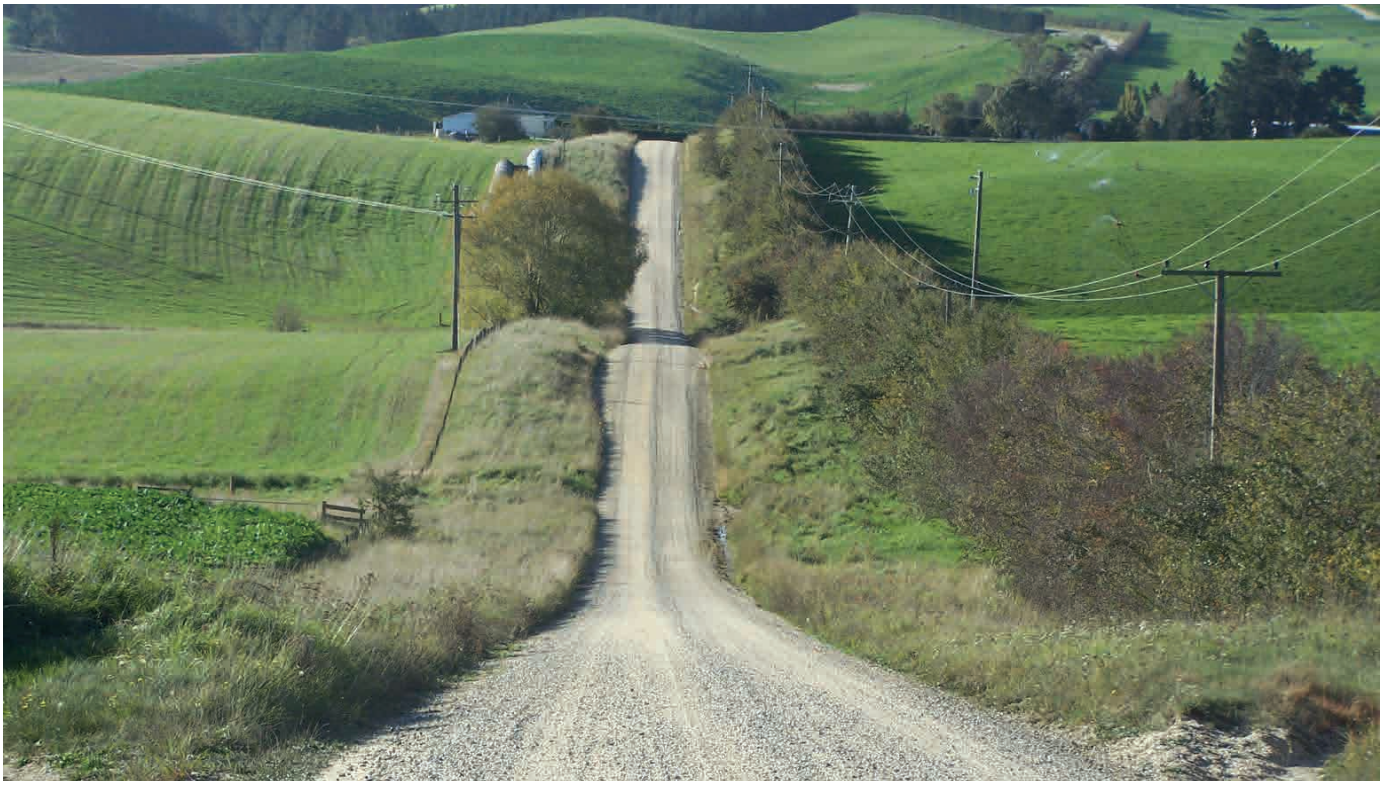
Issue 21 September 2013

ISSN 1174-0523 (print) ISSN 1174-0566 (online)

NZTA research

NZ TRANSPORT AGENCY
WAKA KOTAHI



YEARS OF RESEARCH PAY OFF FOR RURAL ROAD CRASH PREDICTION MODELS

The final stage of a three-stage project to develop crash prediction models for rural New Zealand roads is now complete.

Crash prediction models offer a more robust method of evaluating the potential benefits of road safety remedial schemes than the crash reduction studies used in New Zealand in the past.

This is particularly true for low-volume rural roads, where the recorded crash data that the studies are based on does not always reflect the safety of particular sections of the road. Yet most of New Zealand's fatal and serious injury crashes occur on these two-lane rural roads, and such roads are the norm in rural areas throughout the country, even on the state highway network.

The three-stage research project set out to provide a better way of predicting the crash-reduction improvements that can be expected from particular remedial safety measures. The New Zealand government is committed to such measures, and has already invested in delineation improvement and roadside clearance programmes and strategic road alignment projects for rural roads.

Shane Turner of Beca Infrastructure who headed the research project says there was a need for a robust tool to evaluate the 'value for money and safety benefits' of these remedial schemes, especially at an individual project level.

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Beca's crash prediction models followed a three-stage development process included a scoping study (stage 1); a pilot study (stage 2); and a study to develop and fine-tune the final models (stage 3). The results of stage 3, including the models themselves, are described in NZ Transport Agency research report 509, The next generation of rural road crash prediction models: final report, published at the end of 2012. The results of stage 2 of the study have been previously published in Transport Agency research report 437.

Shane says, 'The crash prediction models we've developed are specific to New Zealand conditions. They can be used to assess the number of crashes by type that might occur on a given segment of road, based on its particular features. They can also be used to assess the changes in the number and type of crashes that could be expected if changes were made to these road features through improvement projects.'

THE MODELS

While crash prediction models have been increasingly used since the mid-1990s to identify and evaluate road safety issues, most of the studies to date have focused on specific features of roads, such as carriage width or curves. The difference offered by the Beca models is that they incorporate the bulk of the recognised features affecting a road's safety performance, as identified in the research literature, allowing different options for addressing safety risks to be compared.

Based on data from almost 7000km of the rural state highway network, the models quantify the mathematical relationship between crashes and traffic volumes, road geometry, cross sections, road surfacing, roadside hazards and driveway density. In doing so, they enable road safety practitioners to gain a better understanding of how these factors interact and affect safety. Practitioners can then calculate the improvements, from among the available options, which are most likely to reduce crashes for particular sections of roads.

Ten crash prediction models were developed for key crash types, including head-on, loss-of-control and driveway crashes. (Loss-of-control and head-on crashes collectively account for 80% of crashes on rural state highways in New Zealand.)

The table below shows an example of the model being applied to assess the cumulative safety benefits of improving the road surface and mitigating roadside hazards for a straight section of road. It compares the base crash rate for that stretch of road, with the anticipated crash rates after the improvements have been made, to show where the best results in terms of safety improvements can be expected.

In the example, the results show that, for this particular stretch of road, improving the road surface would substantially reduce the number of loss-of-control and head-on crashes over time. The additional mitigation of roadside hazards would further reduce loss-of-control crashes.

'In this way, the model gives transport practitioners insight into the effect of introducing particular measures at particular sites,' says Shane. 'From which they can assess whether the measures are justified in terms of their cost, or if that money would be better invested elsewhere.'

The example reflects the study's broader finding that all of the models indicate significant safety benefits can be achieved by improving the road surface. Both curved and straight sections will experience large reductions in crash rates following surfacing remediation to achieve recommended thresholds, especially where a road's micro-texture is improved.

Further research will help refine the models even more, reducing current variations between regions and improving their fit. A key recommendation of the research is the development of a safety analysis software tool to incorporate the models. Similar tools have been developed, in different contexts overseas, providing easy-to-use interfaces for practitioners when applying safety models.

Shane says, 'A spread sheet-based software tool seems to be the best option, as it would be easier to use and maintain, and would have widespread application in evaluating the safety impacts of various state highway designs and improvements.'

NZ Transport Agency research report 509: *The next generation of rural road crash prediction models: final report*

– Beca Ltd

Available online at **www.nzta.govt.nz/resources/research/reports/509**

	Base scenario		**Improve road surfacing**		**Mitigate roadside hazards**	
Model parameters	**Straights-loss-of-control**	**Straights-head-on**	**Straights-loss-of-control**	**Straights-head-on**	**Straights-loss-of-control**	**Straights-head-on**
ADDT	4000	4000	4000	4000	4000	4000
Length	500	500	500	500	500	500
Seal width	7	7	7	7	7	7
Gradient	0.02	0.02	0.02	0.02	0.02	0.02
KiwiRAP weighted severity rating	2.8		2.8		0.7	
%time SCRIM below threshold	0.6	0.6	0	0	0	0
%time MTD below threshold	0.6		0		0	
Injury crashes per year	**0.618**	**0.069**	**0.206**	**0.025**	**0.180**	**0.025**
			Crash reduction compared to base		**Further reduction in crashes**	
			-67%	-64%	-13%	0%

CONCRETE LOADING RESEARCH COULD CHANGE NEW ZEALAND BRIDGE DESIGN

The current shear capacity limit on high-strength concrete bridge beams is overly restrictive and could be increased to improve bridge design accuracy without compromising safety, say University of Auckland researchers.

In New Zealand, the design of concrete beams for shear loading is governed by the provisions of NZS 3101:2006, which imposes limits on the permissible design shear capacity, including a maximum shear capacity of 8MPa. The 8MPa limit influences the efficiency of concrete beam design, particularly bridge beams with concrete compressive strengths of more than 40MPa.

'The proposed increase of the absolute limit on design shear capacity to 10MPa would both improve the accuracy of the shear design provisions of NZS 3101 and allow for more efficient design of concrete bridge beams than allowed by the 8MPa limit currently imposed by the design standard,' says researcher Moustafa Al-Ani.

Only beams with large quantities of transverse reinforcement would be affected by this recommendation, as beams containing less transverse reinforcement were not currently affected by the existing limits on design shear capacity.

The research assessed the validity of the proposed increased limit through experimental investigation, and the analysis of other international design standards and previous experimental research on reinforced concrete (RC) and pre-stressed concrete (PC) beams.

The project, undertaken between June 2008 and July 2012, aimed to provide design benefits for New Zealand bridge designers.

Concrete is widely used in the construction of bridges because of its strength in compression and the ability to allow for tension through embedded steel reinforcing bars.

The study said a revised 10MPa limit on shear capacity would mean the threshold concrete compressive strength concerning elevated shear capacity could increase from 40MPa to 50MPa.

If the proposed absolute limit of 10MPa was to be raised even higher, further experimental testing would be required, focusing on the performance of concrete beams with a compressive strength of more than 50MPa and a predicted shear capacity significantly greater than 10MPa.

Comparative analysis of the performance of the experimental test units known to fail in shear supported the need for a limit on the nominal design shear capacity, but the results of high-strength concrete test units showed that an absolute limit of 8MPa was too conservative.

'By examining the various mechanisms that influence the behaviour of concrete beams when subjected to shear loading, and of the interaction between those mechanisms, it is clear that the phenomenon of concrete shear behaviour continues to be difficult to quantify,' says Moustafa.

THE FINDINGS

Two databases were compiled of all previously tested RC and PC beams that had failed in shear, excluding all beams containing less than the minimum quantities of transverse reinforcement as set out in NZS 3101.

The influence of five design parameters on the ultimate shear capacity of concrete beams was also assessed, along with the performance of the six design standards when predicting the ultimate shear capacity of RC and PC beams.

The parameters identified as influential to the response of a concrete beam when subject to shear loading included concrete compressive strength, beam depth, shear a/d (span to unit depth) ratio, and quantities of transverse reinforcement and longitudinal reinforcement.

The ultimate shear capacity of beams in the RC database rose with increased concrete compressive strength, longitudinal reinforcement ratio and transverse reinforcement ratio, and dropped when beam effective depth and shear a/d ratio was increased.

For beams in the PC database, the shear capacity rose with increasing values of concrete compressive strength, beam effective depth, longitudinal reinforcement ratio and transverse reinforcement ratio, and dropped for increasing ratios of shear a/d.

The six international design standards used four different approaches to the design of a concrete beam for shear loading and imposed different limits on allowable shear capacities.

Eurocode 2 was found to be the most conservative of the design standards, while CSA A23.3 and AASHTO LRFD were the most accurate for predicting the shear capacity of RC beams. NZS 3101 was found to be the most accurate for predicting the shear capacity of PC beams.

'However, the standards found to be most accurate were also observed not to be conservative for significant proportions of the respective database,' says Moustafa.

A third of the beams in the RC database exhibited ultimate shear capacities lower than predicted by CSA A23.3 and AASHTO LRFD, and 40% of the beams in the PC database failed at ultimate shear capacities lower than predicted by NZS 3101. As a result, the study concluded that '...the ability of NZS 3101 to accurately predict the ultimate shear capacity of PC beams comes at the cost of reasonable conservatism'.

There was no noticeable influence of ultimate shear capacity on the accuracy of the design provisions for ultimate shear capacities greater than 8MPa, despite the omission of the 8MPa limit on allowable shear capacity during the study.

'This observation led to the conclusion that the removal of the 8MPa absolute limit on the allowable shear capacity of concrete beams would not unduly affect the integrity of the design provisions in NZS 3101,' says Moustafa.

TEST UNITS

To further assess the validity of the 8MPa absolute limit on design shear capacity, a series of 12 single-tee PC units were designed to fail at shear capacities at or greater than 8MPa.

To address the lack of previous experimental research on high-strength concrete beams with a high ultimate shear capacity, the test units were designed with a variety of concrete compressive strengths and varying amounts of transverse reinforcement.

The shear design provisions of NZS 3101, with its existing limits, deliver conservative predictions of shear capacity for the test units, while omission of the absolute limits results in non-conservative predictions of shear capacity. A similar trend was noted when analysing ACI 318; while the shear design provisions of CSA A23.3, AASHTO LRFD and Eurocode 2 all have overly conservative predictions of shear capacity for the high-strength concrete test units.

NZS 3101 has significantly more conservative predictions of shear capacity for units with a lower amount of transverse reinforcement, than for units with greater quantities of transverse reinforcement.

'An investigation into the NZS 3101 method of accounting for the contribution of varying levels of transverse reinforcement to shear capacity is also recommended, as the design standard was observed to significantly vary in conservatism with varying quantities of transverse reinforcement,' the study concludes.

NZ Transport Agency research report 501: *Assessment of shear stress limits for high-strength concrete bridge beams*

– University of Auckland

Available online at **www.nzta.govt.nz/resources/research/reports/501**

DESKTOP TOOL COULD EASE BUS PRIORITY DECISIONS

A tool to help road controlling authorities select the best bus priority treatments for specific road and traffic situations is now available.

In 2010, AECOM New Zealand Ltd was appointed by the Transport Agency to research the development of a tool to assist road controlling authorities in their selection of bus priority treatments appropriate for given road and traffic situations. The principal project objective was to develop a procedure, which would be practical, easily accessible and which could be easily disseminated to end users.

AECOM's research developed a bus priority assessment tool (BAT), a computerised decision-assisting tool for identifying the most appropriate bus priority treatments for any situation, based upon the route and intersection characteristics where the treatment is to be used.

The drive for bus priority treatments is gaining momentum in New Zealand, which could increase the number of people working in this area who have limited knowledge or experience of the options available to them.

'We wanted to produce a tool that was of practical use for these people,' said research team leader, Michelle Harvey, previously of AECOM New Zealand Ltd. 'Something that would be an active decision-assisting tool that sat on their desktops, rather than a piece of research that sat on their shelves.'

To this end, the research looked at all the bus priority treatments available internationally (over 20 were scrutinised), then culled them down to those that were either already used in New Zealand or, although not currently adopted, were suitable for implementation here. The affordability of each treatment was also taken into account.

From this process, 11 treatments made it into the final tool (see breakout box).

The research focused on developing a set of analytical algorithms for these treatments to assess their effectiveness at intersections and on road segments.

The treatments are incorporated into BAT, where they are rated according to their suitability for a given situation. BAT then displays the appropriate treatment (the highest ranking) and the alternative treatment (the second highest). BAT also produces an economic indicator for the selected treatments – an indicative benefit–cost ratio in the case of intersection treatments, and a total cost for transport corridor treatments – with a warning displayed if the suggested treatment exceeds budget.

The tool is supported by a user manual, which is appendix D of the main report. The user manual covers a description of the system and its uses, information required before it can be used, software requirements and settings, a step-by-step interface guide and frequently asked questions.

The full research report describes the tool's development.

MORE ABOUT THE MODEL

Michelle said that the analytical model encapsulated in BAT is the 'engine' of the research.

'The model contains a set of algorithms, which enable the benefits of the potential bus priority treatments to be estimated in the context of the site where they will be used,' explains Michelle. '

Key performance indicators (KPIs) are a crucial part of the analysis, because they enable the user to influence the model, so that it identifies the best treatments to meet their objectives. Obviously these objectives vary from project to project and site to site, and the user weighting of the KPIs enables the model to be customised to reflect this.

Four KPIs are incorporated in the model (overall bus and car traveller delay, reduced car growth rate over 10 years, lane person throughput in 10 years and cost of vehicle emissions). Users allocate to each of them a percentage weight, which collectively total 100%.

In addition to the KPIs the model uses two types of input data:

- site specific – data known and provided by the user of the model, for example traffic volumes, number of buses, cost estimates for the treatments and project budget
- general – default values, provided as part of the tool, for the performance measures of the respective treatments.

The analytical algorithm in the model is designed to:

- screen the input data to identify the treatments that apply
- analyse the benefits of the treatments
- select the appropriate and alternative treatments
- calculate a rough benefit–cost ratio.

Michelle stressed that the current iteration of the model is only a 'first generation application tool', and will need more detailed appraisal in future.

NZ Transport Agency research report 506: *Identify, evaluate and recommend bus priority interventions*

– AECOM New Zealand

Available online at **www.nzta.govt.nz/resources/research/reports/506**

THE BUS PRIORITY INTERVENTIONS

The 11 interventions incorporated in BAT include five treatments for intersections and six for road segments.

The model can also be applied to transport corridors, which in this context are made up of a combination of intersections and road segments. For corridors, the user selects:

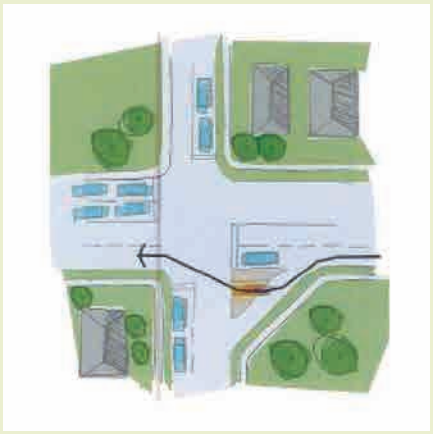
- the individual treatment for each intersection
- suitable treatments for groups of road segments between the intersections.

The model's application is limited to five road segments and six intersections, for any particular transport corridor.

The intersection treatments BAT can choose from include:

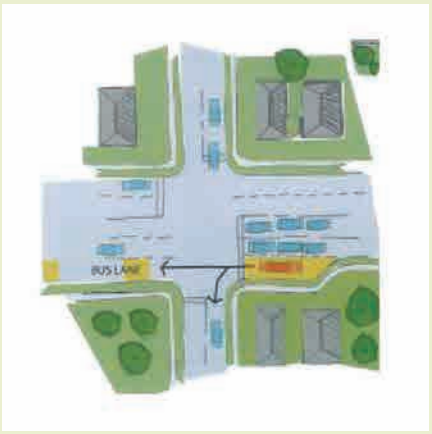
- bus advance with the bus phase – where by using the existing traffic island it is feasible for the bus to reach the stop line, bypassing the traffic queue. The bus phase allows the bus to enter the intersection before the general traffic is released
- transit active signal for the bus detected on the approach to the intersection – the detected bus triggers the signal phase change. By the time the bus arrives at the intersection the traffic signal changes. If the bus arrives on red the red phase is terminated. If it arrives at the end of green the green phase is extended
- queue jump lane – an additional short lane constructed on the approach to an intersection for buses to bypass queues of waiting cars. Therefore buses have free access to the stop line from where they continue with the traffic stream into the bus lane on the far side of the intersection
- bus right turn only – where buses have a dedicated right turn signal phase
- bus gate – for bus right turn from the bus lane at kerb. With the bus gate the bus avoids weaving at low speed through the general traffic ahead of the intersection and travels without reducing speed.

ANALYSED BUS PRIORITY TREATMENTS – INTERSECTION

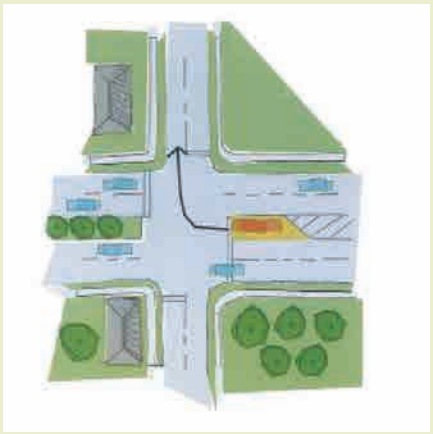


a) Bus advance

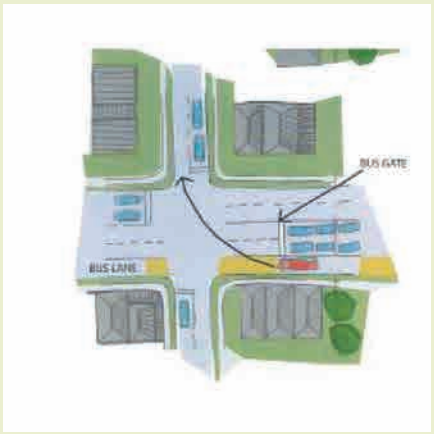
b) Transit active signal



c) Queue jump lane



d) Bus right turn only



e) Bus gate for bus right turn

The six road segment treatments analysed by the model are:

- with-flow bus lane – a traffic lane intended for the use of buses in the direction of the neighbouring general purpose traffic lanes. Some bus lanes allow cyclists and motorcyclists
- contra-flow bus lane – a traffic lane intended for the use of buses, where buses travel in the opposing direction of the neighbouring general purpose traffic lanes
- reversible bus lane – a traffic lane intended for the use of buses, where buses travel in one direction during morning peak and in the opposite direction during afternoon peak
- bus gate (or virtual bus lane) – a useful bus priority device in situations where a bus lane has to be discontinued in the middle of the road segment. The approaching bus in the bus lane triggers the red signal phase for general traffic and bypasses the bottleneck travelling without reducing speed
- T2 transit lane – transit lanes are with-flow bus lanes, which allow multi-occupant vehicles to share the lane with buses. T2 transit lane allows vehicles with two or more occupants to share the lane with buses.

ANALYSED BUS PRIORITY TREATMENTS – ROAD SEGMENT

a) With-flow bus lane/ transit lane

b) Contra-flow bus lane

c) Reversible bus lane

a) Bus gate

COMPARING ROAD, RAIL AND SEA FOR LONG-HAUL FREIGHT

Coastal shipping is the most cost-efficient and environmentally friendly way of transporting 20ft containers between the North and South Islands, according to recent research comparing shipping, road and rail freight efficiency.

However, ships have to move at least 297 containers per vessel (54% capacity) and rail at least 25 containers per train (63% capacity) to equal the per kilometre per container fuel consumption and CO_2 emission rates of road transport, according to the research team from Opus International Consultants. The research also assumed that this freight was not time critical.

With maximum capacity, shipping and rail transport are about twice as efficient as road transport, which carts the containers one at a time. However, trains sometimes use two locomotives, which increases their fuel consumption and CO_2 emissions.

The October 2012 report, *Freight transport efficiency: a comparative study of coastal shipping, rail and road modes*, recommends that 'more consideration be given to better integrating the various transport modes so that the total amount of domestic freight moved by coastal shipping is increased from the current 15 percent'.

Researchers Peter Cenek, Russell Kean and Igor Kvatch fitted a data logger to covertly track the movements and impacts on an empty 20ft container while it made five return journeys between Wellington and Tauranga (550km) by truck and rail, and between Wellington and Christchurch (350km) by truck, rail and sea.

The study focused on fuel use and CO_2 emissions, price, impact forces and transport duration. It followed a 2005 Ministry of Transport study on road and rail freighting, which found a lack of local research on comparative resource use – particularly on fuel usage and damage to goods during transit – was hampering the economic assessment of transport-related capital works projects that could provide alternatives to roads.

Between 2006 and 2012, the cost of transporting a 20ft container from Wellington to Christchurch by rail and road has dropped by 13% and 36% respectively due to greater efficiency and competition in the freight transport sector.

But coastal shipping is still the most cost-effective form of transporting freight that is not time critical over long distances, and road is the least effective.

The disproportionate cost of road–ferry transport across Cook Strait ($15.49 per kilometre (GST exclusive) versus the typical $2.50 a kilometre for road transport) significantly affects the economics of road freighting between the North and South Islands.

For the 1500km journey between Auckland and Dunedin, the cost of transporting a 20ft container by rail is 1.7 more than by sea, and by road it is 2.8 times more than by sea. But over shorter distances, the cost differences between the transport modes decreases.

'Although these cost ratios are lower than for Europe and the US, they highlight that over long distances coastal shipping and rail are a more cost-effective way of transporting goods around New Zealand than road,' says Peter Cenek.

The data logger, which carried a global positioning system receiver and 3-axis accelerometers, measured the number, frequency, magnitude and time of sudden movements and impacts on the container. But as it was empty, the container was more sensitive to disturbances, so accelerations were considered at the upper end of what would normally be expected.

Maritime transport was the least likely to cause damage to goods, followed by road then rail. But with severe accelerations, which caused the most potential damage to goods, the differences between road and maritime transport lessened.

The study found that, 'The high incidence of impact loading in the rail mode reflects an ageing transport network that hasn't received adequate infrastructure investment, with 200km of the 4000km network (ie 5%) approaching the end of its predicted life.'

However, peak longitudinal accelerations for rail transport are less than the expected 2.0g 'suggesting sound practices are being employed in shunting operations'.

New Zealand's rail system has now come back into state ownership and the government has made a substantial investment in the KiwiRail Turnaround Plan. The plan has seen significant investment in upgrading the network, purchasing new rolling stock, plant, equipment, facilities and network management systems, the report notes.

Compared with the container service conditions suggested by the American Bureau of Shipping, the transverse accelerations recorded were six times greater than those expected across all transport modes, and longitudinal accelerations were three times greater than expected for both maritime and road.

'This suggests that existing procedures for assessing ride quality of state highways do not take sufficient account of surface profile features that cause body roll and body pitch in the semi-trailers used to transport containers,' says Peter.

This is viewed as an important issue, particularly as 70% of land-based freight (in tonnes/kilometres) is moved by road and government studies forecast that the amount of freight being transported in New Zealand will double by 2040.

Therefore, the researchers recommend the Transport Agency supplements the quarter-car-based International Roughness Index (IRI) numeric with more freight-focused numerics.

The researchers also support the current practice of industry choosing to use mainly rail to transport bulk goods, such as coal and forestry products, because high dynamic loading is less problematic for these types of goods.

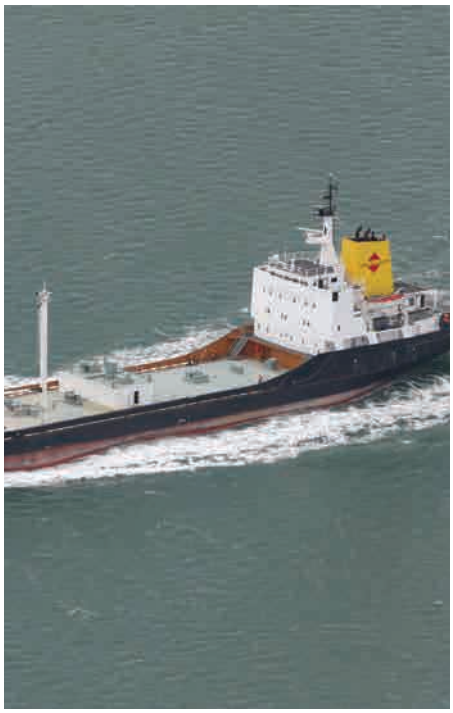
The relationship between transport-induced vibrations and commodity damage is worth further discussion. Commodity groups could also establish critical acceleration levels and frequency ranges to help them decide the most appropriate form of transport in terms of in-transit damage, which could perhaps be worked out as a dollar value.

Another recommendation is that, because the greatest container-impact forces often come from transfers, trials be carried out to find better transfer techniques to reduce these forces. This, along with the report's other findings, will provide better information to those moving freight and choosing the appropriate transport mode for their goods and customers.

NZ Transport Agency research report 497: *Freight transport efficiency: a comparative study of coastal shipping, rail and road modes*

– Opus Research, Opus International Consultants

Available online at: www.nzta.govt.nz/resources/research/reports/497



ROADSIDE CORRIDORS NEED AN INDIGENOUS MAKEOVER

Large tracts of New Zealand countryside lack visible indigenous vegetation, which disconnects New Zealanders from their heritage and identity and may undermine New Zealand's '100 percent pure' tourism pitch, says recent research.

'New Zealand's long-term well-being may partly depend upon development and maintenance of a world-class and distinctive environmental brand. The Transport Agency, through the management of the state highway network, can be a leader in smart 'green' growth, and contribute a vital point of difference to Aotearoa New Zealand,' the 2012 study said.

Involving researchers from Landcare Research (Colin Meurk, Robyn Simcock and Shaun Awatere), Lincoln University (Simon Swaffield and Jude Wilson) and GreenVisioNZ (Robert Watts), the study explored ways to better manage the environmental and cultural assets of the state highway network corridor.

The state highway network is one of New Zealand's primary public infrastructure networks, comprising over 10,000km of highways crossing different natural and modified environments.

The Transport Agency manages the roadside corridor, which consists of the paved road and a 2m to 10m-wide berm of generally mown grass.

'Internationally there is an increasing demand for roadways to have a minimal environmental impact and footprint, to express local environmental and cultural context, and to protect or respect natural, historical and landscape assets,' says Colin Meurk of Landcare Research who headed the research project, 'and that's in addition to being efficient and safe.'

The research team carried out field trials on indigenous species in roadside landscaping, explored perceptual and cultural values of the highway experience, and reviewed existing Transport Agency landscape guidelines, policies, methodologies and asset management as part of the study.

The report suggests planting a greater range of indigenous species to give highways an evolving Aotearoa identity. Road verge designs with dense, frangible vegetation closer to the carriageway can be more sustainable and safe while maintaining necessary visibility.

Particularly recommended is the use of divaricating shrubs and tussocks to form a border or low hedge to roadside plantings. This could minimise the need for expensive mown grass verges, potentially saving on maintenance costs in the long run, but at the same time providing a more New Zealand look and a corridor habitat for insects, lizards and small birds.

The cost of achieving these goals needs to be considered over the longer term – as natural asset values tend to increase over time – and be fitted within the usual road maintenance and building cycles.

Workshop discussions with a range of stakeholders showed that while financial cost–benefit ratios were a key driver, stakeholders recognised that other values were important too.

These included the role of the roadside reserve as a buffer or absorber of pollutants; other environmental services such as biodiversity and carbon sequestration; experiential landscape values such as legibility, which is important to tourism's 'clean green image', variety and visual amenity; heritage; and psychological effects on road users such as calming.

Interaction with community, stakeholders, iwi and territorial local authorities was considered very important to bring in a greater range of support. Adjoining landowners and farmers could also make significant contributions through co-managing activities on their own land and through guardianship of adjacent public land.

A case study of stakeholders, focusing on a range of West Coast settings, was carried out to identify values associated with the environmental and landscape condition of the state highway corridor.

Feedback showed that pristine roadside reserves were highly valued by all stakeholders, but did not always satisfy safety and amenity requirements. Roadside reserves need to be managed on a 'context-sensitive' individual basis, rest areas should be inviting, interesting and suited to the setting, and service areas screened and heritage features well presented.

Māori cultural values were also considered. Land, mountains, valleys, rocks, water and sea ways are viewed by Māori not only as resources that need protecting, but as manifestations of collective identity and mnemonics for their local histories. Accordingly, most kaitiaki (resource managers) support the promotion of indigenous vegetation on roadsides.

'Sustainability and local sense of place are reinforced by planting ecologically suitable and locally sourced indigenous plants,' says Colin. Shaun Awatere reminds us that 'plants also have a whakapapa that reflects and embodies the place. Vegetation, like people, has a history and is context bound – to be healthy it will be in harmony with the local environment.'

Application of Māori values in resource management is also contextual. 'Not only are there variations in approach to resource management amongst iwi, but individual hapū may have their unique take,' says Shaun.

Extensively and expensively mown roadside embankment with little ecological value, SH1 Northern Motorway, Silverdale (Auckland)

TOWARDS A NEW APPROACH

A steady development of legislation, policies, strategies and plans in New Zealand over the past 25 years has recognised the cultural and economic importance of the clean, green branding to nationhood. They all emphasise sustainability, economic benefits, integration of multiple purposes, accountability to diverse stakeholder interests, Treaty of Waitangi partnership and international obligations to preserve New Zealand's part of global diversity. Yet, the study observes that 'there is nevertheless considerable inertia, lost opportunities and lack of awareness leading to ongoing attrition.'

As a result, the report recommends the creation of a natural environment and cultural asset management system (NECAMS) to extend the current engineering asset management framework operated by the Transport Agency, using best current practice derived from a number of countries including New Zealand.

A collaborative and visionary learning approach is recommended, involving a cross-section of experts, stakeholders and adjacent land managers, so that the new system is 'owned' by the Transport Agency, the wider public and tangata whenua.

In addition, the system must be integrated within the conventional practices and established systems of highway asset management and be part of the institutional culture. Finally, it must recognise multiple values, attract champions and ensure capacity building within the Transport Agency, so that interrelationships between use, safety, water quality, ecology, socio-cultural needs, heritage and aesthetics are widely understood.

Any asset management system for the state highway corridor has to be viable over the long term, says Colin. 'It's taken 150 years to build the current road network so it could take another 150 years to resurrect and retrofit desirable values into this asset where they have been lost in the wider landscape.'

This will require precise ecological, landscape and historical knowledge in the design and protection of primary remnants, not only for motorways and highways, but for the adjacent vistas and catchments. Tangible environmental, biodiversity, social and cultural performance indicators will also have to be defined and adopted in order to track progress.

Roadside swale of tussock sedges, rushes and mountain flax filtering road runoff, Stoke, Nelson.

As an example, the report suggests it would be reasonable to set a 20-year target of 10% of all roadsides through cultural landscapes to be dominated by indigenous vegetation and New Zealand trees; and 90% of all picnic lay-bys to be framed by indigenous species and have an interpretation of local natural and cultural history; so that in a century, 75% of the road experience is clearly and distinctively Aotearoa New Zealand.

The next step in developing the system is to test the concept in a desk exercise among managers and practitioners within the industry. Then a full-scale pilot study could be carried out on a road sector, with the Christchurch – Akaroa Highway proposed as a possible test case.

Despite the start-up costs involved in these processes, the researchers predict that the system will become cheaper to run over time, while the heritage assets will increase in value and become largely self-sustaining.

Subsequent to publication, the Transport Agency has assessed the issues in implementing the report's recommendations through the creation of a NECAMS project. This has involved establishing factors and values representing key components of natural character and cultural and landscape issues that fit the concept model, and considering how to use these in decision making for new roads and in managing the existing state highway network.

The NECAMS project was piloted on SH11 from Kawakawa to Puketona Junction in Northland. Desktop-derived factors and values were assessed through on-site confirmation and stakeholder consultation. The study identified that, to achieve the aspirations of a NECAMS concept across the state highway network, there will need to be considerable collaboration between government agencies and regulatory authorities to agree on the important factors and values. Using this information the Transport Agency will be able, through its spatial planning tools, to influence decision making and procurement requirements. Results of the pilot project have confirmed that implementation of the NECAMS concept is achievable, although it will need to be simplified to be manageable but still effective.

NZ Transport Agency research report 503: *A natural environment and cultural asset management system for New Zealand's state highway network: towards a practical concept and application*

– Landcare Research

Available online at **www.nzta.govt.nz/resources/research/reports/503**

Motorway and associated green corridor of local forest species in the heart of Auckland City, Grafton Gully. High aesthetic and calming values are desirable as traffic volumes are >100,000 vehicles per day and sometimes progress is very slow!

NEW RESEARCH REPORTS

Reallocation of road space

Research report 530

T Fleming (Allatt), S Turner and L Tarjomi - Beca Infrastructure Ltd

Freely available online at www.nzta.govt.nz/resources/research/reports/530

This research project investigated the economic impacts of transport and road space reallocation in shopping areas located in central cities and along major transport corridors in New Zealand. It focused on three research questions. The first being to understand the retail spending of transport users; resulting in data that provides an average $ spent per user and primary mode of transport. The second element focused on identifying the road space allocation and design elements important to retailers and shoppers. Finally, a case study compendium was developed.

The data shows that sustainable transport users account for 40% of the total spend in the shopping areas and account for 37% of all shoppers who completed the survey. The data indicates the pedestrians and cyclists contribute a higher economic spend proportionately to the modal share and are important to the economic viability of local shopping areas.

The study also identified that retailers generally overestimate the importance of on-street parking outside shops. Shoppers value high-quality pedestrian and urban design features in shopping areas more than they value parking and those who drive are willing to walk to the shopping precinct from other locally available parking areas.

OBTAINING TRANSPORT AGENCY RESEARCH REPORTS

All research reports published since 2005 are available free of cost for downloading from the Transport Agency's website – www.nzta.govt.nz/planning/programming/research

PDF scans of research reports published prior to 2005 are available by emailing research@nzta.govt.nz

A NOTE FOR READERS

NZTA research newsletter

NZTA research is published quarterly by the NZ Transport Agency. Its purpose is to report the results of research funded through the Transport Agency's Research Programme, to act as a forum for passing on national and international information, and to aid collaboration between all those involved. For information about the Transport Agency's Research Programme, see www.nzta.govt.nz/planning/programming/research.

Advertisements of forthcoming conferences and workshops, that are within the newsletter's field of interest, may be published free of charge when space permits.

Contributed articles are also welcome, should not exceed 1000 words and are to be emailed to research@nzta.govt.nz. Illustrations must be of high quality. *NZTA research* reserves the right to edit, abridge or decline any article.

All general correspondence, queries related to conference notices, and requests for additions or amendments to the mailing list, should be made to research@nzta.govt.nz.

Editions of this newsletter, NZTA research, are available in hard copy or on the Transport Agency website at www.nzta.govt.nz/resources/nzta-research/. Back editions are available online only.

Disclaimer

The views expressed in NZTA research are the outcome of research and should not be regarded as being the opinion, responsibility or policy of the Transport Agency or of any agency of the New Zealand Government.

Email alerts of newly published research reports

Email notification is provided when new Transport Agency research reports are published on the Transport Agency's website at www.nzta.govt.nz/planning/programming/research. Please email research@nzta.govt.nz if you would like to receive these email alerts.

Do we have your correct details?

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