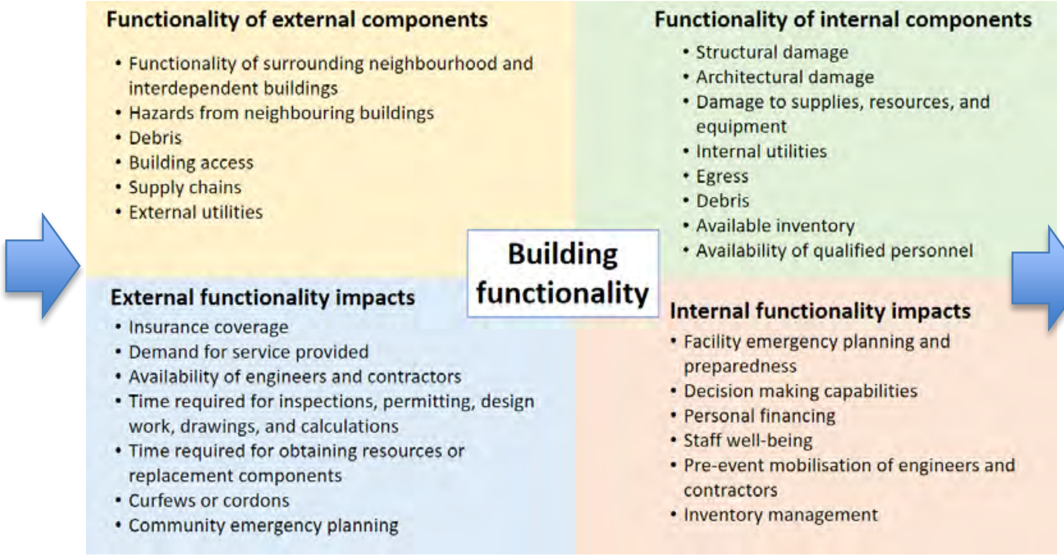


Fig. 2 Systematic Review Results classifying components of building functionality

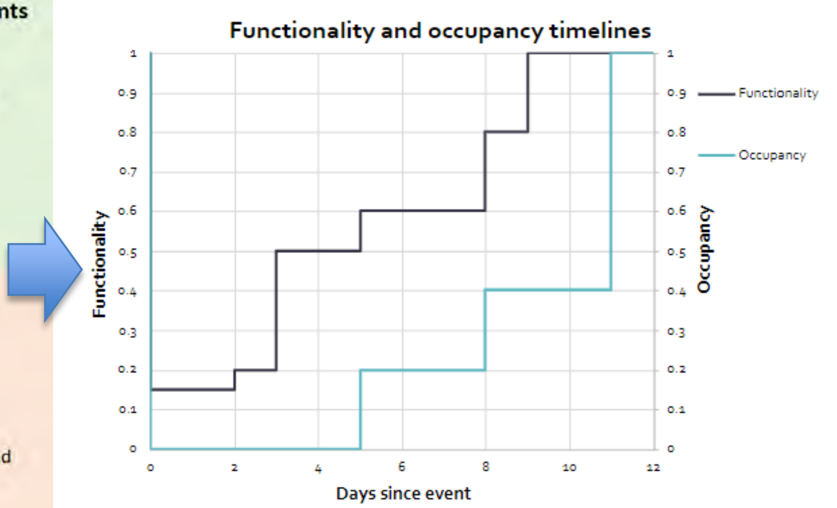


Fig. 3 Planned work to combine functionality and occupancy

Planned results

- ***Learn from past post-earthquake experiences of NZ tertiary education facilities***
- ***Develop a framework for post-earthquake building functionality and occupancy***

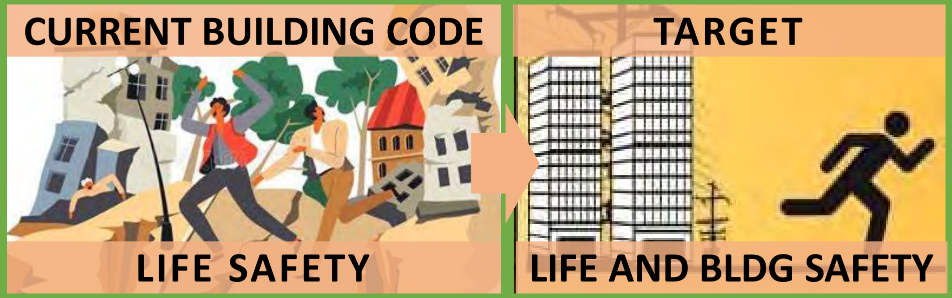
Conference Publication: Mayer, B., Boston, M., Chang-Richards, A. (2023) Post-disaster building functionality: Preliminary findings of a systematic review. NZSEE Annual Technical Conference. Auckland, NZ. April 2023

Operationalising occupier preferences of post-earthquake functional recovery of buildings

Nkrumah et al.
Poster #66

1 Research gap

- Modern buildings need to cater to shifting occupier preferences: physical spaces that support collaboration, attract and retain talent, access to technology; office layouts are more open space w/ natural light and views
- The trend is "flight to quality" with rental rates in prime offices 200-250% > than in older buildings. Tenants seek extra assurances through lease agreements: min seismic rating, re-occupation and rent reduction clauses. Therefore, tenants expect minimum level of damage following a major seismic event.



POST-EQ OCCUPIER PREFERENCES

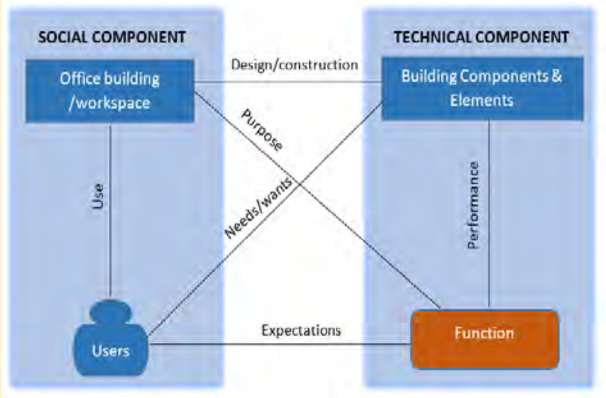
RETAIN TALENT = LIFE SAFETY
RETAIN PRODUCTIVITY = BUILDING SAFETY

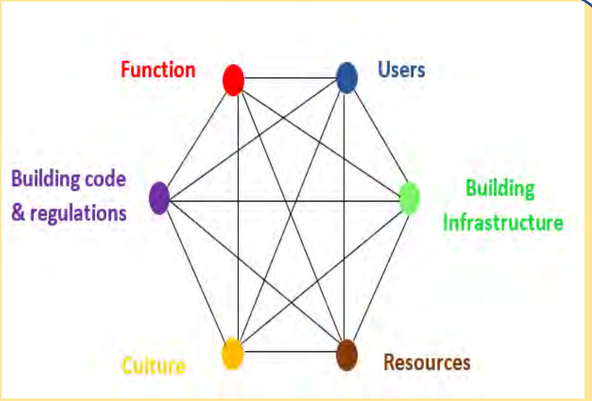
2 Research significance

- The changing needs and preferences of building users affect **office designs and building functions**.
- Understanding their needs will prioritise building functions to enhance **the effectiveness of post-event functional recovery.**

3 Proposed framework

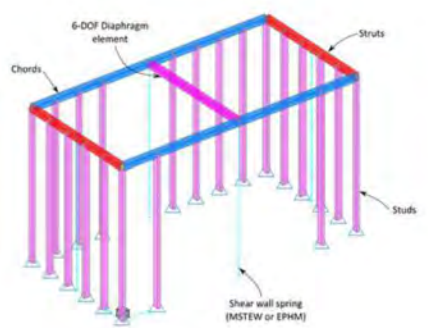
- The building function is conceptualised as a system. Thus, the study uses a theoretical lens, **socio-technical system (STS) theories** to develop **building function system frameworks** from micro and macro perspectives.





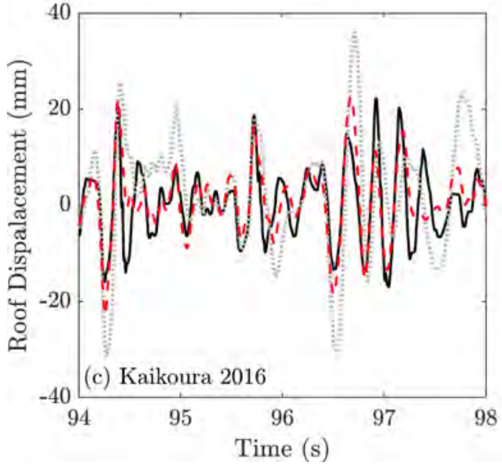
Advanced testing, modelling and assessment of New Zealand housing

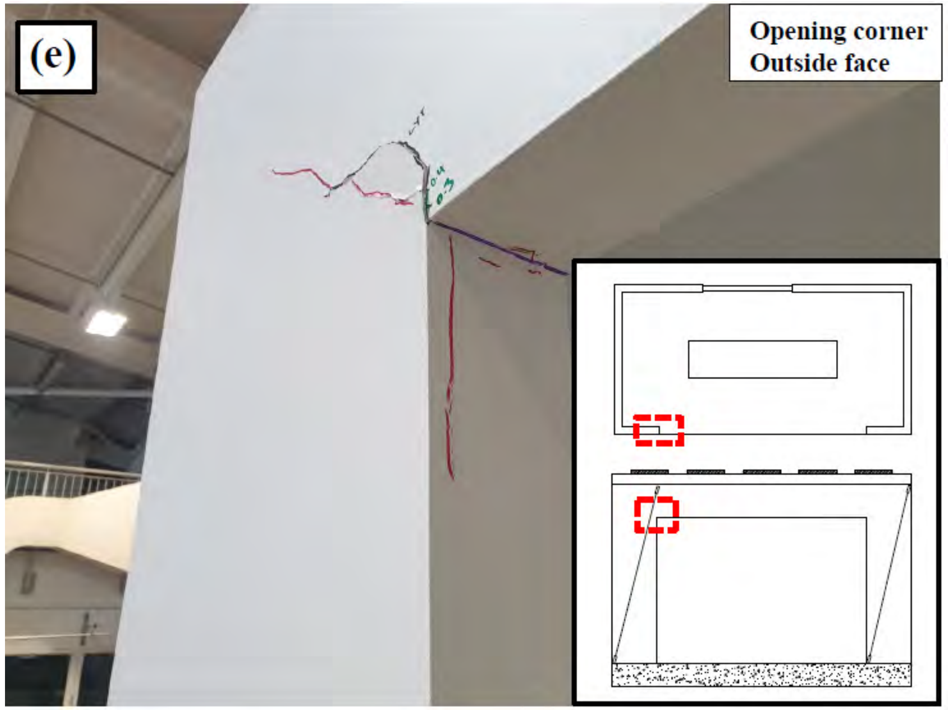
Francis et al.

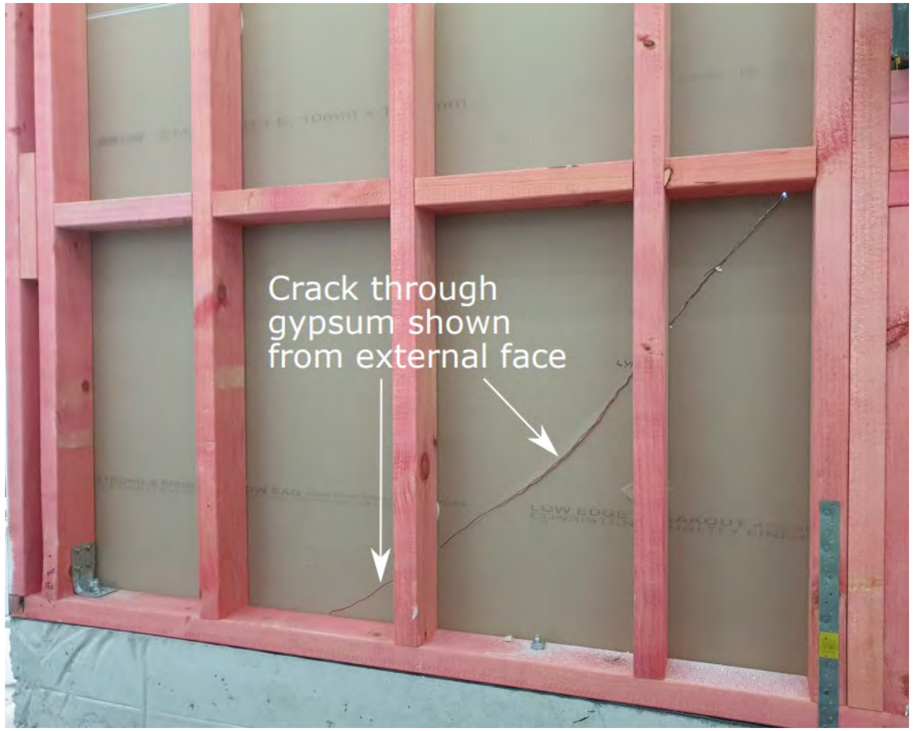


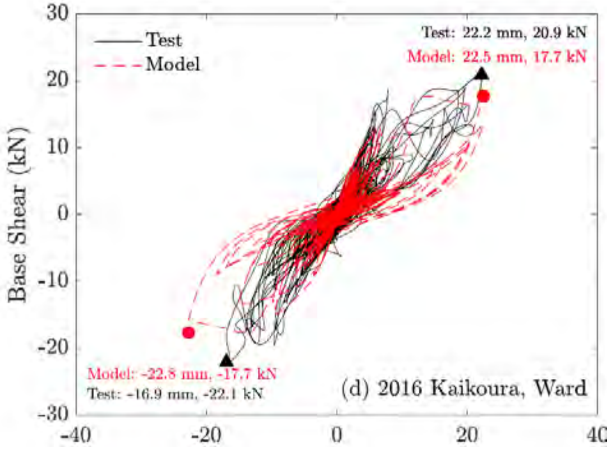
Shake-table testing results used to verify advanced numerical modelling and assessment approach to aid vulnerability assessment of NZ housing (timber-framed walls with plasterboard panels).

Published in ASCE Journal of Structural Engineering









Expectations and performance of wooden framed houses, Wellington, NZ

Miranda et al.

Phase 1: Social Aspects

What are the homeowners' expectations of damage to wooden-framed houses before and after seismic strengthening?

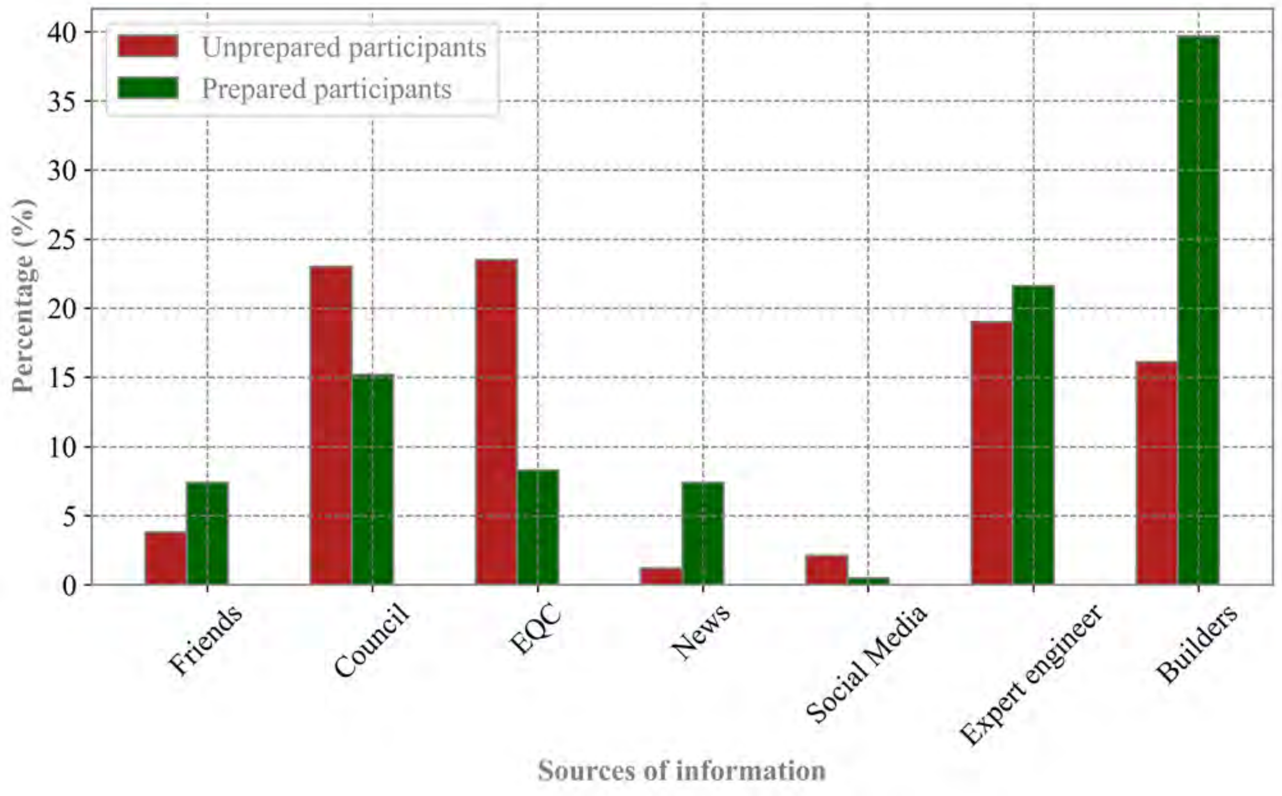
Phase 2: Engineering Aspects

What is the predicted seismic performance of wooden-framed houses with and without seismic strengthening?

- We cannot rely on direct experience of earthquakes to motivate seismic strengthening.
- **All participants expected lower levels of damage** than what is covered by current seismic codes (i.e. life safety).
- Numerical models validated the **positive effects** of sub-floor strengthening on slope timber houses; however, their effectiveness is affected by different geometric parameters.
- Analysis showed that the reduction of damage after strengthening meets the philosophy behind the building codes – life safety; however, **damage will still** occur, which will **not satisfy** owners' expectations of building performance who have voluntarily undertaken building strengthening.

Understanding the influences of builders on building a resilient community

Miranda et al.



A project that looks at how **builders interpret seismic risk** information and how this translates into activities related to **earthquake strengthening**.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

JOINT CENTRE FOR DISASTER RESEARCH

Toka Tū Ake EQC

Resilient Infrastructure: Planning Emergency Levels of Service (PELOS)

Mowll et al.
Poster #71

- Wellington-based study
- Aimed at understanding how to develop emergency levels of service
- Framework devised, which can be adapted locally/internationally
- Investigation into mapping tools that can help visualise PELOS
- Being considered in new Emergency Management Bill in NZ.

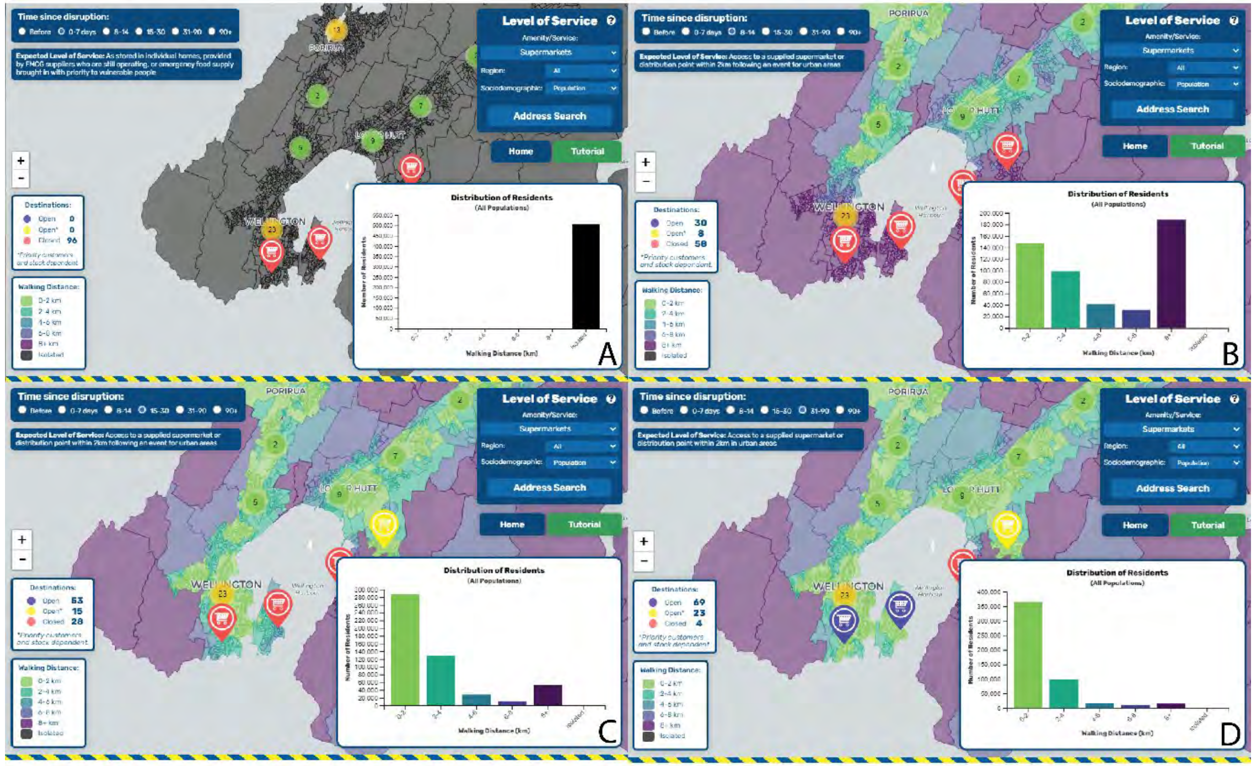
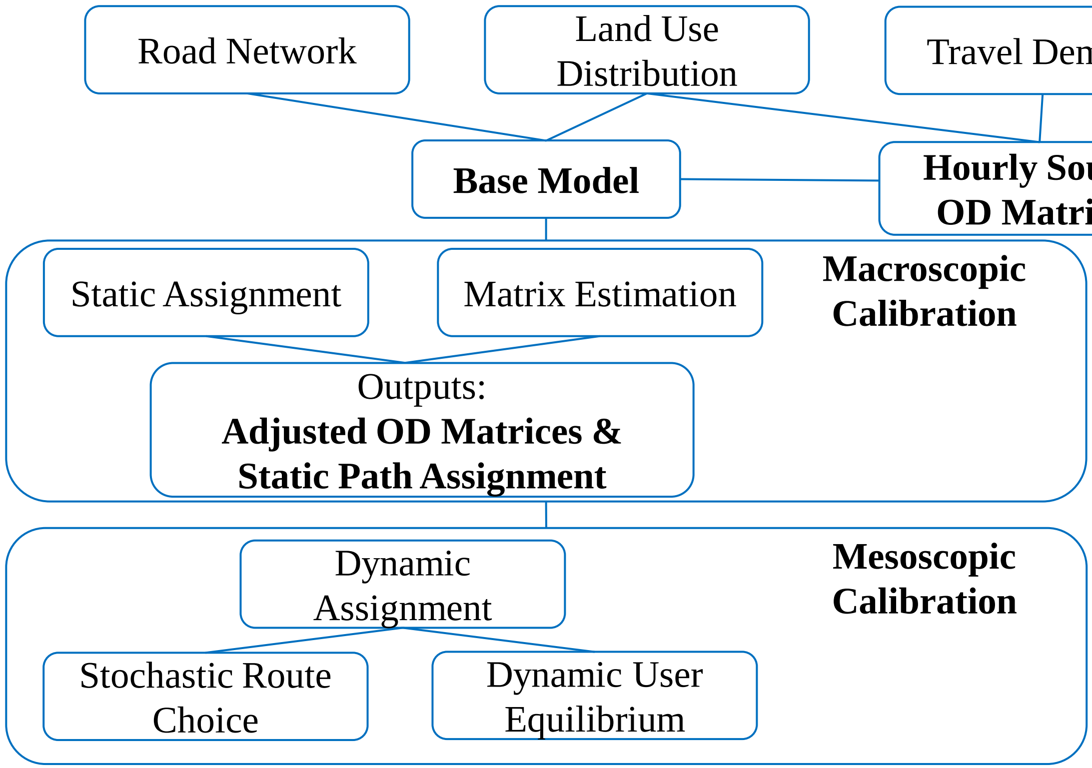


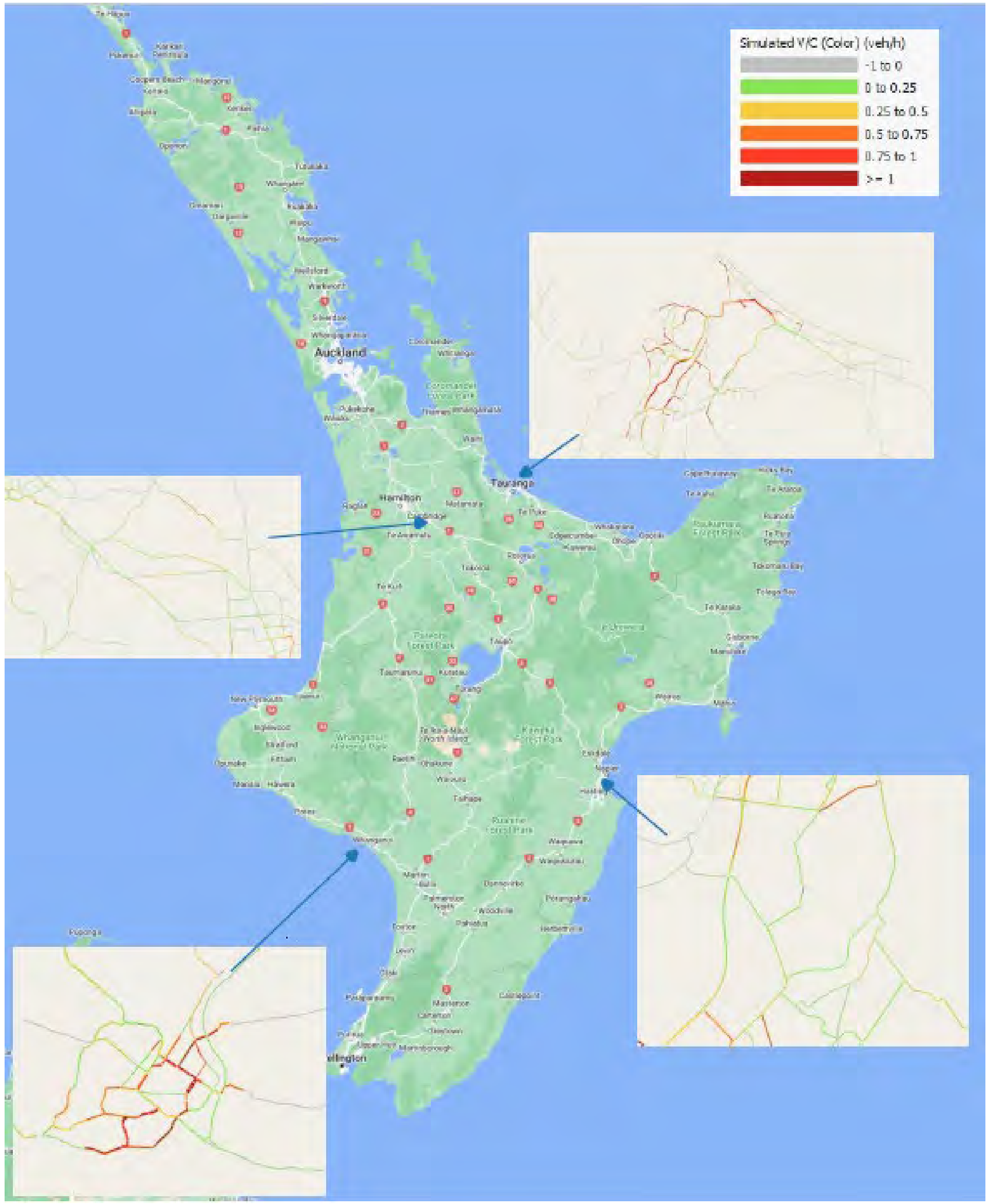
Figure 1: Accessibility to food sources over time. The mapping tool shows how access to supermarkets changes over four time periods post-event: 0-7 days, 7-14 days, 15-30 days, and 31-90 days.

Development of North Island Road Transport Model

Khakda et al.

Commuting, freight and tourism
Travel times, speeds and volumes





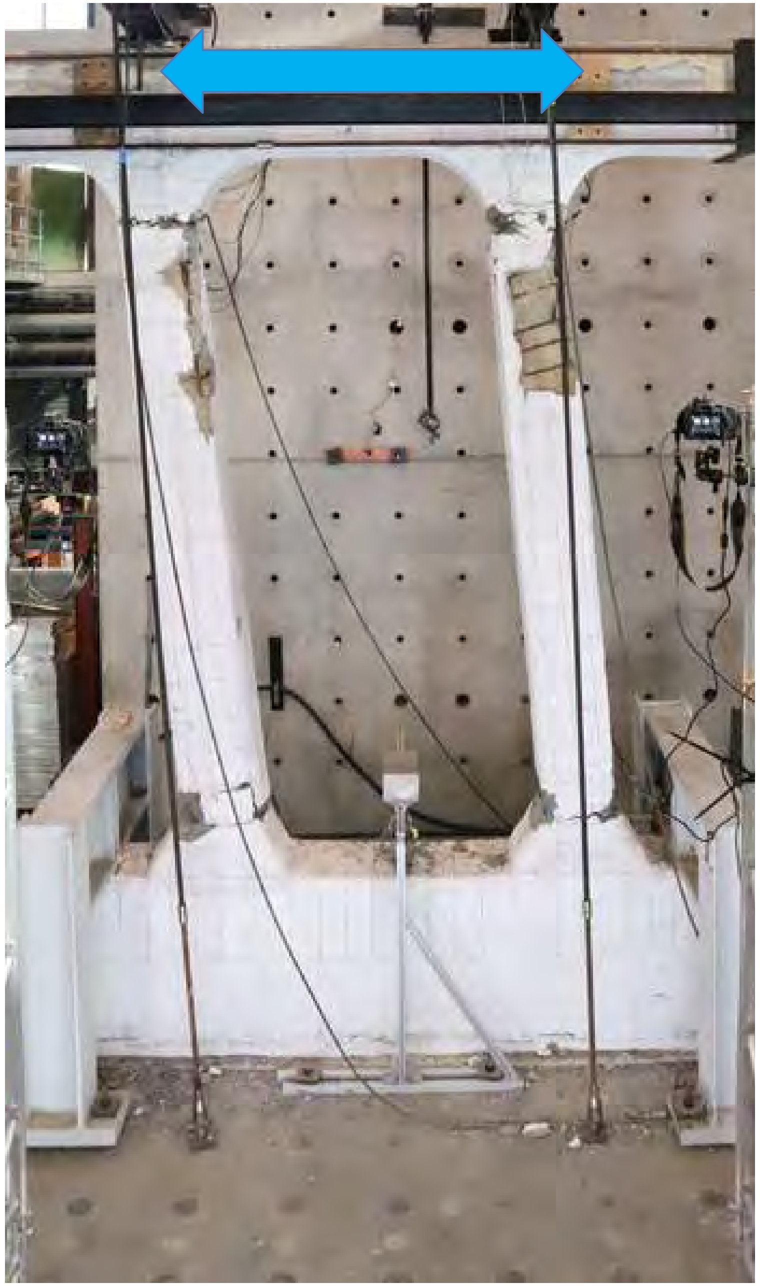
Result: *First transport model for the North Island, enabling assessment of impact of earthquakes on road network*

Bal et al.

Bridge Performance: Field-to-lab testing

Physical testing to understand performance of older construction typologies

Extract specimens and test under cycles of loading



~4 m

Result: *Improved understanding of capacity, helping to inform bridge stock assessment and decision making*

Cyclone Gabrielle Response

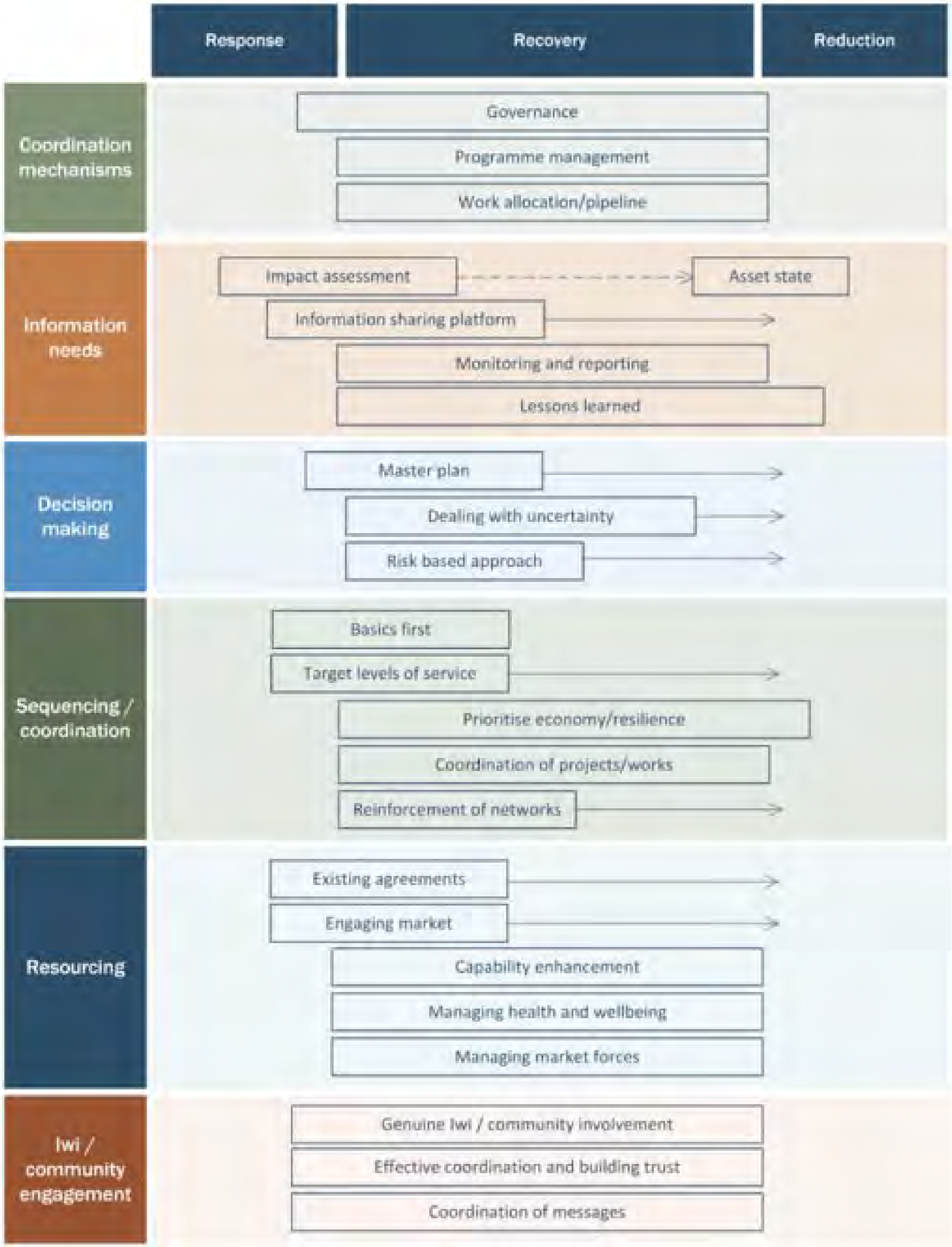
Wotherspoon, Brown et al.

Post-event support for response and recovery of critical infrastructure

Result: *Policy briefs to support infrastructure recovery across the North Island*

Critical infrastructure recovery: Key Lessons

Building resilience through recovery: Investment decision making



EXTREME WEATHER RESEARCH PLATFORM
Te Rāngai Rangahau Āhuarangi

P-wave-based S-wave intensity estimation with PLUM to extend the warning window for EEW

Chandrakumar et al.
Poster #85

Stage 1: Selection of P-wave Detection Algorithm

•Our project commenced with a thorough selection process to identify an optimal P-wave detection algorithm. This choice is crucial as it accurately identifies P-wave arrivals within seismic waveforms. [1][2]

•We assessed multiple algorithms, considering their performance metrics and capacity to handle diverse seismic data. This comprehensive evaluation guarantees the reliability of our subsequent analysis. [3][4]

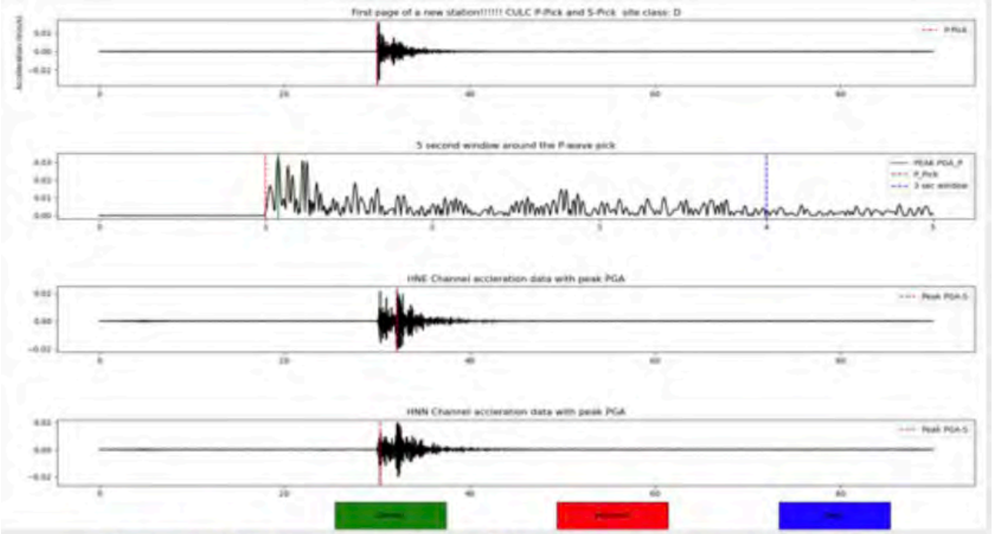


Figure 1: Our Custom-Built Tool P and S-wave parameter picking

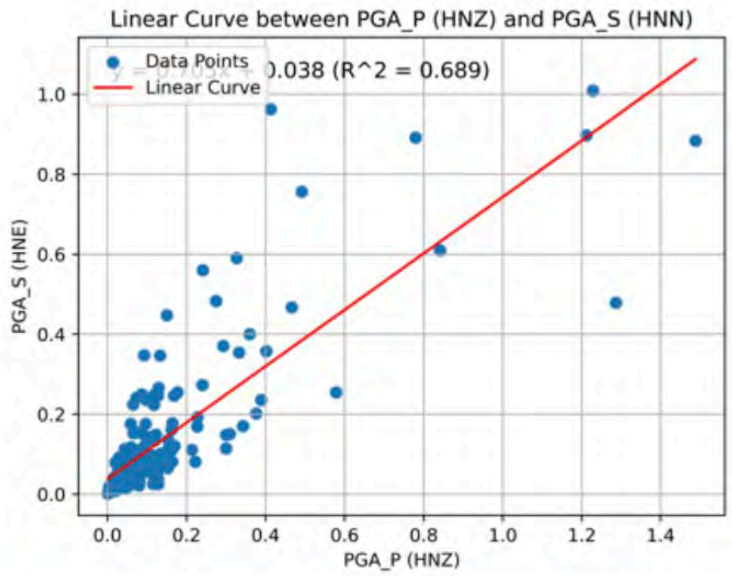


Figure 2: An empirical relationship built between the Peak Ground Acceleration of P and S-waves

Stage 2: Building a relationship between P and S-wave's intensity

•**Data Source Selection:** Our study is centred on CUSP stations in Canterbury (2015-2022) with labelled P-wave picks, ensuring robust data quality.

•**Waveform Collection:** From the selected stations, we acquired 3085 waveforms, forming a substantial dataset for analysis.

•**P-wave and S-wave Parameters:** Extracted key parameters within three seconds of P-wave arrivals and during the S-wave using a tool (Figure 1) developed by the research team.

Relationship Building: Our ongoing work involves correlating the extracted parameters, and building an empirical relationship between P-wave and S-wave intensities (e.g., Figure 2).[5]