

In-Touch

Opus Central Laboratories

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STAYING IN TOUCH

Opus Central Laboratories has a proud history. Originating from the Ministry of Works more than 50 years ago, it was formed to undertake experimental research to inform the design and construction of major national infrastructure projects such as hydro-electric dams and state highways.

Today, Central Labs undertakes a broad range of research, consultancy and laboratory services for the infrastructure sector. We are a member of the Independent Research Association of New Zealand (www.iranz.org.nz) and, like all members, we have an excellent track record of delivering valuable services for our clients.

We've created the In-Touch newsletter to provide regular news on projects we have been working on and the services we offer.

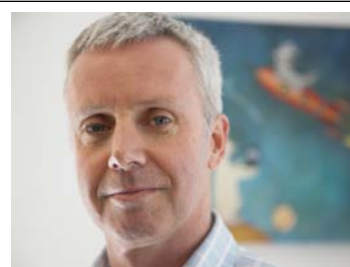
In this, our first issue, we cover our work relating to natural hazards such as earthquakes and how we are contributing to the Christchurch re-build. We have been particularly active in the seismic investigation

of buildings in a number of urban centres since the Christchurch earthquakes and there is a story on our specialist services relating to assessing concrete structures. We also profile our Roding Laboratory's services, as well as some of our recent transport research on the use of software to reconstruct vehicle crashes and to evaluate the crash potential of roads.

I hope you enjoy reading these articles and find them useful. We'd love to hear your feedback and if you have any queries, please don't hesitate to contact me at peter.benfell@opus.co.nz or one of the team at Central Labs.

PETER BENFELL

Manager, Central Laboratories





NATURAL HAZARDS RESEARCH

A movement away from building new infrastructure in the 1990's also led to a shift in natural hazards research, towards finding out what people need from their infrastructure and how they interact with it.

As an already established leader in this area, Central Labs also shifted its focus, developing a new body of research around the behaviours and social economics of how New Zealand communities would respond to and recover from the impacts of a natural disaster.

At the time of this shift, there had been no recent events in any of New Zealand's major population centres to draw on, so new research methods that mimicked the style of some computer games were developed.

These methods tested people's behaviour – such as their trust in different media for information, their travel behaviour, the extent they would follow authority after an event and how quickly they would return to work – when faced by situations they had never experienced before. Business behaviours were also an important part of this research – their potential for recovery, the likelihood they would migrate from damaged areas and the future functioning of the businesses.

The Gisborne earthquake of December 2007 was an opportunity to validate the results of this research and extend it, using a real-life experience,

especially when it came to the impacts on business and its long-term recovery.

The Christchurch earthquakes have become the research programme's main focus and this effort has become part of the Natural Hazards Research Platform.

The Platform was started in 2009 and brings together the knowledge and research capabilities of the organisations that were then carrying out natural hazards research funded by what was then known as the Foundation for Research Science and Technology (now part of the Ministry of Business, Innovation and Employment). The Platform's members are GNS Science, NIWA, Massey University, the University of Auckland, Canterbury University and Opus Central Laboratories.

Total funding for the Platform is around \$14 million a year for a 10 plus 10-year timeframe, with an additional \$3 million a year for the next four years added to draw lessons from the Canterbury earthquakes.

This long-term funding allows a more strategic approach to setting research priorities, as well as the opportunity for members to support the development of research capabilities in emerging areas of new research.

Currently the research falls into five themes: geological hazards; weather-related hazards; modelling and analysis to link these hazards

to risk; building and infrastructure engineering research; and societal research.

There have been opportunities for new research within the Platform and Central Labs is part of two new projects. The first is the improved modelling of wind flows across hilly terrain (see page 5), which is significant when designing buildings in high-risk areas and also has spin-off benefits for wind farm modelling. The second investigated acceptable levels of risk for older commercial buildings, an area that is now under more scrutiny after the damage from the Christchurch earthquakes.

The Natural Hazards Research Platform provides Opus, as a major infrastructure and planning consultancy, with a number of significant opportunities. The new knowledge, methods and innovations, plus the easy access to this expertise provided by Opus' participation in the Platform, will benefit its international and local projects.

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DYNAMICS OF URBAN RECOVERY

Rebuilding Christchurch's CBD is estimated to take up to 20 years. Understanding the spatial dynamics of economic activity in the wake of the earthquakes will help inform the rebuilding process in the short term as well as have an impact on risk analyses and economic models in preparation for future events.

Underpinned by funding from the Natural Hazards Research Platform, Central Labs has embarked on a long-term research project to identify these patterns of economic recovery.

Since the February 2011 earthquake, the CBD has been largely cordoned off and businesses originally located there have moved to other parts of the city or country, or closed down. At the same time, identification of earthquake-prone buildings in the suburbs has also forced some non-CBD businesses to look for new premises.

As a result, the city's suburbs have experienced a large influx of office-based businesses taking on previously under-utilised commercial properties.

Other less mobile industries such as hospitality, however, have seen significant reductions in employment within the city.

For the first stage of the Central Labs' project, researchers analysed secondary data sources relating to business relocations, economic activity and business demographics, using Geographic Information Systems (GIS) to map the spatial patterns prior to and since the earthquakes started in September 2010.

So far, the evidence has shown a significant shift away from the CBD as well as the eastern and southern sides of the city in favour of the suburban centres west of Colombo Street. The next stage will focus on learning from business owner-managers about the reasons behind these shifts and their likely implications for the rebuild.

In the short term, understanding these spatial patterns of economic activity could help identify potential problems within the rebuilding process that can then be quickly addressed through

policy interventions. Longer term, in a country such as New Zealand that has population centres at risk from a range of hazard events, knowledge of the wider economic impacts could help enhance recovery and mitigation planning.

The researchers are working closely with the Canterbury Earthquake Recovery Authority and the Christchurch City Council throughout the project and will continue to scrutinise secondary data sources as the city's recovery progresses.

Felicity Powell

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ASSESSMENT TIME

It may look indestructible but even concrete deteriorates. Corrosion, impact, structural overloading, freezing and thawing, abrasion and chemical attack can all affect concrete's condition, which in turn affects how well many structures do the job they were built for.

This is why Central Labs' independent service for the condition assessment, maintenance and repairing of concrete structures is so valuable.

Combining detailed visual inspections with specialist instrumented testing, the concrete assessment service can establish the cause and the extent of deterioration, and it has been used on everything from buildings to bridges, marine structures to sewage reticulation and treatment facilities.

These specialised assessments are increasingly used as a valuable asset management tool. Not only can they be used to identify immediate action for structures that have obvious deterioration, but they can also be used to predict when deterioration is likely to occur in structures that seem to be in good condition, as well as to determine the ongoing maintenance requirements.

It's an ideal basis for developing short or long-term maintenance and repair strategies, taking into consideration the most technically appropriate and cost-effective options for that particular structure and the needs of its owners.

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THE CHRISTCHURCH EFFECT

The Christchurch earthquakes have already left an enduring legacy and more changes are no doubt still to come as a result. One of the effects has been an increased focus on the seismic assessments of buildings, especially in Wellington.

As a result, Central Labs has seen a significant increase in materials testing services to support seismic evaluation. These include a wide range of measurements, from determining the size and space of reinforcing steel to hardness testing of in-situ reinforcing bars, and a number of tests have been carried out to assess the fixity of facade elements.

All these tests bring together skills in the structural testing and concrete technology areas at Central Labs, both of which are part of the Asset Performance group led by Sheldon Bruce.

CASE STUDY

Tutaekuri (Waitangi) Bridge, Hawkes Bay

Central Labs was called in by Opus Napier working on behalf of NZ Transport Agency to carry out a condition assessment on the Tutaekuri Bridge in order to determine its current condition, future corrosion risk and residual life. The 1930's structure had been extensively repaired in the 1990's and the question now was whether it could be further refurbished or needed to be replaced.

While assessment confirmed that the bridge could be successfully maintained for at least another 20 years with further patch repairs, Central Labs used Structural Health Monitoring (SHM) techniques to

further alleviate any concerns about its future structural performance.

SHM has just been installed on Tutaekuri Bridge based on initial monitoring of its vibration response under a known truckload using MEMS (micro sized) accelerometers. These accelerometers will be permanently installed on the bridge to provide a continual record of the bridge's response under traffic.

SHM is a relatively new technology in New Zealand and, through Central Labs' work, Opus is keeping up with advances in technology to offer clients a comprehensive service relating to structural performance.





WIND SPEEDS AT HILLY SITES

The same factors that make New Zealand an ideal location for generating wind power - the hilly geography and its location in the path of the “roaring forties” - also mean that wind loadings are an important consideration when it comes to our building codes.

Hill shape has a huge effect on wind speed, and can increase its force up to three-fold compared to flat terrain nearby. This makes the hill shape multiplier very important when taking wind actions into consideration for constructing buildings and structures on hilly sites.

Central Labs is part of the New Zealand Wind Engineering Research Consortium, which is investigating how to reduce the vulnerability of built infrastructure to wind damage by improving design wind speed analysis

procedures. The other members of the consortium are NIWA, University of Auckland and GNS Science. The consortium has received funding from the Natural Hazards Research Platform (see page 2) to undertake this research.

In 2011 the consortium investigated the wind speed hill shape multipliers measured at a line of nine anemometer masts in Belmont Regional Park near Wellington. Wind speeds were also predicted with computational fluid dynamic computer modelling and wind tunnel testing in order to compare the results to the existing loading standard.

Central Labs performed the wind tunnel testing for this project.

While the results from all three research components were generally

in agreement, they differed from the wind speed hill shape multipliers calculated through the existing loadings standard. Differences in the way that the organisations interpreted the standards also created marked differences in the multipliers they calculated.

These comparisons will be used to provide a database of information to improve analysis procedures used by structural engineers to calculate design speeds for hilly sites.

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STUDENTS IN ACTION

Part of our funding from the Natural Hazards Platform is used to sponsor post-graduate students whose studies complement our work programme. One of these students is Abi Beatson who is currently researching and writing her MA in Media Studies at Victoria University.

Abi has a professional background and expertise in social media and communications management. Her main professional interests are the efficacy of networked organisational practices; the development of networking for social, environmental and ethical businesses and organisations; and the use of crisis mapping and crowd sourcing technologies in disasters and emergencies.

Her Masters thesis is titled 'Social Media, Information Flows and Crisis Mapping: Information Sharing Practices in Response to the Christchurch Earthquakes'. Her research is focusing on information flows, directed through and utilised by crisis mapping, during the initial recovery period of the 2011 Christchurch earthquakes.

Abi has also taken a strong interest in, and is working towards, crisis mapping for disaster preparedness, mitigation and resilience in her hometown of Wellington.

Abi Beatson

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THE VALUE OF PREVENTION

An important part of preventing deaths on the road is being able to understand and model crashes to find out why they happened and whether the road design can be improved to help prevent future similar crashes.

Of course, because of the safety issues, it's often not practical to do full-scale testing to determine this. PC Crash fills this gap.

Central Labs has been using this internationally recognised 3-dimensional (3D) vehicle crash and trajectory simulation package as a research tool since 2010.

In PC Crash, 3D road models can be imported as CAD files or created from scratch and then road geometry, road conditions, vehicle models, their paths and speeds and much more can be defined. The simulations can then be run to produce a variety of 3D

animations, 2D plans, tables or plots, or detailed reports, and repeated with different model conditions.

In particular, Central Labs has used PC Crash to research the effect of changing crossfall on vehicle stability, vehicle loss of control during cornering as a function of speed, and the effect of raised profile marking on motorcycle stability.

Central Labs' successful use of PC Crash in these three applications proves the software has a role to play in evaluating the design and crash potential of new and existing road construction, especially where topographic constraints can force significant design compromises.

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NEW TO THE TEAM



Dr Vivienne Ivory joined Opus in May as an urban studies researcher. She has a PhD in public health from the University of Otago and was previously a principal investigator on the Health Research Council-funded Health Inequalities Research Programme. Vivienne brings with her experience gained from working in the multi-disciplinary field of neighbourhoods and health, examining the relationships between where people live and their health. Vivienne also maintains a part-time research role at Otago's Wellington campus.

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Dr Joel Burton recently returned to New Zealand after completing his PhD in psychology, a study funded by the UK Ministry of Defence that investigated the use of auditory warnings to improve pilot performance in time critical situations. He joined Opus in August as a researcher in the Behavioural Sciences team.

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Bill Graham started as a technician in the Roding Laboratory in August. He has extensive laboratory experience and spent the past 14 years atASUREQuality as a Chemical Analyst working in a Regulatory Laboratory testing foodstuffs.

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BLACK GOLD

Throughout history, it's been used as a sealant, adhesive, building mortar, incense and decorative application on pots, building or human skin, but in modern times bitumen is most recognisable as a major component in our roads.

Bitumen is a naturally occurring organic byproduct of decomposing organic material which is separated from other components in crude oil by distillation. It needs to be tested extensively to ensure it meets the necessary standards before it is used in such essential infrastructure.

This is where the Roding Laboratory at Central Labs comes in – it has a long history of providing standard and specialist testing for the roading industry. The Roding Lab is also one of the few laboratories certified by International Accreditation New Zealand (IANZ) to test asphalt cores using the Parafilm method, a requirement of the New Zealand Transport Agency's P9 specifications.

Staff members Gary Bentley and Bill Graham have extensive knowledge of both testing in the field and in the lab, while Phil Herrington brings specialist

chemical knowledge and testing. All of which has also helped the Roding Lab develop a strong track record of new product development.

Recent work with Transfield Services on the Wainuiomata Hill Road is an example of this skill and knowledge in action. The project included basecourse testing using a Benkelman Beam and a Nuclear Density Meter, along with various lab tests. During compaction of the asphalt, nuclear density testing was used to ensure adequate compaction had been obtained. Samples of the asphalt were also tested in the Laboratory. This was also followed later with texture measurements through the use of sand circles and British pendulum testing.

It's the Roding Lab's ability to use best practice in order to ensure quick and efficient turnaround, as well as the ability to work in conjunction with the Concrete and Soil Laboratories, that can really add value to any contract.

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