Faculty of Engineering, The University of Auckland

Hazard and Disaster Management

Helping rebuild communities from the lab to real life.
Disaster recovery - rebuilding

Our research helps communities prepare for, and rebuild after, a disaster. We understand what happens to soils during earthquakes, how buildings and other structures respond to earthquakes, how to optimise emergency responses to natural disasters, and how communities rebuild and recover after a disaster event.

Seismic Retrofit Solutions

The University of Auckland and University of Canterbury researchers have developed targeted cost-effective seismic retrofit solutions and advanced seismic assessment procedures to estimate building performance and risk to life from earthquake prone buildings. Simple and cost-effective retrofit solutions for each specific situation can then be identified for implementation. This work specifically addresses the unique characteristics of New Zealand’s buildings at risk from earthquakes.

OUR EXPERTISE

- Modelling and seismic strengthening of concrete-encased riveted steel frames
- Welded steel frames and steel moment frames with sliding hinge joints
- Seismic assessment and retrofit technologies for unreinforced masonry buildings which pose the greatest risk of structural collapse in an earthquake
- Dynamic characteristics of existing building foundations
- Overcoming impediments to implementation of seismic retrofit strategies by building owners.

Emergency Logistics - Real Time Analysis

We have developed software for efficient scheduling of emergency service staff and resources which is now commercially available through the Optima Corporation. (www.theoptimacorporation.com)

- The Predict software is a simulation-based planning system for determining the best base locations, dispatch rules, staff rosters and other operational policies to maximise ambulance effectiveness. This software can simulate both road closures and large scale incidents, and thus is useful when planning for effective operations of emergency services through civil emergencies such as earthquakes or tsunamis.

- The Live software is a real time dynamic deployment tool for decision support and resource optimisation. Using a mathematical optimisation model that includes current vehicle activities, incident rates and realistic travel times, the software provides dispatchers with minute-by-minute recommendations on how to best configure their vehicles to optimise future ambulance deployments. Its real-time analysis and visualisation capabilities can help dispatchers better manage their resources in both normal and crisis situations.

Resilient Organisations

Following a major disaster, conventional project management and construction industry approaches are not applicable to disaster recovery and rebuilding projects. The disaster affected regions usually face resourcing problems, such as shortages of building materials, lack of tradespeople, market inflation, and increased cost of rebuilding, all of which is likely to translate into frustration for communities as they attempt to recover.

‘Resilient Organisations’ is a six year research project designed to assist New Zealand organizations to recover economic competitiveness after hazard events by improving their resilience. (www.resorgs.org.nz)

Recovery and reconstruction has been extensively studied following the 2004 Indian Ocean tsunami in Indonesia, the 2008 Wenchuan earthquake in China, the 2009 Victorian ‘Black Saturday’ bushfires in Australia, the 2005 hurricane in New Orleans and the 2009 tsunami in Samoa.

In addition to examining the construction industry’s capacity and resourcing for rebuilding post-disaster, we consider all aspects of rebuilding. These include:

- Building code changes post-disaster and their impact
- Requirements for post-disaster legislative changes
- Incorporation of build-back better techniques into rebuilding
- Analysis of how urban environments change post-disaster
- Contractual processes for rebuilding.

These findings are key in helping communities rebuild following a natural disaster.
a community

When Solid Ground Turns To Liquid
The Geomechanics group of the University of Auckland is involved in many research activities geared towards understanding the response of soils due to earthquake shaking and on ways to mitigate damage caused by ground shaking, soil liquefaction, and other earthquake-induced instabilities.

MODELLING
One key research area is the investigation of the response of pile foundations and shallow foundations during seismic excitation through physical modelling, such as snap-back testing or using a mobile shaker, and numerical modelling. The results are used to develop an integrated approach to the seismic design of foundation-structure systems which can be used in making retrofit decisions and for the design of new structures.

GEOMATERIALS
Understanding the dynamic properties of geomaterials has been an important research activity of the group. We are investigating not only the cyclic properties and liquefaction characteristics of local soils, such as pumiceous and other volcanic-derived soils, but also those of iron sand and Christchurch soils. In addition, the small-strain behaviour of Auckland residual soils have been examined through on-specimen linear variable differential transducers and bender elements.

CLASSIFICATIONS
The group is actively engaged in the use of a non-intrusive method to characterise the properties of soil and rock. The Spectral Analysis of Surface Waves (SASW) method is conducted for the geotechnical classification of sites for seismic design. It provides soil properties for design to quantify the shear wave velocity of a range of representative sites and advances the understanding of the stiffness and dynamic characteristics of the soils.

From Lab To Real Life
The University of Auckland is involved in a range of laboratory and field testing research projects to try and better understand the response of structures to seismic loading. This research covers areas such as structural and foundation rocking, bridges, multi-storey buildings and soil foundation structure interaction.

CONTROLLED EXPERIMENTS
In the lab, facilities are available for testing the dynamic response of full and reduced scale structures and structural elements. Shake tables are used to apply an earthquake response to experiments to simulate the loading experienced during such events. Hybrid testing combines physically tested structural elements and numerical models, allowing sections of a structure whose response is less understood to be modelled physically and connect it to a numerical model of the remaining structure. This approach allows for full scale specimens to be tested without constructing entire structures in the lab.

FIELD TESTING
In the field a range of dynamic test methods have been used. Snap back testing and forced vibration testing using eccentric mass shakers have been used to apply dynamic loading. Ambient vibration testing using the vibrations from natural and human activity in the area has been used to determine the response of civil engineering structures. Buildings and bridges have been instrumented and tested in this way to determine their dynamic characteristics in real world conditions.

COLLABORATIVE APPLICATIONS
Researchers are working in collaboration with the Institute of Earth Science and Engineering (IESE) on the Borehole Instrument Centre at Eden Park (BICEP) project, a 383 m deep borehole instrumented with an array of seismometers to measure the vibrations of the surrounding soil and rock. This is part of the Strata to Structure project, whose aim is to develop a better understanding of the dynamic characteristics of the Auckland region from deep in the stratum up to the ground surface and into overlying structures.
The University of Auckland

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