OPUS

In-Touch

Opus Research

Issue 3, June 2013

IN THIS ISSUE

THIS ISSUE OF IN-TOUCH FEATURES SOME OF OUR RECENT ROAD SAFETY RESEARCH.

Opus Research has undertaken a wide range of road safety research often providing a strong multi-disciplinary approach.

Also profiled in this newsletter is our comprehensive structural testing facility which has the capability to test a variety of materials and products under simulated loads, giving clients an independent assessment of structural performance.

Many of you will know we recently rebranded as Opus Research after more than 50 years as Central Laboratories. The new name reflects our strong applied research base which is complemented by our various specialist consulting and laboratory services. We've received a lot of positive feedback about this new name.

We have recently revised our website, and also produced a new brochure outlining our current research and services. You can source a copy of the brochure at www.opus.co.nz/opus_research/publications/

Plans are well underway for our move in late 2013 to modern premises on The Esplanade in Petone, Lower Hutt. We're thrilled with the prominent and convenient location, and with the opportunity the building provides to physically integrate our activities. I'm very much looking forward to hosting you at our new facility.

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HELPING DRIVERS STAY IN THEIR LANES

EVERY YEAR, THE NZ TRANSPORT AGENCY (NZTA) SPENDS AROUND $4 MILLION INSTALLING AUDIO TACTILE PROFILED (ATP) ROAD MARKINGS, OTHERWISE KNOWN AS RUMBLE STRIPS, ON ROADS ACROSS THE COUNTRY. THE MARKINGS ARE AN EFFECTIVE WAY OF MAKING DRIVERS AWARE WHEN THEY ARE DRIFTING OUT OF THEIR LANES OR ONTO THE SHOULDER, BY CREATING BOTH NOISE AND VIBRATION INSIDE THE VEHICLE.

Research shows that the audio tactile profiled (ATP) markings reduce road accidents, but a major issue for the NZTA was determining when to replace them. Opus Research developed a study, funded by NZTA, to measure the effects of ATP design and wear-and-tear on the noise and vibration levels produced, and the threshold at which drivers no longer perceive them.

Plastic or wooden blocks of a range of heights and at variable distances were used to simulate new ATP markings. A test car was driven over each strip at differing speeds and the noise and vibration levels inside the vehicle were measured each time. The effects of the different blocks and their position, on both the overall noise levels and the quality of this noise were analysed by our noise modelling team.

Our Behavioural Scientists then examined driver response to the changes in noise and vibration from the different block heights to determine the height at which drivers would reliably detect ATP markings using a specially designed simulator. Drivers had to reliably identify the markings as distinct from other sounds, such as road noise and seal joins, while performing other tasks that replicate the demands on a driver's attention, and both with and without background music.

Using signal detection theory, a method used in psychology for determining sensitivity to stimuli, a height of 4mm was found to be the threshold at which drivers reliably perceive the ATP markings. However, as driver age and the presence of background music were found to reduce the driver's ability to detect the markings, a more conservative 5mm height was recommended. Through this research, Opus Research was able to provide NZTA with a basis for future maintenance plans to ensure ATP markings remain effective in warning drivers, while reducing costs by not replacing markers until this is necessary.

The full research report for this project can be viewed at: www.nzta.govt.nz/resources/research/reports/478/

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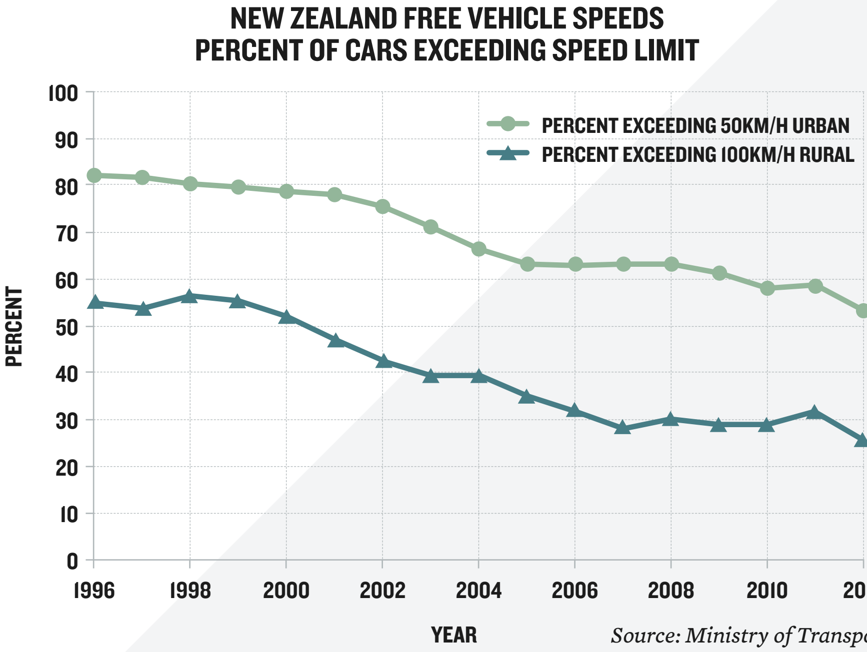
NATIONAL FREE SPEED SURVEYS – *MONITORING ROAD SAFETY IN NEW ZEALAND*

Most New Zealanders will be familiar with the Government's ongoing campaign to highlight the dangers of speeding. The annual cost of speed related crashes is estimated at around $675 million (Ministry of Transport, 2011), although the social cost can be much higher. We have a mix of urban and rural roads, and a wide range of driving environments, surfaces, and maintenance requirements. Understanding driver behaviour around speeding involves pulling together a complex set of variables to provide a useful set of data, with the ultimate aim of saving lives.

In 1996, the Ministry of Transport (MoT) began undertaking an annual Free Speed Survey to monitor safety and driver behaviour on New Zealand roads. Opus Research has been responsible for carrying out the survey since it started, with the last survey completed in September 2012 and the next starting in July 2013. Free speeds are those where only vehicles not impeded by others are measured, and at sites not limited by the road geometry. They are particularly important as they indicate a driver's preference or desire around speed. Surveys are undertaken during off-peak periods and during the school term to reflect normal weekday patterns.



Source: Ministry of Transport

The survey involves Opus staff taking measurements at 137 sites across the country using laser speed guns or digitectors with tribo-electric cables, as well as counting traffic flow and vehicle types. The survey sites include 71 rural and 66 urban areas with both 100km/h and 50km/h speed limits. Opus staff from Auckland, Paeroa, Gisborne, Wanganui, Blenheim, Invercargill and Wellington collect data, which is then collated by Opus Research staff and reported to the MoT. Changes in recorded speeds over time allow the MoT to measure the success of speed management interventions. The Ministry can then direct resources appropriately to enforcement, education and design.

Since the survey started 17 years ago, the percentage of cars driving over the speed limit in 100km/h areas has decreased from 56% to 25%. On 50km/h roads, this has decreased from 82% to 53%, emphasising the success of measures that have been implemented over that time to decrease open road speeds and draw attention to urban speed compliance.

Success for this project relies not only on technical expertise and logistics, but also great communication and coordination between seven Opus offices around New Zealand.

The Free Speed Survey is an important tool in monitoring and influencing road safety in New Zealand, and Opus is proud of its contribution to helping save lives.

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LIGHTING THE WAY – *MAKING ROADS SAFER*

HOW WELL A ROAD IS LIT HAS A SIGNIFICANT IMPACT ON HOW WE DRIVE. RESEARCH SHOWS THAT IMPROVING LIGHTING CAN REDUCE CRASHES BY AS MUCH AS 35%.

Under New Zealand's 'Safer Journeys' approach to road safety, any individual safety measure is measured in relation to other safety measures to create a driving environment and road system that minimises the risk of serious injury and death.

NZTA commissioned Opus Research to conduct a study investigating the relationship between road lighting and road safety. The study examined a section of road in a number of different urban areas managed by nine local authorities, and aimed to determine the minimum and maximum levels of road lighting to improve the safety of each stretch of road.

The lighting parameters measured related to the amount of light, glare level and the absence of dark patches between lights. The results were then compared to the crash history for each section of road, including the ratio of night-time to day-time crashes. The sections of roads were split into three groups depending on how much traffic they received – fewer than 9,000 vehicles per day, 9,000-12,000 vehicles per day, and 12,000-30,000 per day.

The results showed that overall, the better lit a road is, the fewer accidents there are, making it a significant road safety consideration. There was also an indication that the impact of lighting may be even larger where more serious crashes are involved. This is shown in the figure below which plots the ratio of night crashes to day crashes against average luminance. The findings applied to both dry and wet road surfaces, suggesting that road lighting is effective even when the surface is wet.

Roading authorities now have better information about the levels of lighting necessary to create safer roads, allowing them to develop road safety plans with a clearer picture of the relationship between different safety measures and what priority should be given to each of them.

The full research report for this project can be viewed at: www.nzta.govt.nz/resources/how-does-the-level-of-road-lighting-affect-crashes-in-nz/

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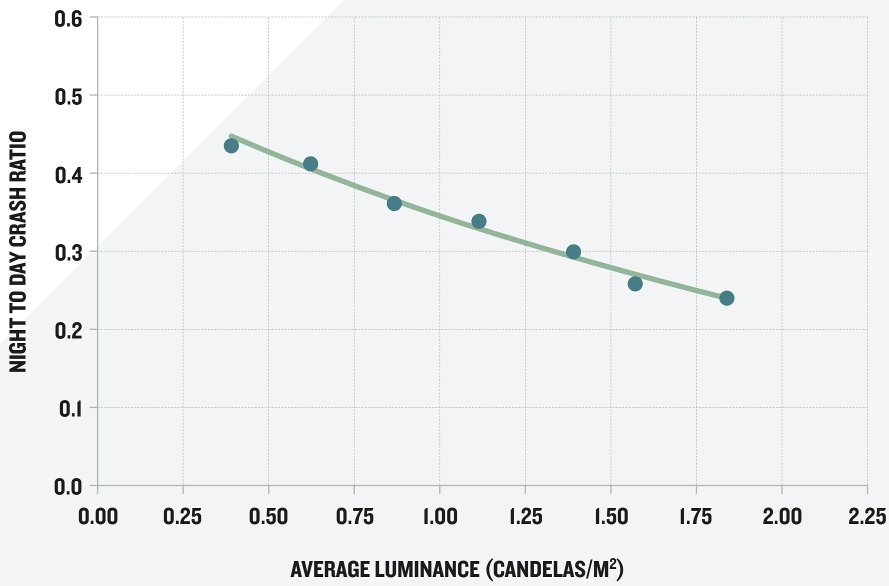
RATIO OF NIGHT-TIME CRASHES TO DAY-TIME CRASHES AGAINST LUMINANCE



HANDS-ON DRIVING – *THE HUMAN FACTOR*

IN OUR EFFORTS TO IMPROVE ROAD SAFETY AND DESIGN, WE ARE CONSTANTLY LOOKING FOR WAYS TO OBJECTIVELY MEASURE THE EFFECT OF INTERVENTIONS. ONE METHOD THAT HAS BEEN USED SUCCESSFULLY BY OPUS RESEARCH FOR ALMOST A DECADE IS THE "HANDS-ON" METHOD.

The idea behind the "Hands-On" method is that drivers vary their hand positions based on the level of risk they perceive and the complexity of the environment in which they are driving. When drivers perceive the driving environment is riskier and more complex, they tend to keep their hands on the top half of the steering wheel. When they feel there is less risk – so they are more relaxed – they tend to put their hands on the bottom half of the steering wheel. The method gives us a way to measure how complex the driving task is for the driver, and therefore evaluate what can be done to make the task easier and less prone to driver error.

The "Hands-On" method is simple, shows more variation between drivers than other objective measures such as speed and following distance, and can be adapted to a range of evaluation tasks. From the roadside, and preferably from an inconspicuous and elevated position, two observers independently count the number of hands each driver has on the top half of the steering wheel: two hands, one hand or no hands.

"Hands-On" has been shown to be a sensitive measure of perceived risk. A simple illustration is that drivers keep their hands on the top half of the steering wheel more often when they are driving at 100km/h than when driving at 50km/h, a lower risk situation. Being able to measure drivers' perceived risk has allowed us to make some useful conclusions. For example, we have found that different driving groups show different behaviours, with drivers of larger vehicles such as SUVs showing a more relaxed hand position than those in smaller vehicles, and men tending to be more relaxed drivers than women.

Potential applications of the results of "Hands-On" surveys are measuring signage interventions, such as variable messages for hazards and incidents, road narrowing and speed interventions, as well as delineation and changes to driver road views. It could also be used to identify roads where drivers tend to take more risks and where more interventions could therefore be considered.

Funded by the NZTA, Opus Research recently evaluated the effectiveness at night time of a series of road marking improvements in the Wellington region. Night vision equipment was needed to compare hand positions before and after the improvements, and the results – that drivers were more relaxed after the environment had been enhanced – demonstrated that the road marking improvements had been a successful undertaking. From NZTA's point of view, the result shows that investment in bigger, brighter markings can provide an environment that is effectively closer to safer daytime driving in dry conditions.

The full research report for this project can be viewed at: **www.nzta.govt.nz/resources/research/reports/442**

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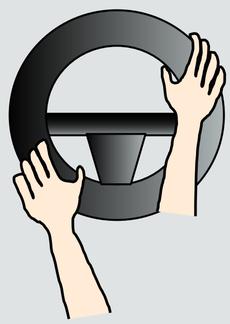
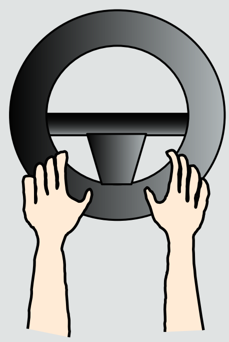
TWO HANDS

- Two hands on the top half of the steering wheel
- Most control over vehicle in emergency situations



ONE HAND

- One hand on the top half of the steering wheel
- Moderate control over vehicle in emergency situations



TWO HANDS

- No hands on the top half of the steering wheel
- Lowest control over vehicle in emergency situations

ENFORCEMENT AND SAFETY – *INTELLIGENT SPEED ADAPTATION*

Around 70% of rural crashes on bends occur on curves that can only be safely negotiated at speeds considerably lower than the posted speed limit. New Zealand uses recommended speed signage to signal drivers that they are approaching a significant curve to try to reduce this crash rate, however compliance with the recommended speeds is low. NZTA wanted to examine the benefits of using GPS technology to increase driver compliance with the recommended speed.

Intelligent Speed Adaptation (ISA) systems have been widely used and evaluated in overseas contexts and shown to reduce speeding behaviour. These systems use GPS information to inform the driver of their speed relative to the speed limit, with feedback to the driver varying from visual and audio response to limiting the speed of the vehicle. As significant investment would be needed to implement an ISA system in New Zealand, proof of its benefits and an evaluation of the costs involved in a local context were required.

Opus was part of a project funded by NZTA which examined the use of ISA systems in New Zealand, in conjunction with collaborators from MWH and the University of Leeds. The focus of this research was a version of ISA that provides recommended speeds for specific curves, as well as speed limit information. The premise was to determine how drivers responded to having the technology in their cars and what difference it made to their driving behaviour.

Our team focussed mainly on user acceptance of the technology, the effect on driver behaviour, and any legal barriers to introducing an ISA system in New Zealand (such as legal challenges to Police speed measurement and enforcement). Focus groups were used to determine what people want from ISA systems, how they would like them to be designed, and what incentives might encourage their use.

Road trials on both urban and rural roads showed that drivers responded well to the technology, driving below the speed limit 7% more of the time overall when using the ISA device, and reducing speed to within 15km/h of advisory speed limits a further 7% of the time. Feedback showed drivers would prefer greater customisability of the information provided by the ISA device, and a better alignment between this information and natural driving styles; for example, the system did not allow for early acceleration out of curves. The research provided NZTA with suggestions on how to make the technology acceptable to the driving public. But most importantly, it provided evidence that ISA technology could have a positive impact on driver behaviour and in reducing crashes.

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STRUCTURAL PERFORMANCE – *CONFIDENCE UNDER PRESSURE*

THE LAST THING YOU WANT IN ANY KIND OF CONSTRUCTION IS FOR THE MATERIALS YOU'RE RELYING ON TO FAIL, WHICH MAKES STRUCTURAL TESTING A CRUCIAL PART OF THE PROCESS.

Opus Research has a comprehensive structural testing facility with an extensive range of loading, measurement and data logging equipment. This provides the capability to test a variety of materials and components under simulated loads, giving clients an independent assessment of structural performance.

This equipment includes a range of traceably calibrated universal testing machines with capacities from 1 tonne to 100 tonnes that can be used for tension and compression testing. In addition, simulated seismic or cyclic loading can be applied with 5 tonne and 25 tonne portable dynamic actuators, as well as a 200 tonne servo-controlled testing machine (shown in the image), all of which are driven by a newly-acquired state-of-the-art controller.

A 3m x 2.4m shaking table is used as a reaction frame for testing the seismic performance of components and structures and we also have two smaller shaking tables appropriate for smaller components that require higher test frequencies.

The facility's 25m x 5m concrete strong-floor means load tests can be carried out on virtually any material or structure, including full-size building components. Loads are applied to the specimens through specifically designed reaction frames and using hydraulic jacks that range in capacity from 1 tonne to 200 tonnes. These loads can be used to prove strength or failure in areas such as compression, tension, flexure or impact.

Traceably calibrated load cells are used to measure loads and forces, and displacement is measured using both optical and electronic gauges. Specialist skills are available in the use and application of bonded strain gauges for measuring strain, and computer controlled multi-channel data logging is available for data acquisition.

Recently a major source of work has been intruder resistance, impact and load testing of prison and security doors for a variety of clients. This work has involved the use of existing international standards as well as developing in-house methods to suit the specific needs of our clients.

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BUILDING EARTHQUAKE RESILIENCE EXPO

RECENTLY OPUS PARTICIPATED IN A SUCCESSFUL EXPO ON RESILIENT BUILDINGS.

The Canterbury earthquakes have heightened public awareness around New Zealand about the importance of earthquake-resilient buildings. To provide accurate, useful information to the public, Wellington City Council, BRANZ and the Ministry of Business Innovation and Employment organised a two day earthquake building safety expo in Wellington in April. The expo brought together exhibitors to showcase their products and services to property owners.

Opus Research, alongside Opus structural engineers and architects, profiled the innovative multi-disciplinary solutions we offer clients seeking more resilient buildings. We featured projects that exemplified the seismic upgrade of existing buildings, as well as new buildings that incorporate damage resistant technologies, and demonstrated some of the technologies we use to assess earthquake susceptibility in buildings and other infrastructure.

The expo was well attended by both commercial and residential property owners from around the region. An earthquake engineering conference was taking place nearby and delegates were among the 1,200 visitors to the expo. The expo allowed Opus to promote our integrated and complementary services, while sharing our expertise with the public.

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NEW TO THE TEAM

Dr Steve Bagshaw joined Opus Research in February as a pavement researcher. Steve has an extensive background in materials chemistry and nano-porous materials research. He has developed several novel materials that showed activity in areas ranging from catalysis and molecular sieving to energy and bio-medical devices. Steve spent the past four years building a motorcycle road-racing coaching academy, and a motorcycle manufacturing business-designing, manufacturing, developing and marketing a new GPMono/Moto3 racing motorcycle.

Anthony Paterson started in January as an instrumentation engineer. Anthony holds an honours degree in mechatronics from the University of Canterbury, and worked at Times-7 Research Ltd for three years as a product engineer. Anthony has a wide range of skills including mechanical and industrial design, manufacturing, embedded electronics and software programming. His particular interests are rapid prototyping and manufacturing technologies, sensor technologies and performance monitoring of vehicles.