QuakeCoRE USER programme: *Undergraduate Studies in Earthquake Resilience*

Summer Scholarship Programme

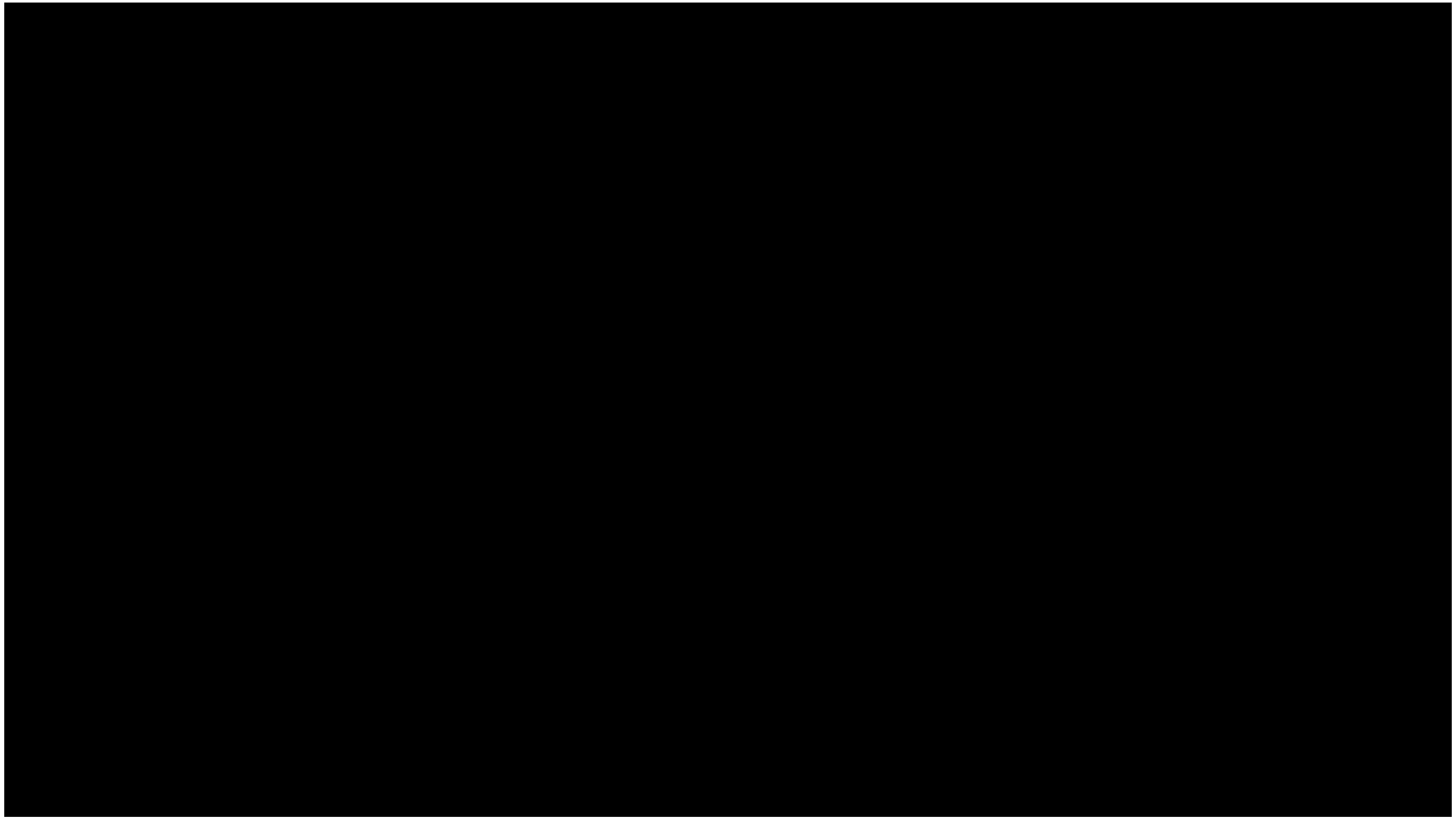
Aim: A multi-disciplinary research opportunity for 10+ undergraduate (UG) students to become exposed to various aspects of the earthquake resilience problem working alongside NZ's best earthquake researchers.

$5000 scholarship; Practical work accredited

2020-21 Grand Challenge

‘Modelling, visualising, and communicating future major earthquakes and their impacts to the New Zealand public’

Example: Output from 2016-17 programme: Visualization of 14 Nov 2016 Kaikoura earthquake



Example 2: Earthquake resilience on campus brochure

Damage-resistant design: a new approach

Normally buildings are designed for earthquakes with 'life safety' in mind. Buildings are designed to be safe, but are often badly damaged following large earthquakes.

Damage-resistant buildings take a different design approach. They employ innovative construction techniques which minimise building damage during large earthquakes, while still ensuring safety.

Examples of seismic design techniques

Fluid Viscous Braces
During an earthquake, fluid inside the brace heats up and is forced to move between two chambers. Similar to a vehicle's suspension, the brace acts as a damper and reduces the seismic energy that is transferred to the rest of the building.

Buckling Restrained Braces (BRB)
BRBs consist of a ductile steel core, a concrete fill, and a steel casing which resists buckling. BRBs absorb energy, resist the horizontal load exerted on buildings during earthquakes, and therefore reduce the potential for damage to the rest of the building.

Seismic Joints
Used to connect two adjacent buildings and allow for parts of the building to move independently during earthquake shaking. Seismic joints prevent the damage caused by parts of the building colliding during large earthquakes.

Rocking Systems
Cables are threaded through hollow beams and columns. A rocking systems enables building sections to move before being pulled back into place by the cables, with little or no damage to the building during a large earthquake.

Feb 2019

QuakeCoRE

QuakeCoRE is transforming the earthquake resilience of communities and societies, through innovative world-class research, human capability development, and deep national and international collaborations. They are a Centre of Research Excellence (CoRE) funded by the New Zealand Tertiary Education Commission.

www.quakecore.nz

Quake Centre

The UC Quake Centre is a dynamic partnership between the New Zealand Government, the University of Canterbury, and several leading industry groups, all working together in the engineering sector to provide world-class knowledge, research and industry solutions to seismic issues.

www.quakecentre.co.nz

A Resilient City - Walking Tour

The central city has some great examples of low damage design, including technologies developed here by researchers at UC. Scan the QR code for a central city walking tour developed by 2018-19 QuakeCoRE USER students.

USER: Undergraduate Studies in Earthquake Resilience

USER is a summer research programme led by QuakeCoRE at UC. The USER programme provides multi-disciplinary research opportunities for undergraduate students on various aspects of the earthquake resilience problem.

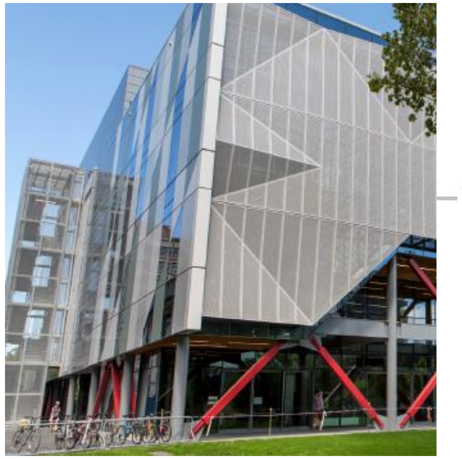
Brochure developed by 2018-19 USER students

QuakeCoRE
NZ Centre for Earthquake Resilience

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Earthquake Resilient Buildings and Design

UC Self Guided Tour



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QuakeCoRE

UC UNIVERSITY OF CANTERBURY
CANTERBURY

Conventional Seismic Design

Ernest Rutherford
1
Buckling Restrained Braces (BRB)

The red BRBs are a striking feature of Ernest Rutherford, inside and out. The ductility of the steel core offers a predictable dissipation of seismic energy. The concrete casing restricts the steel core from buckling, and limits damage to the rest of the building.

Psychology/Sociology
2
Retrofitted BRB

The Psychology/Sociology building was constructed from 1972-1975 and retrofitted with BRBs in 2000. It was the first building in New Zealand to use this system. BRBs can now be seen in many of the rebuilt steel buildings in the Christchurch CBD.

Rehua
3
Seismic Joints

Rehua was severely damaged following the Canterbury Earthquakes and was unable to be occupied until 2019, following extensive refurbishment. Go to each floor and find the seismic joint; it separates the building wings. The joint gets much wider as you go up the building.

Damage Resistant Design

Rehua
4
Fluid Viscous Dampers

The refurbishment features 144 fluid viscous dampers. During an earthquake, the dampers will convert seismic energy into heat. After a large earthquake, the building will be more likely to be able to be occupied as normal.

Have a look around and see how many dampers you can spot.

Beatrice Tinsley
5
Pres - Lam

Pres-Lam is a rocking joint system developed by UC engineers. This system involves steel cables stretched through laminated timber beams, designed to pull the building back into place without damage during earthquakes. The steel brackets have been engineered to yield in large earthquakes and they are relatively easy to replace.

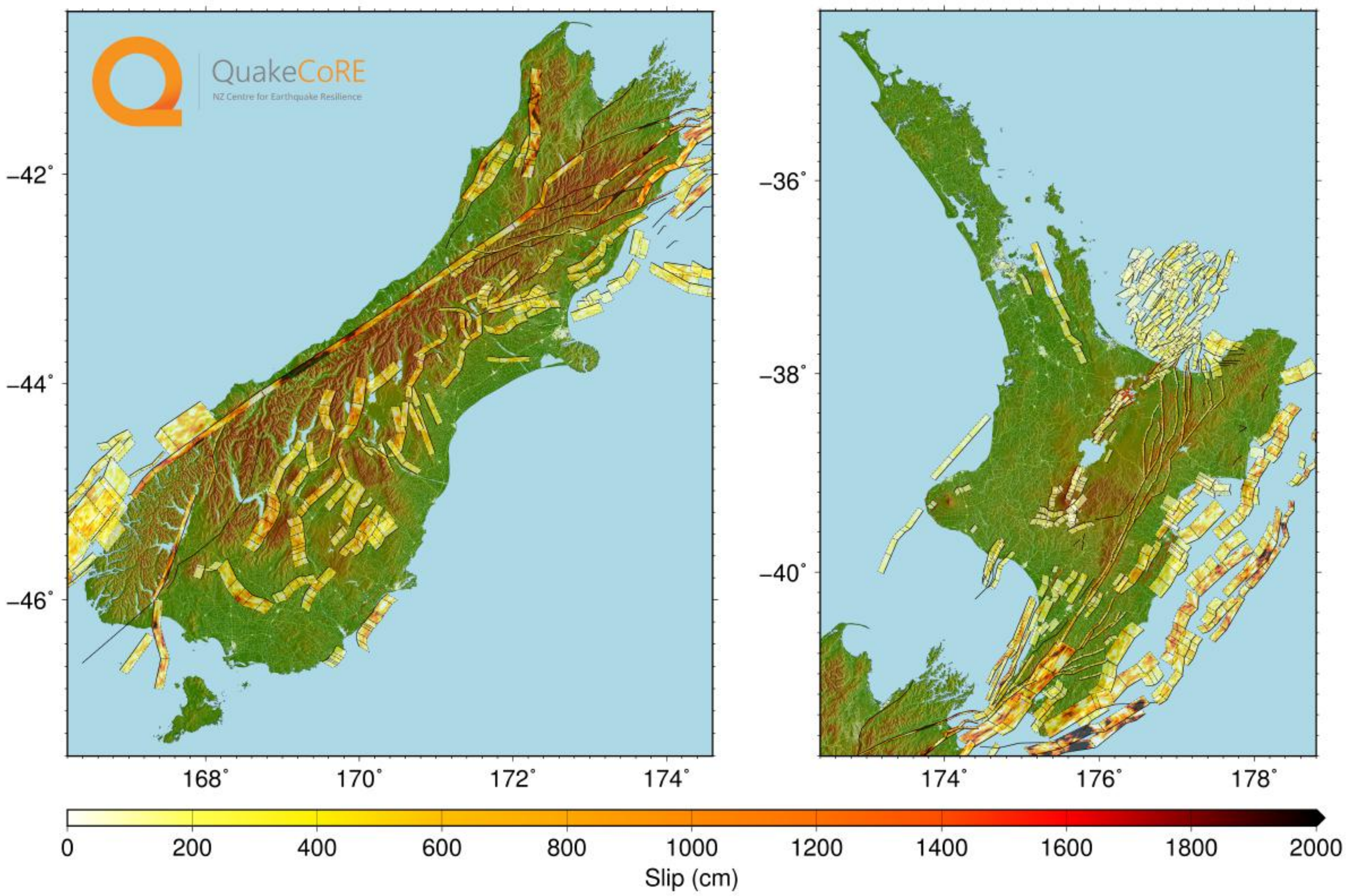
Research

Structural Engineering Laboratory (SEL)
6
Restricted Entry

The SEL is a world-class facility designed for the full-scale testing of seismic loading on structures. If the SEL is not open to tour, have a peek through the windows on the west side of the building to see what is going on.

But what about future earthquakes?

There are over 540 modelled faults in NZ that could produce magnitude 6.5+ earthquakes! Numerical simulations of these events have recently been performed by QuakeCoRE researchers.



And what about all the types of impacts?

Liquefaction

Landslides

Buildings

Lifelines

2020-21 Grand Challenge

The specific aims of the USER Grand Challenge are to:

1. Improve the prediction of earthquake-induced ground shaking through model representation of new sedimentary basins, and near-surface geotechnical conditions. (students with background in Science, Engineering)
2. Use existing models to determine the consequent liquefaction, landslides, building and bridge damage, highway/pipeline/telecommunication systems damage, and socio-economic impacts. (students with background in Science, Engineering, Social Science).
3. Apply Machine Learning methods to develop surrogate models from large datasets of simulation results. (students with background in Engineering, Mathematics, programming, computer science).
4. Use computational visualisation tools to convey the earthquakes, their ground shaking, and the modelled impacts (students with background in Mathematics, programming, computer science).
5. Use one of more audio-visual methods to develop materials (e.g. posters, videos, podcasts, blogs, webpages) which can be used to efficiently and effectively communicate to the general public (students with background in the creative and performing arts, hazard management, social science).

Any (quick) questions?

Apply online: https://tinyurl.com/qcuser2020 by 4th Sept
(takes only 5min)

… or get in contact (brendon.bradley@canterbury.ac.nz)