



PERFORMANCE ASSESSMENT AND MONITORING OF BRIDGES

Live-load testing on the Kawarau Bridge

THE INCREASED PRESENCE OF 53-PLUS TONNE (HPMV) VEHICLES ON NEW ZEALAND ROADS HAS PROMPTED THE NZ TRANSPORT AGENCY TO INITIATE A MAJOR PROJECT INVOLVING ANALYSIS AND STRENGTHENING OF BRIDGES TO ENSURE THEY CAN ACCOMMODATE THESE LARGER LOADS ON DESIGNATED ROUTES.

Many bridges throughout New Zealand – and globally – were constructed during the 1930s and 1940s. These structures are now, by and large, nearing their design life and taking loads and traffic volumes far in excess of those for which they were built.

The NZ Transport Agency has commissioned Opus Research to obtain performance data for many of these bridges. We have so far completed assessments for bridges in Southland, Canterbury, Marlborough, Nelson, Wellington, Manawatu, Taranaki, Waikato, Hawkes Bay and Bay of Plenty.

...continued on back cover

IN THIS ISSUE

- 2** *Innovation in pavement testing*
- 3** *Next generation public transport*
- 4** *Performance assessment and monitoring of bridges*
- 4** *New to the team*

INNOVATION IN PAVEMENT TESTING



Shaun Cook: Pavements Research Laboratory Technician



Section through basecourse sample showing tyre, rut in asphalt surface and laser line measuring system.

SHAUN COOK: PAVEMENTS RESEARCH LABORATORY TECHNICIAN

Shaun Cook undertakes many of our clients' pavements testing work on the ORAPT machine. Shaun joined Opus Research twelve years ago, and initially undertook quality control testing of roading materials for local authorities and contractors.

Shaun has gained extensive knowledge of roading surfaces, roading construction, and quality control of hotmix testing and bituminous materials. His technical skills include bitumen, asphalt and aggregate testing, nuclear density meter operation, Shaketable testing, and compression/tension testing, as well as bridge conditioning assessment work.

Shaun is also involved in both new development projects and site investigation work. Shaun is also heavily involved in testing of underground services for the MBIE Underground Service project. This involves investigating pipe joints and water meters – including how they fail – by using our large in-house shaketable to simulate earthquake effects.

Shaun Cook

e. shaun.cook@opus.co.nz

OPUS RESEARCH'S ACCELERATED PAVEMENT TESTING MACHINE (ORAPT) IS A CENTRAL PIECE OF APPARATUS WITHIN OUR PAVEMENT MATERIALS AREA.

Designed and built as a full scale loading device that requires just a small pavement sample size (1.5 tonnes), the apparatus is used to test responses of compacted granular pavement materials (basecourse) and pavement designs under a range of real life tyre loads.

We use six lasers to measure the rate and depth of rut formation. Photographs of the laser lines relative to a fixed position datum are captured across the wheelpath as testing progresses, and image analysis software is then used to determine the shape and size of the ruts that form. We also dissect samples at the end of test runs to analyse shear around the rut indentation.

Accelerated pavement testing devices can be either large and expensive to operate, or use small scale tyres sometimes made from solid rubber. By comparison, our instrument uses actual full scale tyres and loads but is relatively small in physical size, enabling us to keep testing costs low, but without introducing unwanted scale effects. The default wheel and tyre

combination consists of an AUSTROADS-adopted standard truck tyre and wheel, but this configuration can easily be modified as needed. Loading is typically 10-20kN, although the device has capacity for vertical loads up to 40kN in almost any increment.

The tyre load is usually applied only in one direction of travel at 1.35 km/h, although bidirectional loading and varied speeds are also available.

Previously the device has been used for research into pavement compaction methods by varying the magnitude of compaction stress during pavement construction. This gave a better understanding of how to minimise the occurrence of post-construction deformation (rutting) in thin chip sealed pavements.

A current study involves investigating the addition of Geogrids and Geocells to low-cost aggregate basecourse. Results so far indicate that while rutting initiates very quickly in samples without Geogrid, asphalt surfacing can significantly reduce rutting rates. Adding Geogrid can slow rut formation by up to 50%.

We encourage you to get in touch with our Pavements Research Team for more detailed information on the benefits our small-scale accelerated pavement testing device can deliver for your specific pavement testing requirements.

Steve Bagshaw

e. steve.bagshaw@opus.co.nz



Opus Researcher Courtney Jones

NEXT GENERATION PUBLIC TRANSPORT

OPUS RESEARCH SOCIAL SCIENTISTS HAVE BEEN EXAMINING THE NEEDS OF THE 'NEXT GENERATION' OF PUBLIC TRANSPORT USERS AS PART OF A PROJECT INITIATED BY THE NZ TRANSPORT AGENCY.

There has been an internationally recognised growth in public transport use, and reduced rates of car ownership, by Generation Y (aged 15-35 years) compared with rates for previous generations. But why has there been such a change? Is it an ongoing trend? How might investment better align with changing customer needs?

To answer these questions, our team tracked existing national and international travel trends amongst members of Generation Y, and ran focus groups to better understand their specific transport needs. We also surveyed 1191 travellers about their likely future demand for public transport under targeted future scenarios. Future demand prediction is difficult, so innovative methods were applied to improve the robustness of the eventual

predictions. Life change scenarios were used to step travellers through major life phases and to predict future travel patterns under these changes. Responses were adjusted to offset over-representation of future use, to minimise known gaps between intended and actual travel behaviours.

Top service improvements to attract and retain Generation Y are the same as older age groups, particularly service frequency and coverage. Once the basics are right, more specific changes become desirable for Generation Y – including smarter pricing mechanisms that reward high-use or provide users with a 'win' (e.g. free transfers), and improved real-time information to support rider experiences.

This study adds to a body of evidence showing that there will be sustained growth in public transport use, led by younger patrons. People increasingly see public transport as a viable option, but to realise this underlying demand and growth, lead-investment opportunities will need to be taken, and transport policy (particularly investment shifts at the national level) will need to occur.

Jared Thomas
e. jared.thomas@opus.co.nz

THE STUDY FOUND:

- Public transport share of Generation Y's main trips (work/education) is predicted to increase from 35% to 54% with key service improvements introduced.
- Generation Y's demand for public transport use for other trips could more than double, from 19% to almost 50% with improvements such as off-peak route upgrades introduced.
- Generation Y respondents indicated an increased desire to increase travel by active modes (cycling, followed by walking), with public transport coming third.
- Approximately 90% of Generation Y respondents expect their travel patterns will change over the next 5 years (as opposed to 50% in the older group).
- Key life stages should be targeted for positive travel interventions, such as moving house, or starting a family.

PERFORMANCE ASSESSMENT AND MONITORING OF BRIDGES

...continued from front cover

The work has been carried out by our bridge monitoring team along with our wider Opus team to facilitate effective response to bridge monitoring requests globally.

Our bridge monitoring team's most frequently requested work involves measurement of material strengths using steel hardness testing and concrete core testing. This allows actual strength values to be used in structural analysis instead of conservative default values.

In some cases durability assessments have been carried out to understand the remaining service life of the bridges and the viability of strengthening if required.

Instrumentation of a structure's response under live loads has also been carried out for some structures. This work ties in with an in-house R&D project to develop a cost-effective structural monitoring system for road and rail bridges. We are developing low cost instrumentation and an understanding of instrumentation options for gathering dynamic structural data to provide cost-effective monitoring solutions.

A major project we are currently undertaking involves determining whether the 144-span Rakaia River Bridge in Canterbury can carry HPMV loads



or requires strengthening. Our bridge team is monitoring dynamic structural deflections, which are correlated with live-load calibrations and data from a weigh-in-motion platform installed by the Transport Agency. We are also developing a software model in conjunction with

Victoria University to see whether we can develop a 'bridge-specific impact load function' that is transferable to other bridges of similar design.

Richard Curtis
e. richard.curtis@opus.co.nz

NEW TO THE TEAM



PAM ILLINGWORTH

Pam is our new Office Manager. She recently returned to New Zealand – and her home city of Wellington – after 21 years in Australia. Pam has worked in a variety of industries during her career, including the professional

sports arena, aviation, executive consultancy and not-for-profit sectors. She also brings engineering sector experience to her Opus Research role from a previous position with the civil engineering department at the University of Western Australia in Perth.

e. pam.illingworth@opus.co.nz



ANNA DAVISON

Anna has recently joined Opus as a researcher in the Behavioural Sciences team. Anna has 6 years' experience as a human factors researcher specialising in transportation, and has previously worked as a clinical researcher at

Bristol University in the UK. Formerly a registered general and sick children's nurse with nine years' nursing experience, Anna also has a BSc in Psychology with Ergonomics from Loughborough University.

e. anna.davison@opus.co.nz

Opus Research

33 The Esplanade, Petone
PO Box 30 845, Lower Hutt, Wellington, New Zealand
t. +64 4 587 0600 | f. +64 4 587 0604

Opus International Consultants
www.opus.co.nz/opus-research