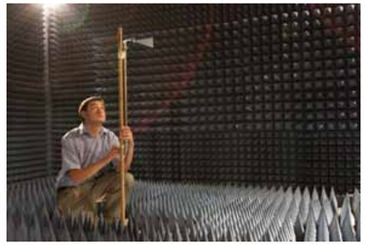


Wireless friendly buildings

The presence of interfering radio signals will always limit communication system performance. Researchers in the Department of Electrical & Computer Engineering, in collaboration with the University of Kent and the University of Manchester in the UK, are developing wallpaper-like materials that deliberately attenuate the passage of radio signals at specific frequencies, while allowing signals at other frequencies to pass through largely unaffected. Known as Frequency Selective Surfaces, these materials could be applied to the walls of a home or office to significantly reduce interference from rival communication systems nearby.

Research is being conducted on the most practical ways to deploy Frequency Selective Surfaces in buildings, and on quantifying the benefits to system performance. In conjunction with the research into radiowave interference modelling, new approaches to architectural and engineering design to create "wireless friendly" buildings are being explored so that a plethora of wireless systems might coexist without mutual interference. Similarly, techniques for designing buildings which deliberately prevent the propagation of specific frequencies, such as cellular telephony transmissions, in theatres or prisons are being investigated.

Indoor radiowave interference modelling for improved wireless communications

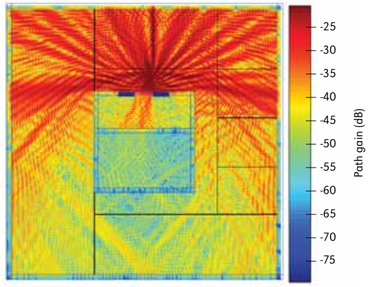
Recent developments in communications technology, such as mobile telephony and wireless local area networks, have been revolutionary. However, performance of wireless systems in indoor environments can be significantly constrained by electromagnetic interference between users attempting to use the same radio frequencies in close physical proximity. Radio propagation is influenced by building walls and floors, and modelling these effects provides insight on how interference might be mitigated via infrastructural modifications. The diverse nature of indoor environments and their very large size, in relation to the wavelengths of the radio signals, makes modelling extremely challenging.

Existing electromagnetic models are limited by extremely high computational load requirements which restrict the size of the area that can be modelled and involve excessively long processing times. In order to overcome limitations with existing modelling techniques this project aims to apply higher-order electromagnetic modelling techniques to these large scale problems. These techniques show promise in allowing very large scale propagation problems replicating real environments to be studied in a comprehensive manner. These models will be used to understand the mechanisms by which radiowaves propagate, from which simple, ie, effective, yet accurate models for use in infrastructure design and improved wireless communications deployment will be derived.

Design of composite floor systems for severe fires

Composite floor systems in office buildings are built to maintain structural integrity in severe fire through passive fire protection techniques. We have optimised the Slab Panel Method of designing composite floor systems to identify those parts of the structure requiring insulative fire proofing and those that do not. This means that only those areas that are critical for support of the structure require fire proofing, while non-critical regions can be left unprotected, resulting in significant cost savings during building construction.

This project has been ongoing for 10 years and involves collaboration between The University of Auckland, the University of Canterbury, BRANZ and the steel, composite steel and concrete industries through the New Zealand Heavy Engineering Research Association (HERA).



Radiowave propagation coverage map in the presence of a steel-reinforced concrete services core in in the Faculty of Engineering building.

Sediment flux in the Tongariro River

Catchment management is dependent on accurate understanding of sediment movements and associated system adjustment. The primary aim of this research is to analyse relationships between river flow and sediment fluxes along the Tongariro River, highlighting the implications of this work for river rehabilitation planning. In this work, we are combining engineering, hydrological and geomorphological methods across multiple spatial and temporal scales in order to:

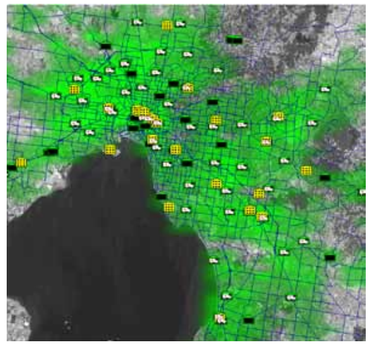
- provide a framework for interpreting complex morphological responses to river flow and sediment flux
- understand factors that act as controls on how river systems adjust and what they are responding to.

Analysis of the identified relationships over the last 50-100 years for the Tongariro River will be used to predict likely future adjustments of the system, providing a physical platform for process-based rehabilitation of the river. This is a collaborative project between the Faculty of Engineering and the School of Environment.

Optimised ambulance scheduling

This research has focused on developing software for efficient scheduling of emergency service staff and resources and is now commercially available through the Optima Corporation.

A simulation-based planning system has been developed for determining the best base locations, dispatch rules, staff rosters and other operational policies to maximise ambulance effectiveness. A real time dynamic deployment tool for decision support and optimising resource use has also been developed. Realistic travel times for specific vehicles, vehicle capabilities, and deployment recommendations are all incorporated. The software helps dispatchers by giving minute-by-minute recommendations on how to best configure available vehicles to optimise future ambulance deployments.



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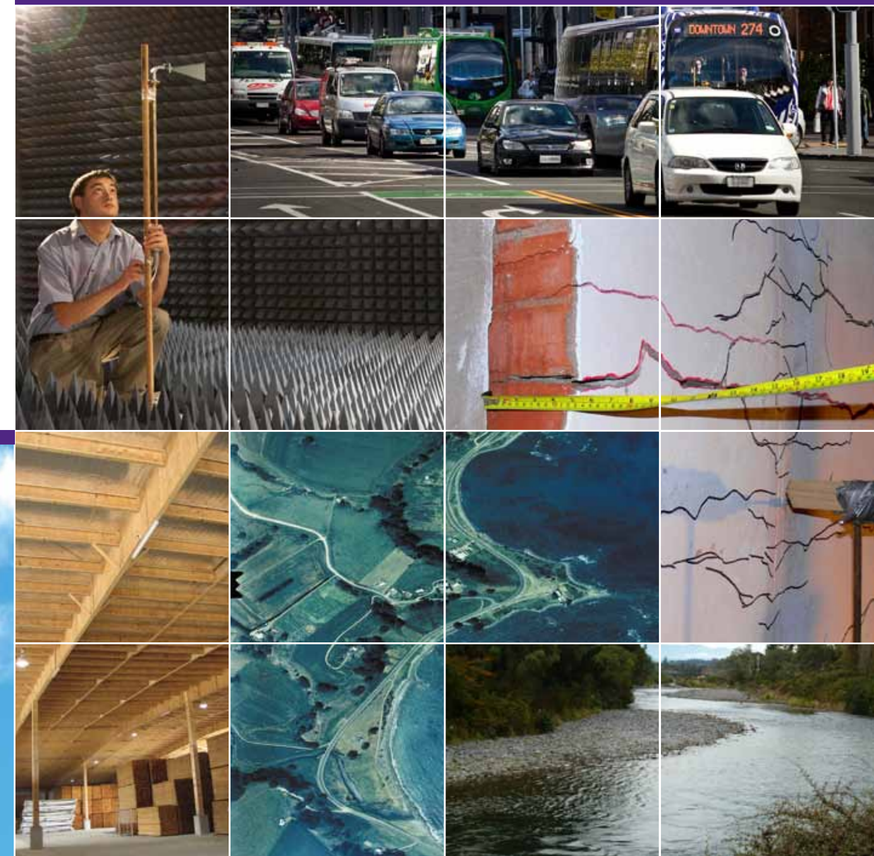
Infrastructure and Environment Research Theme



Introduction

The main challenge that the Infrastructure and Environment research theme faces is to enable the development of high performing infrastructure while minimising its impact on the environment.

By 2030 New Zealand's population will have increased by 22% to 5 million, with 62% of that growth occurring in the Auckland region which will have a population of 2 million[1]. Globally, world population will have increased by 20%[2], 60% of people will live in urban areas[2], and many of these people will not have access to clean water, good telecommunications, power, transportation or suitable buildings.

In consultation with independent research and industry interests, a set of focus areas have been developed for the Infrastructure and Environment theme. These include:

- **Buildings and structures:** developing resilient solutions for buildings and bridges subjected to severe earthquake; developing standard and agreed tools and systems for life cycle costing and measurement of energy efficiency, including energy efficient building materials and solutions; improving the resilience of infrastructure to the effects of climate change, extreme natural events and fire
- **Transportation:** ensuring the safe and efficient movement of people and goods by land, sea, and air; planning, design, construction, maintenance and operations of transport systems including their economic, social and environmental impact; better management of New Zealand transport infrastructure
- **Water, power and telecommunications:** ensuring better storm water management; improved water quality; improving telecommunications design, delivery and management; improving power transmission
- **Environment and sustainability:** improving sustainability assessment and technology; developing clean technologies; minimising waste from infrastructure development; improving use of natural resources in infrastructure development; ensuring the sustainable use and management of New Zealand rivers.

1 National Infrastructure Plan 2010, www.infrastructure.govt.nz/plan/mar2010

2 World Urbanisation Prospects, The 2007 Review, UN 2008, http://esa.un.org/unup/

A selection of programmes and projects

Construction industry productivity

The construction industry is one of the largest and most important in the New Zealand economy, employing over 8% of the workforce, while the built environment represents a national investment valued at over $430 billion. The Building Research Association of New Zealand (BRANZ) have invested $550,000 in a collaborative joint venture between The University of Auckland, Massey University, Auckland University of Technology and industry to study productivity issues in the New Zealand construction industry. This research programme brings together a number of research projects into a coordinated initiative with the objective of delivering improvements in sector performance.

Current projects under this programme are:

- improving information flows across the industry
- proposing better ways of managing skills, training and recruitment
- reducing defects and waste in the construction sector
- improving construction procurement practices
- incorporating constructability into planning and design
- improving logistics management.

The programme makes use of a combination of skills in areas of construction management, communications, education and training, procurement and strategy analysis.

Seismic retrofit solutions

This programme has 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 are then identified for implementation. This programme has developed a body of knowledge and expertise in targeted seismic retrofit techniques that specifically address the unique characteristics of New Zealand's buildings at risk from earthquakes.

Specific areas of focus are:

- seismic zonation and default suite of ground motion records for time-history analysis in New Zealand
- detailed seismic assessment and retrofit technologies for unreinforced masonry buildings
- modelling and seismic strengthening of concrete-encased riveted steel frames
- studies on the dynamic characteristics of existing building foundations
- understanding and overcoming impediments to implementation of seismic retrofit strategies by building owners.

This project has involved collaboration with the University of Canterbury and with steel and concrete industry representatives and companies.

Allen's Trading Complex building, Gisborne, badly damaged in the 2007 earthquake. This image shows crack patterns that developed after implementing and testing a low intervention and low cost technique used to strengthen unreinforced masonry buildings against earthquakes.

Endocrine disrupting chemicals (EDCs)/pharmaceuticals and personal care products (PPCPs) in the environment

EDCs and PPCPs occur ubiquitously in the environment and have the potential to affect animal growth and developmental and reproductive outcomes, though little is known of their effect in the New Zealand situation. This project focuses on assessing the risk to the New Zealand environment from EDCs and PPCPs by characterising their sources, degradability in treatment systems, pathways of transport, and impact on receiving environments.

This study is:

- developing analytical techniques for measuring concentration and toxicity of EDCs/PPCPs
- monitoring EDC/PPCP sources and identifying priority compounds
- assessing performance of biological treatment processes
- assessing the affect of including an additional treatment step to degrade EDCs/PPCPs.

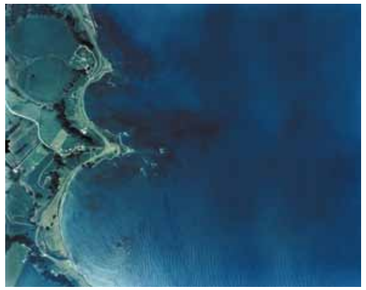
This project brings together expertise in fate and transport processes, microbiology, toxicity assessment, reaction kinetics and wastewater treatment.

Timber group

The timber research group mission is to support the timber construction industry through research and education for the advancement of non-residential timber construction within New Zealand and abroad. It does this through the dissemination of its research results but also through a dynamic research environment.

Its principal research areas are:

- connections for timber structures
- long span single storey roof systems
- material characterisations
- long term serviceability effects on connections
- new product development
- design standard advancement.



Transportation research

Transportation research is focused on identification, development, analysis and implementation of innovative solutions and new technology to persistent traffic and transportation problems.

A sample of the projects undertaken by staff from the faculties of Engineering, Business and Economics, Science and the School of Population Health includes:

- travel time and delay studies on major Auckland City routes to investigate congestion levels
- evaluation of the operational efficiency of different intersection types
- developing a framework for public transport connectivity measures
- modelling vehicle types for public transport timetables and vehicle scheduling
- improving travel time predictability using ITS tools
- investigating driving behaviour.