

BRIDGES

What we can do today for a resilient tomorrow



Dr Royce Liu



Prof. Alessandro Palermo

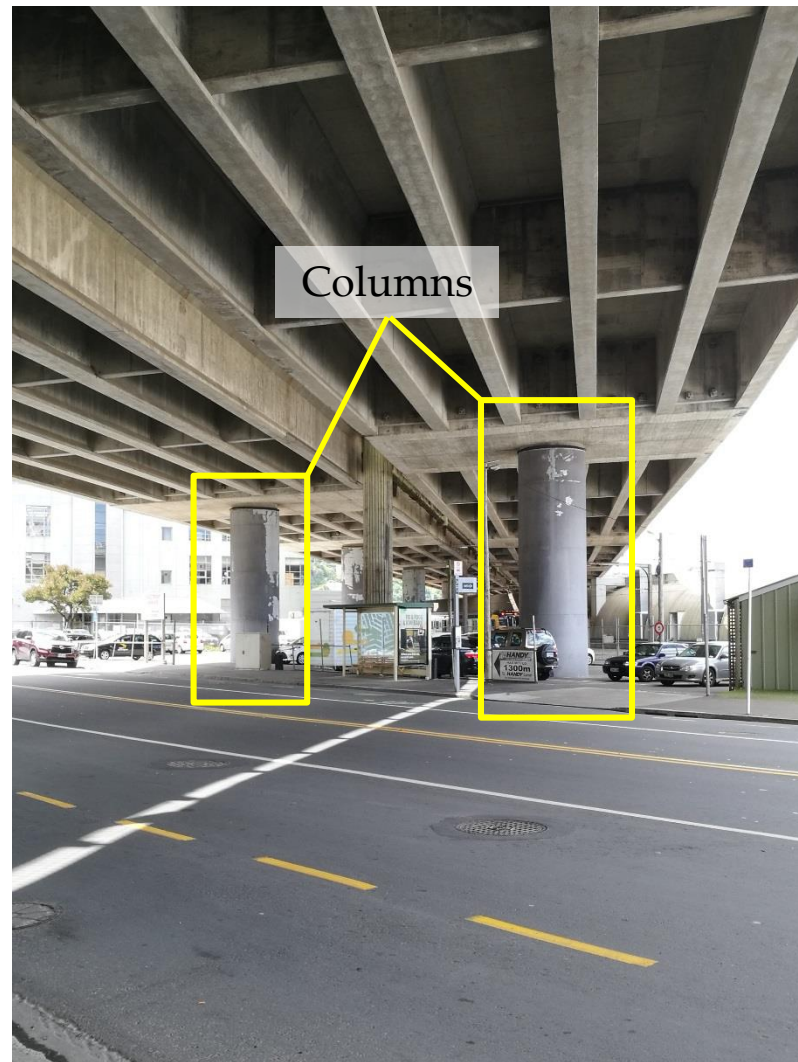


RESILIENCE
TO NATURE'S
CHALLENGES

Kia manawaroa
– Ngā Ākina o
Te Ao Tūroa

National
science
Challenges





In the 1990's...

Introduction

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Seismic Performance of Retrofitted Reinforced Concrete Bridge Piers

Laboratory Testing of the Proposed
Thorndon Overbridge Retrofit Scheme

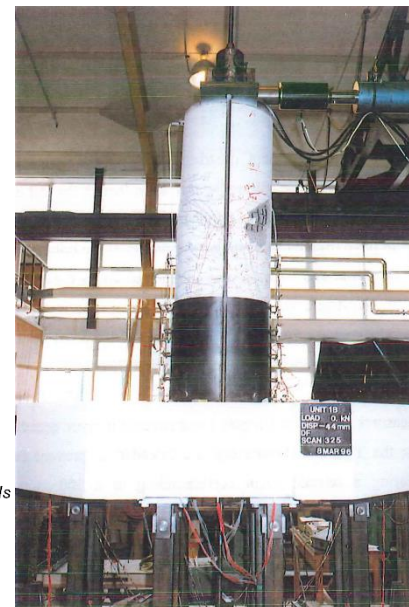
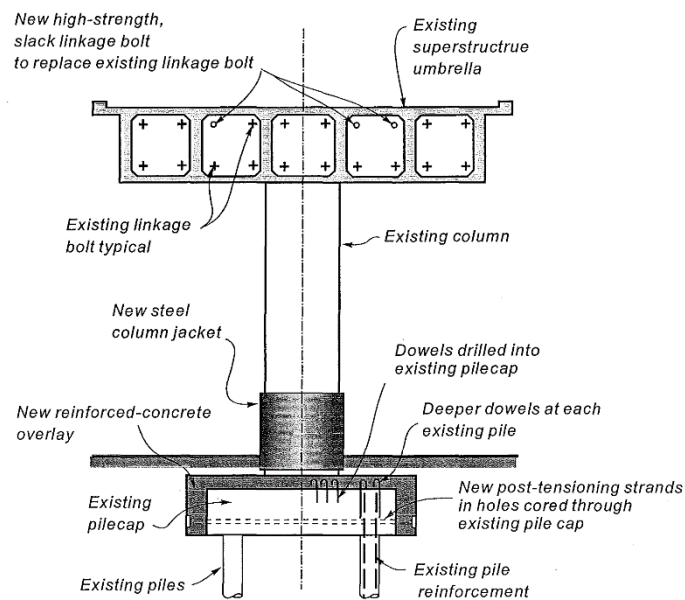
A thesis submitted in partial fulfillment of the requirements for the
Degree of Doctor of Philosophy in Civil Engineering
at the University of Canterbury

BY
ROBERT A. PRESLAND

SUPERVISED BY
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R. PARK

University of Canterbury,
Christchurch,
New Zealand

1999



Natural Hazards & Population Density

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Motivation

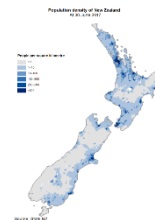
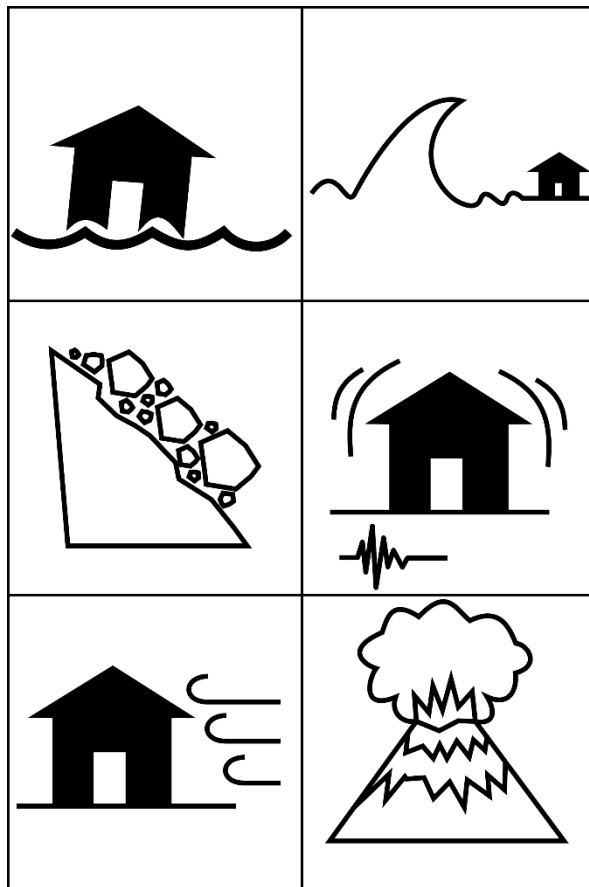
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Natural Hazards & Population Density

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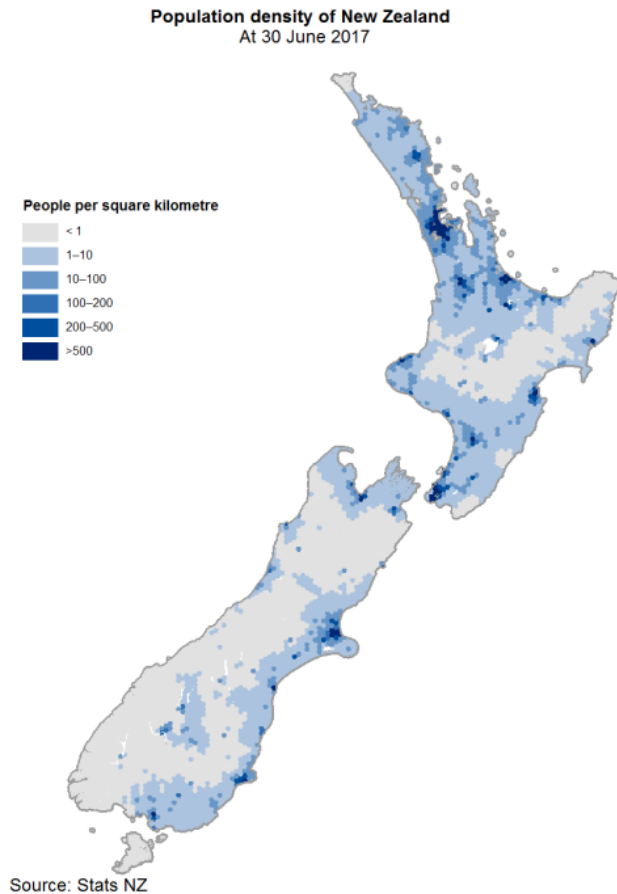
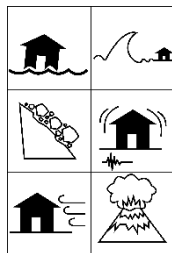
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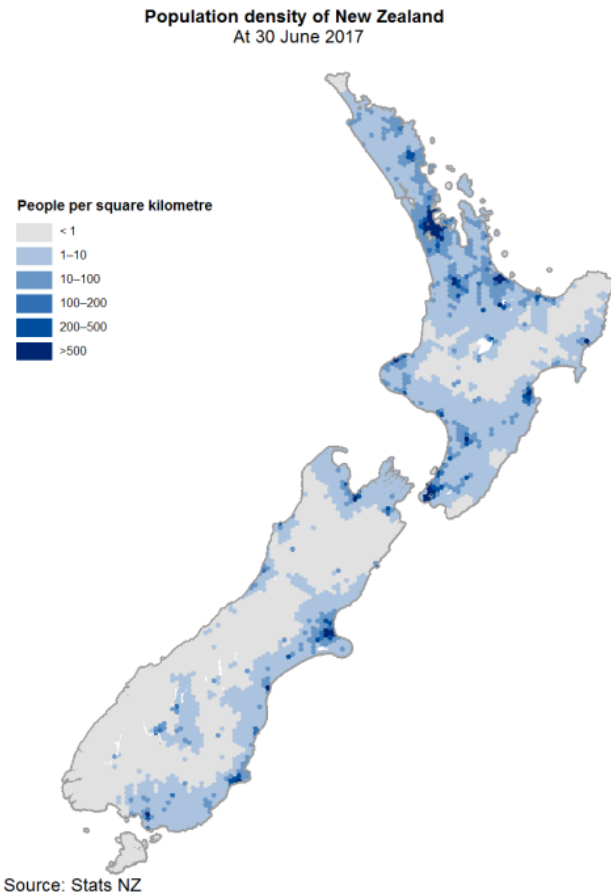
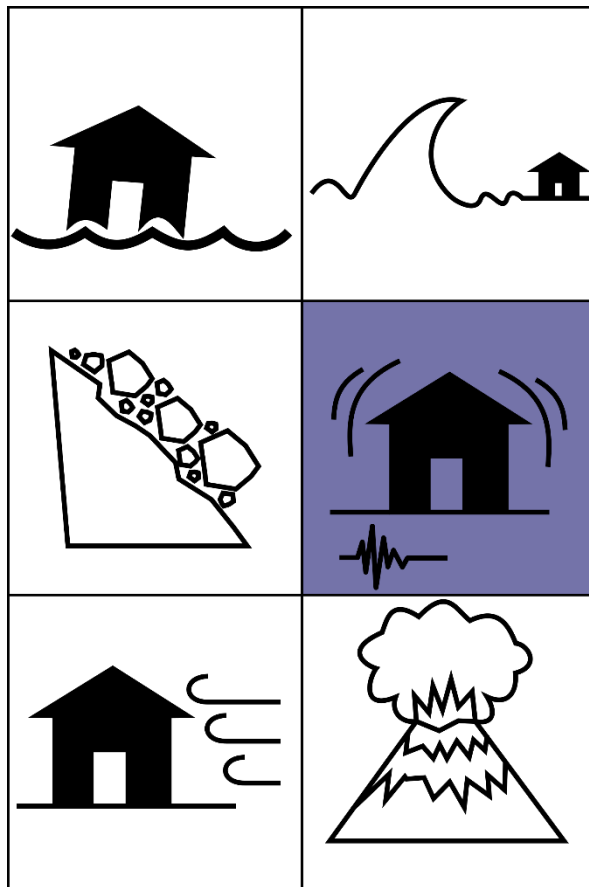
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What is the real issue with
our bridges that we should
be dealing with?

RESILIENCE

What is Resilience?

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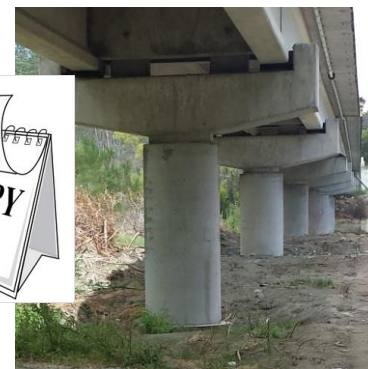
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Minimise loss in functionality

AND

Minimise downtime



How can we achieve resilience?

How to achieve resilience?

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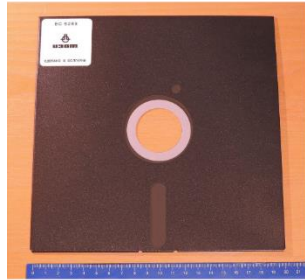
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1971



8 inch floppy

1995



Deep blue
(chess computer)

2011



Apple i Pad

2016



HoloLens

How to achieve resilience?

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Kaikoura Earthquake 2016, Waiau

What are our capabilities today?

Research themes at UC

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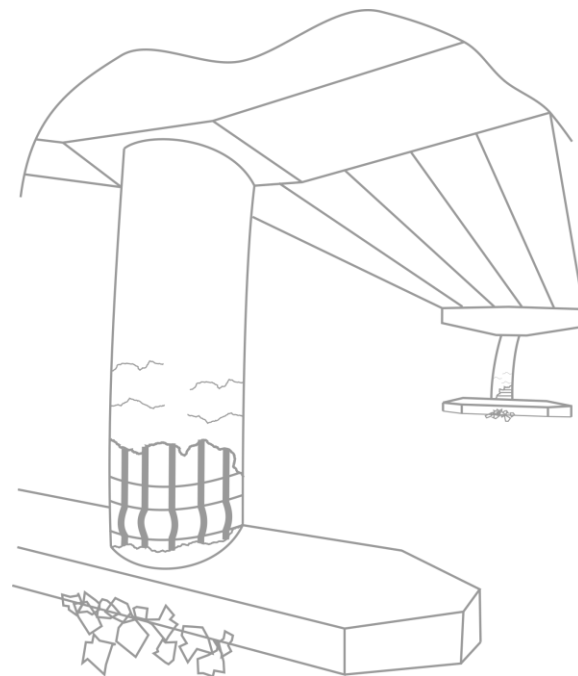
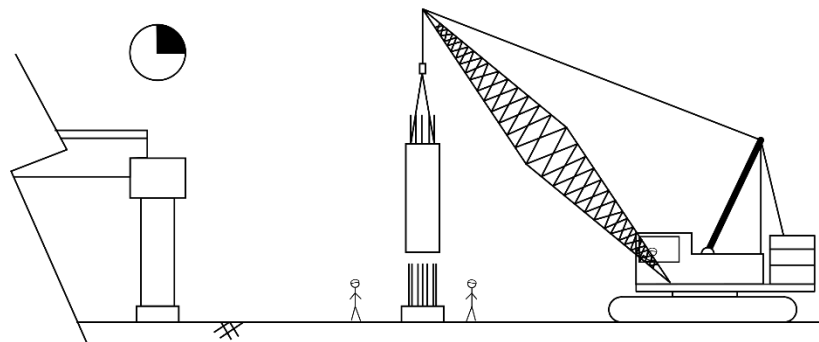
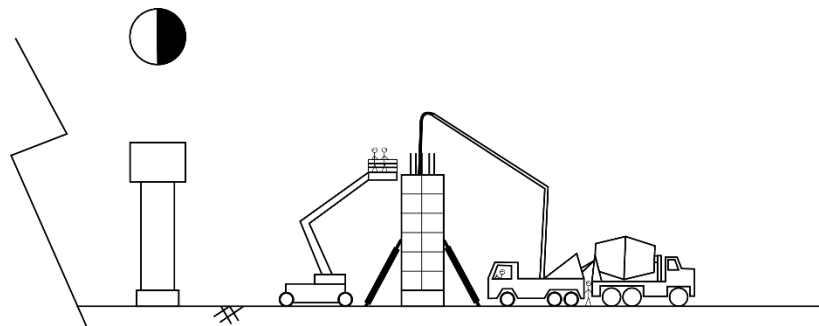
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Research themes at UC

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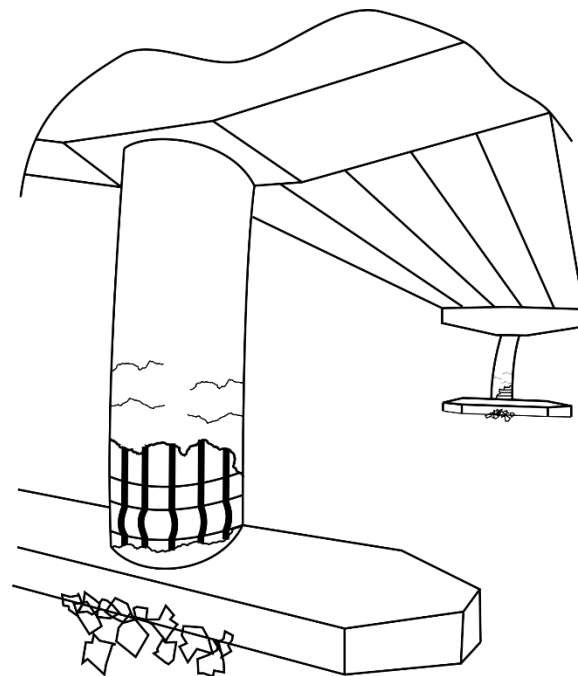
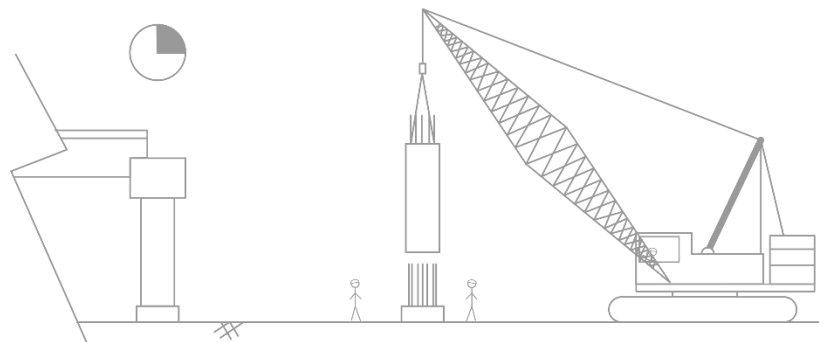
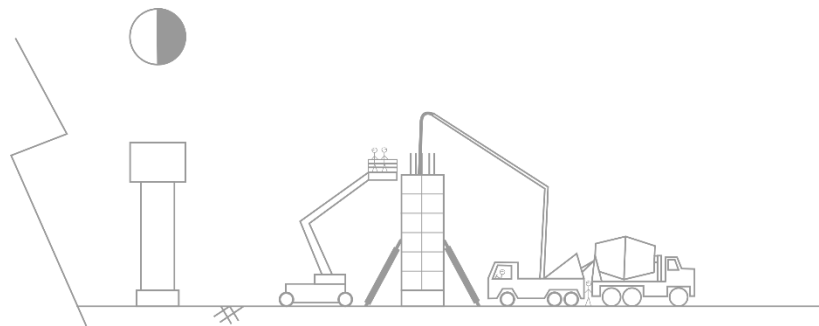
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Low EQ damage system: Rocking system

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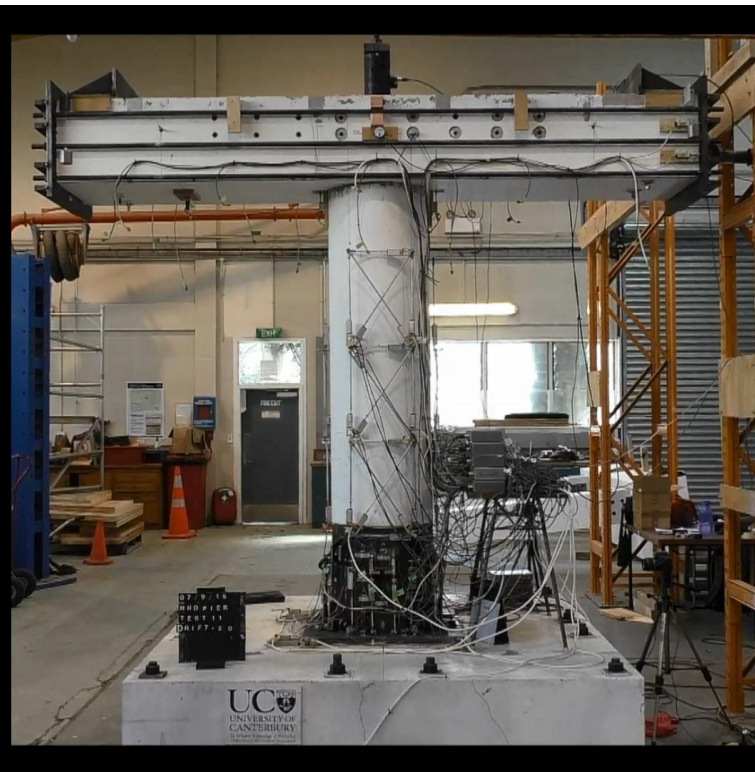
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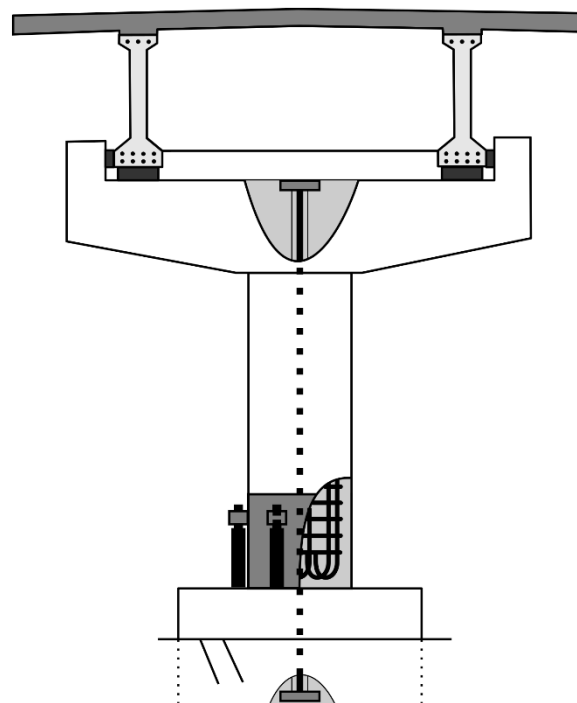
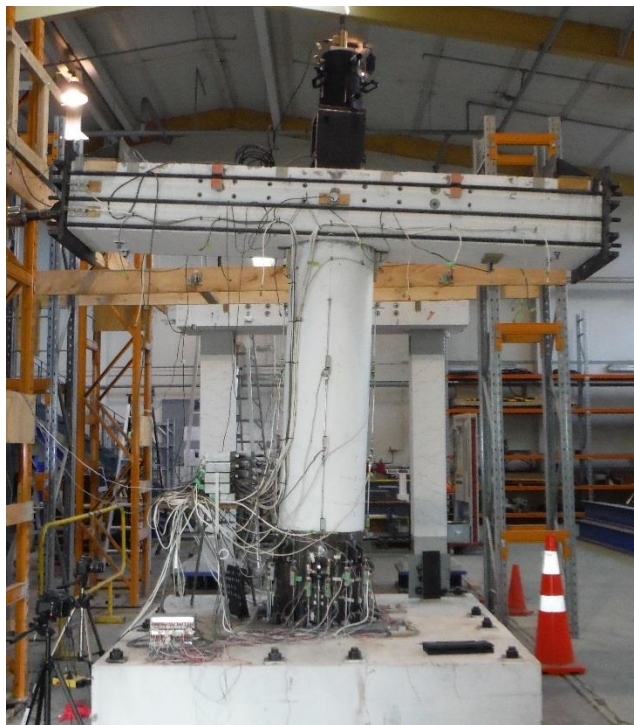
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Low EQ damage system: Rocking system

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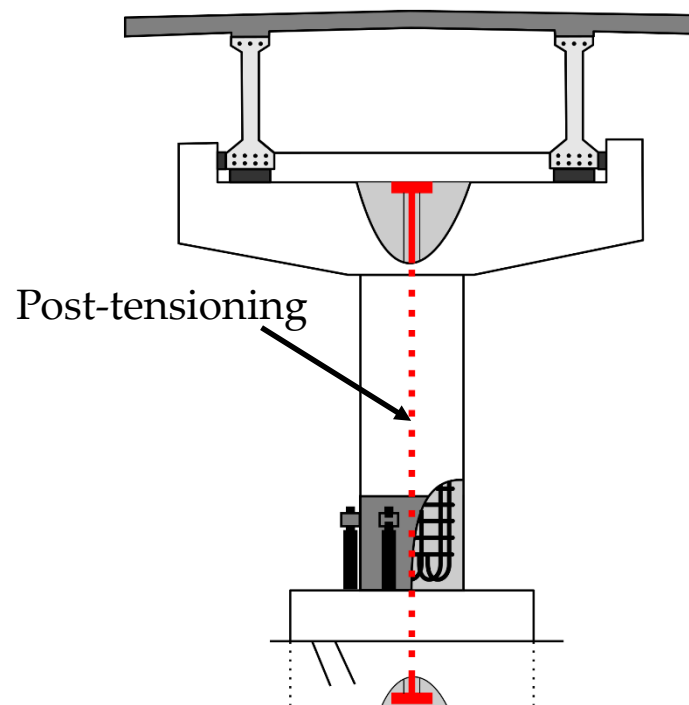
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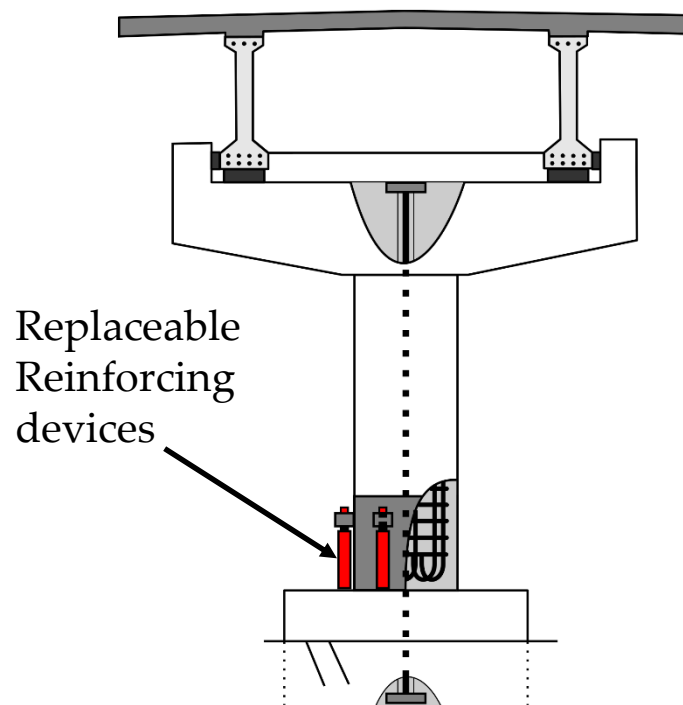
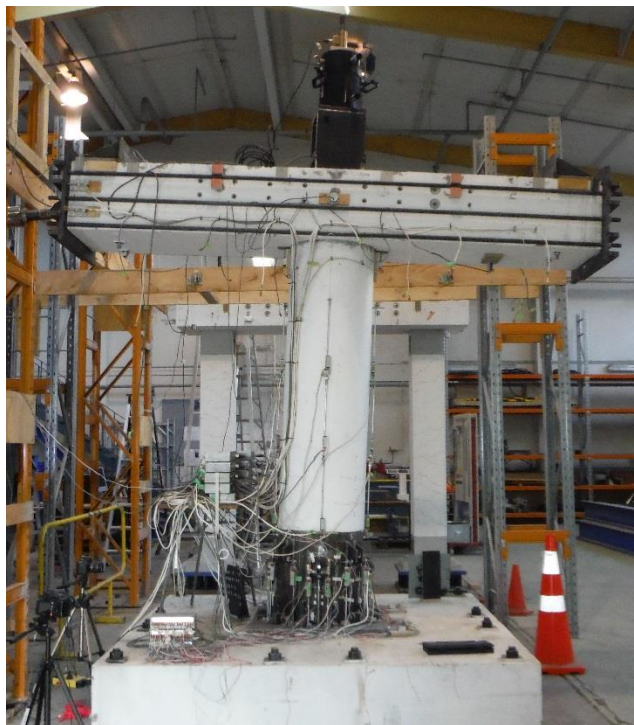
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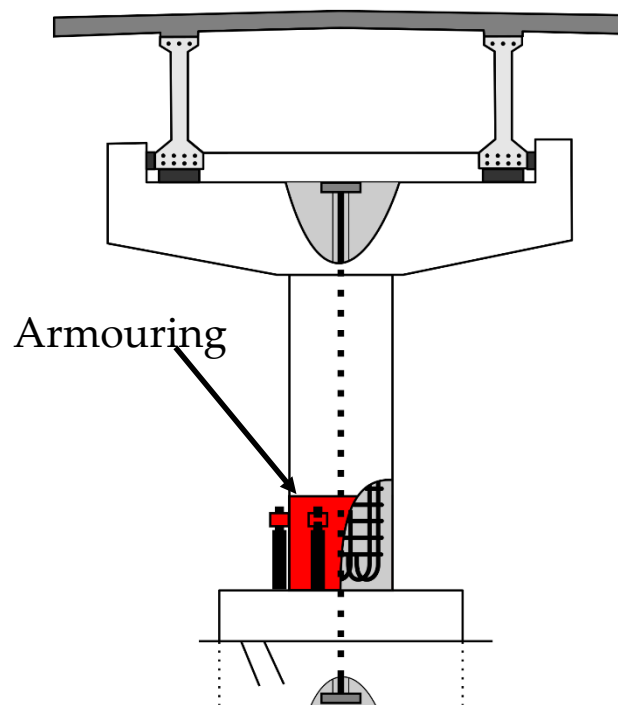
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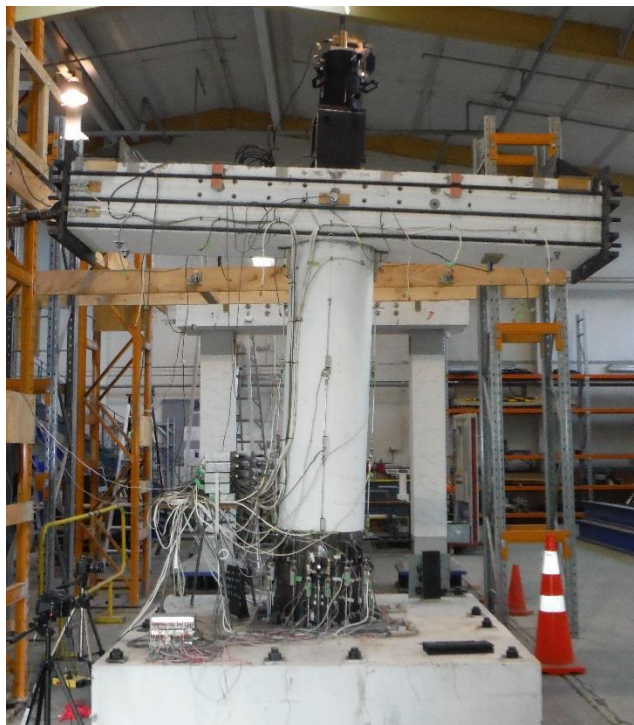
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Recent Bridge Research at UC

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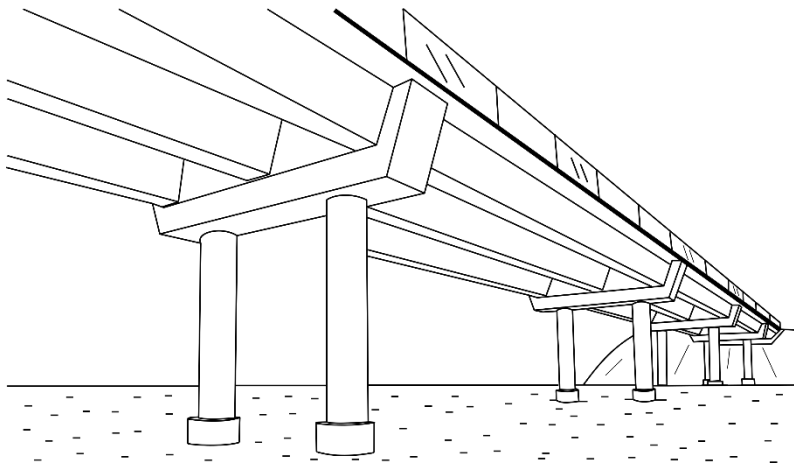
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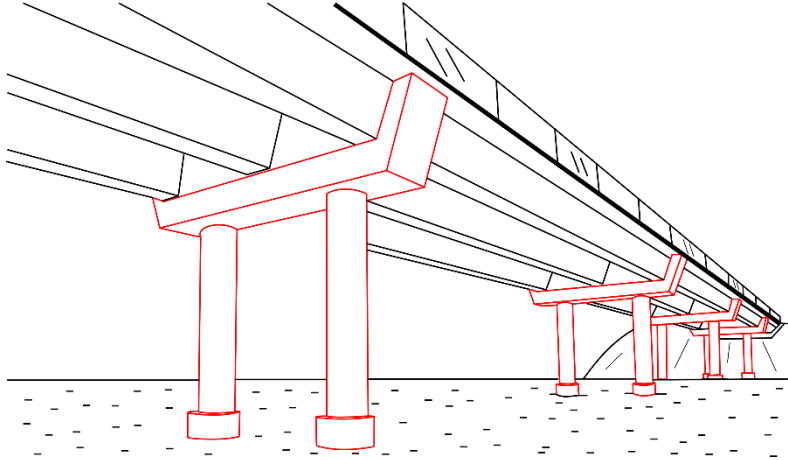
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Sam White



Recent Bridge Research at UC

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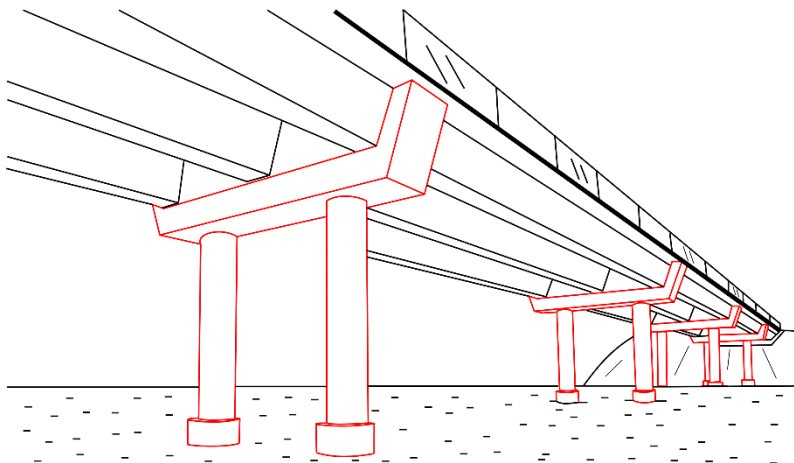
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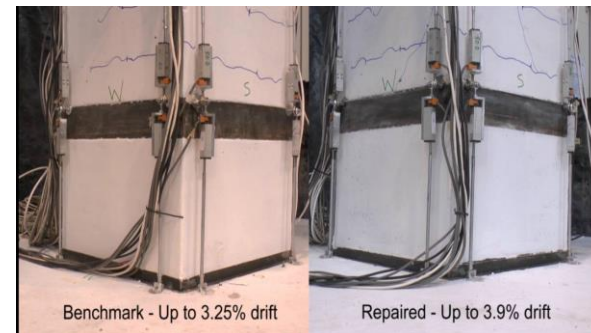
Conclusion



Sam White



Mustafa Mashal



Recent Bridge Research at UC

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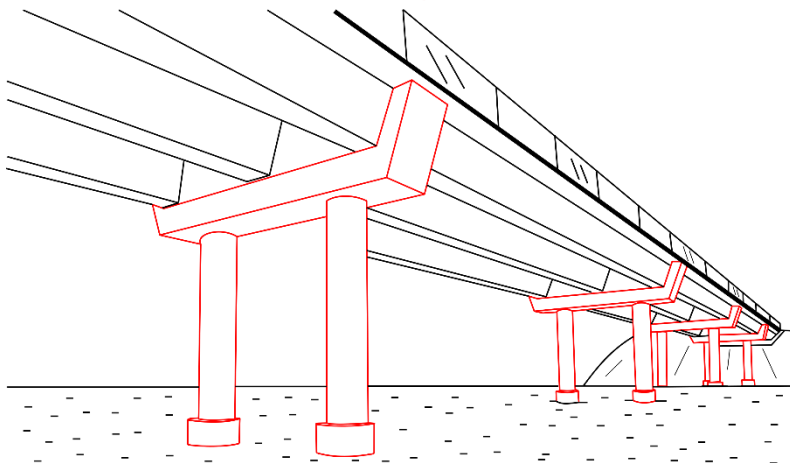
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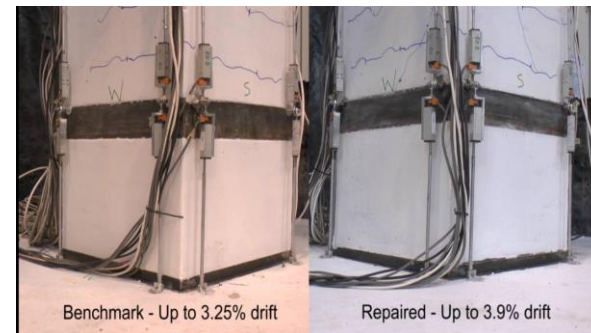
Royce Liu



Sam White



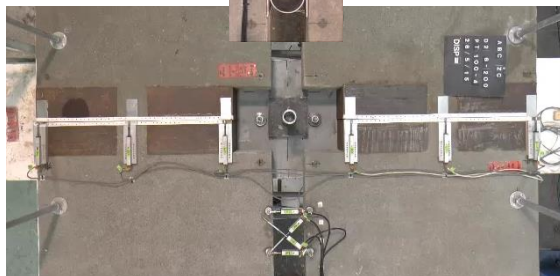
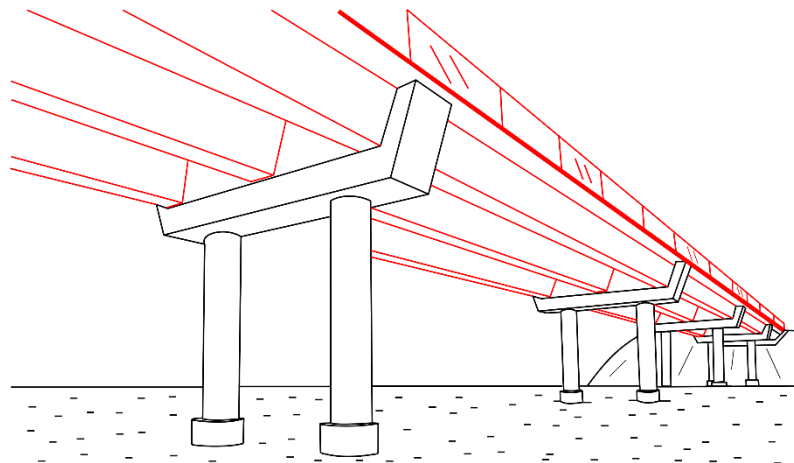
Mustafa Mashal



Recent Bridge Research at UC



Zeinab Chegini



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Recent Bridge Research at UC

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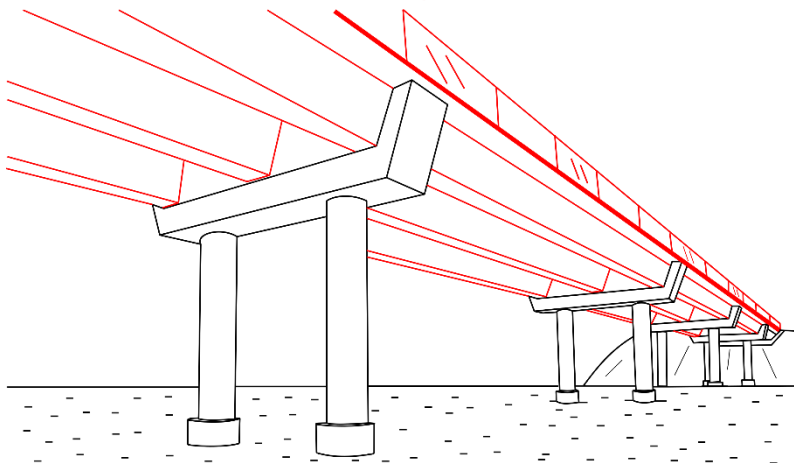
Action

Research to Date

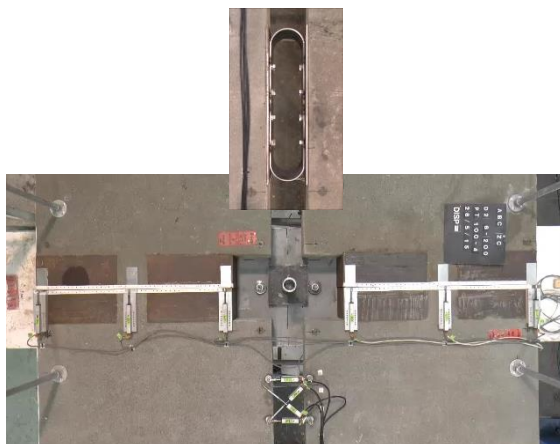
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Zeinab Chegini



T1-PT: Deck to Deck rocking 2.0% and 2.75% drift



Are there practical examples of research implementation?

Implementation: Wigram Magdala Christchurch

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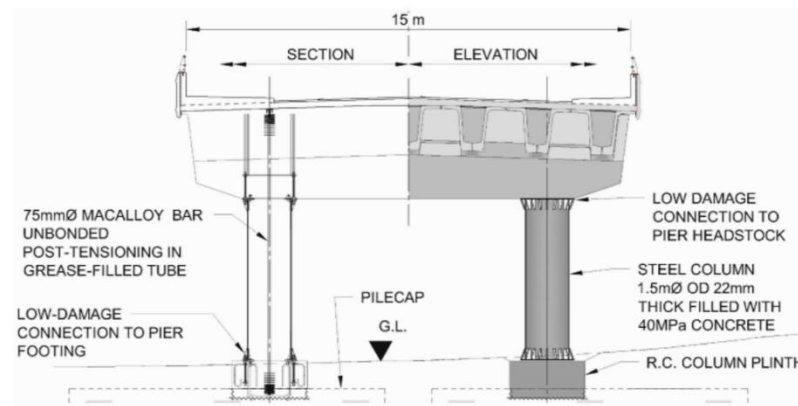
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Constructed 2016



Images courtesy:
M. Cowan, WSP-Opus



Implementation: Wigram Magdala Christchurch

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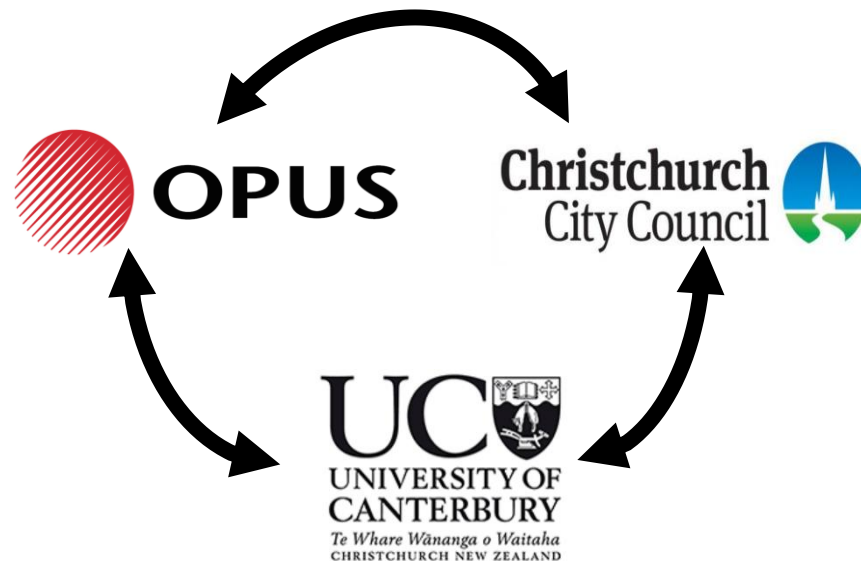
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Canterbury Bridge Group launched in 2011, more than 20 seminars and at least 10 Lab tours for the Industry

Examples of Accelerated Bridge Construction

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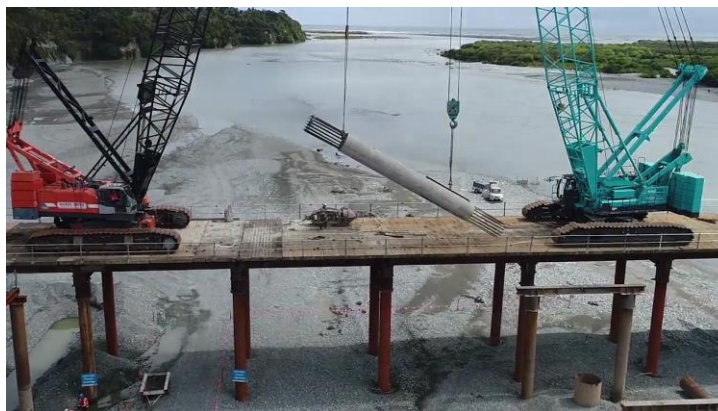
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Mackays to Peka Peka Expressway, 2017 (Khan, 2018)



Taramakau River Bridge, 2018 (Fulton Hogan)

Other Examples of Low Damage Technology

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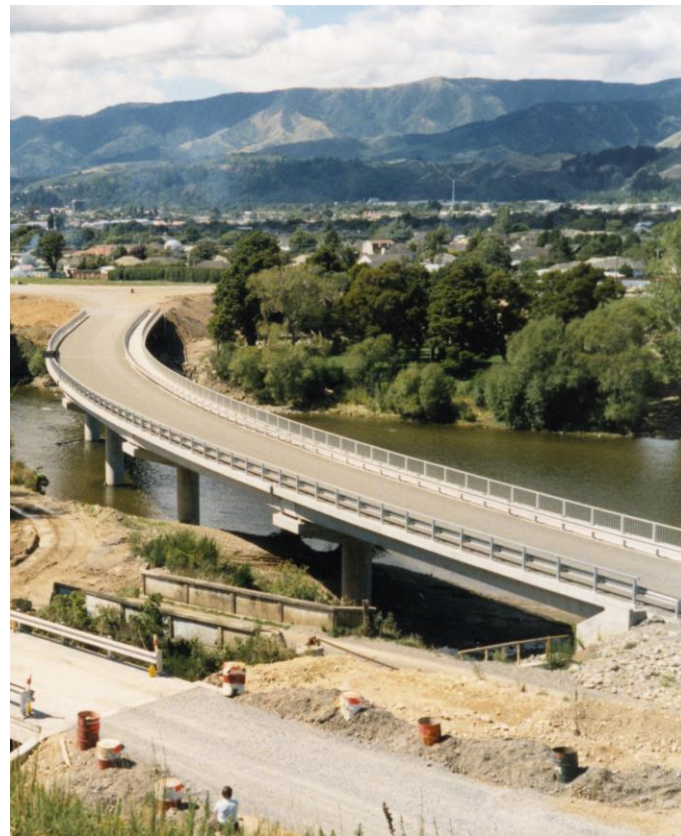
Conclusion



Rocking: Rangitikei Viaduct, built 1981



Base isolated: Maitai River, built 1988
(Wood, 2016)



Base isolated: Moonshine Bridge, built 1986
(Hutt Library Image Collection)

What is in-store for the future?

Short term: Climate Change

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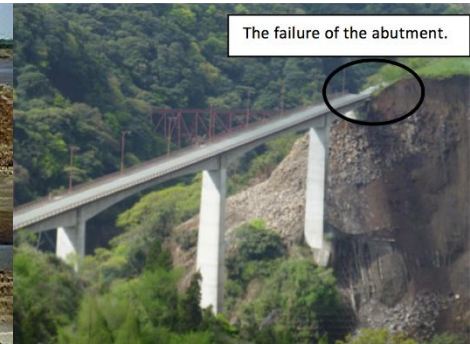
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The failure of the abutment.

Short term: Multi-Hazard Scenarios

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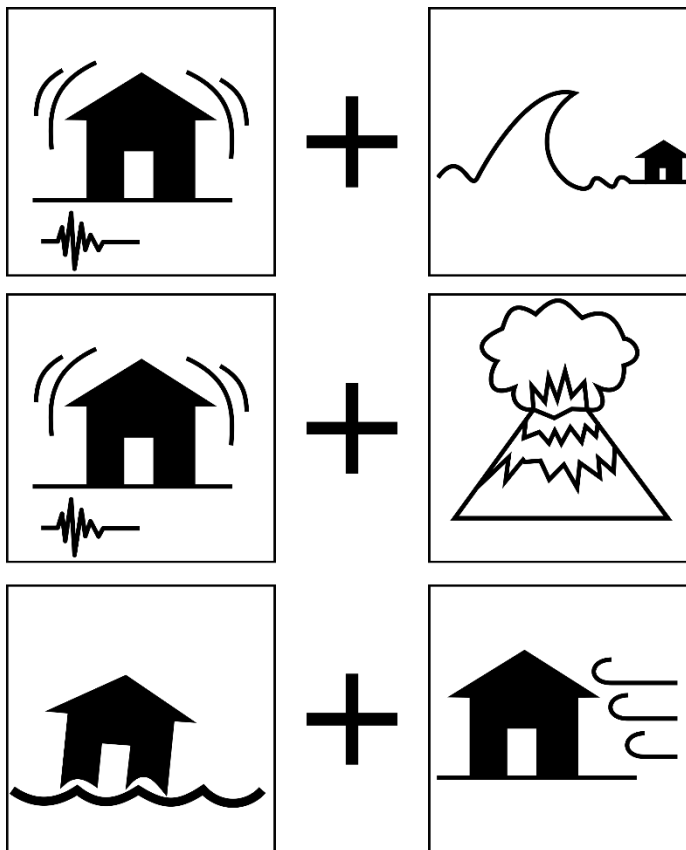
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Short term: Materials

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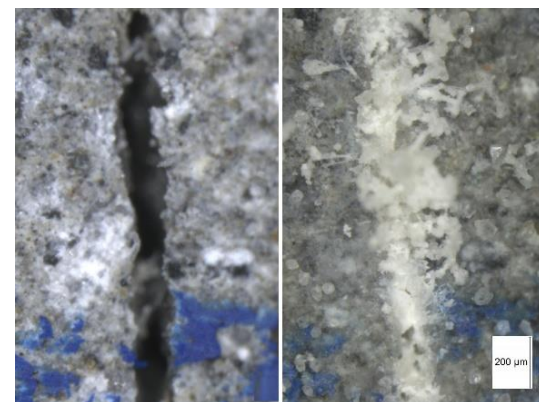
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Durable
Ultra High Strength/Performance
Recyclable
Adaptable



Long term: Sustainable Design

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Long term: Digital Fabrication

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Eindhoven University of Technology & Bam Infra, Netherlands

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Acknowledgements

