Infrastructure

Programme Title: Infrastructure and built-environment solutions
Programme Leaders: Professor Brendon Bradley (University of Canterbury) and Dr Liam Wotherspoon (The University of Auckland)

Programme Overview

This Infrastructure toolbox aims to develop an improved understanding of the resilience of spatially-distributed infrastructure networks to natural hazards through development of new methodologies fitted to NZ-specific infrastructure. We will develop an "infrastructure resilience rating" for various systems, that can be used to fine-tune and improve the resilience to natural hazards of the infrastructure serving a community. This system will be used to drive public policy in infrastructure investment and provide asset owners with knowledge of externalities when investing in building resilience.

Programme Outcomes

Contribution to Challenge Mission: In the face of NZ's unique natural hazard environment, and based on engineering science evidence, this toolbox will enable New Zealanders to anticipate critical infrastructure vulnerabilities, and protect and transform the built environment to support thriving communities.

Vision Mātauranga ("VM") outcome: Through partnering with the Vision Mātauranga Programme we will identify how infrastructure resilience directly affects Maori communities who may also themselves be infrastructure asset owners. The dependency of Maori communities on critical infrastructure is expected to differ to that of society at large. We will thus seek to understand how Maori communities can play a critical role in societal resilience as it relates to infrastructure network vulnerability.

10-year outcome: An infrastructure resilience rating methodology will be developed and applied through case studies to NZ-specific distributed infrastructure systems. Through the application of this methodology, the vulnerability of infrastructure systems to natural hazards will be demonstratively quantified, improvement measures well targeted to maximum effect, and the benefit of mitigating measures can be well illustrated to investors and communities.

5-year outcome: Infrastructure owners, and society at large, will be more resilient to extreme natural hazards as a result of actions taken (pre-disaster mitigation or planning for post-disaster rapid recovery) in light of the results of the analyses of direct and cascading consequences from distributed infrastructure networks.

Specific Projects within Programme

1. **Networks and Components.** This project aims to development risk-based methodologies to quantify the direct damage and resilience of large distributed infrastructure networks to multiple types of natural hazards.

2. **Network Interdependencies**. This project aims to advance risk-based methodologies of infrastructure networks from simply understanding the loss of service due to damage to network components onto understanding the cascading impacts which result from network service disruption, and ultimately impact societal resilience.

3. **Performance Measures and Impacts**. This project aims to develop a 'National report card' framework and an "infrastructure resilience rating" by which distributed infrastructure network resilience can be understood by the general public in order to lead to societally-driven and public policy improvements in resilience.

4. **Electricity Distribution Resilience Framework.** This project, funded from the Challenge's contestable funding process in 2017, is developing a novel electricity resilience framework, along with a realistic micro-grid restoration solution enabled through communication lifelines, following a significant Alpine Fault earthquake.