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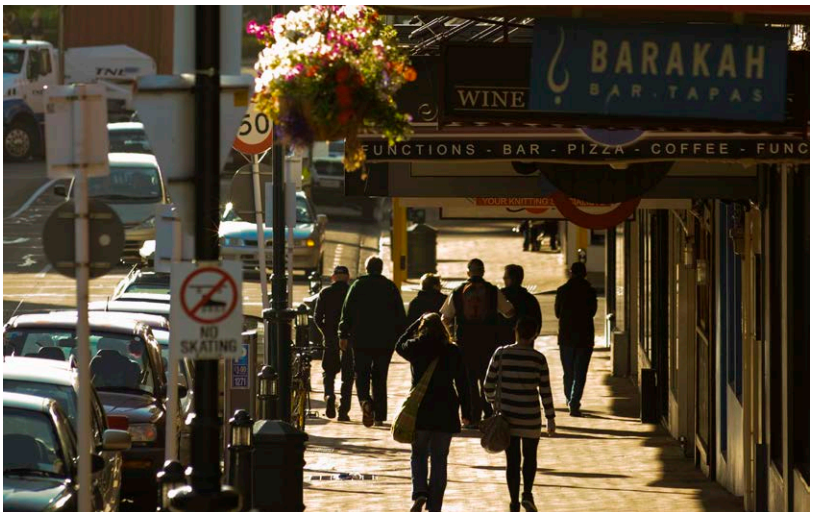
NZ TRANSPORT AGENCY
WAKA KOTAHI



ROAD SPACE REALLOCATION CONFIRMED AS A POSITIVE APPROACH FOR LOCAL CENTRES

Research on the economic impact of transport users in New Zealand urban shopping centres makes an important local contribution to the growing international interest in reallocation of road space.

The research by Beca Infrastructure has found that, although shoppers and retailers may have differing perspectives on the role of parking, the safety and attractiveness of the shopping environment is more important for attracting trade. Often, the situation is even more complex than this, and a multitude of factors need to be taken into account in order to create economically viable shopping centres.

THE ROAD SPACE REALLOCATION DEBATE

In recent years, there has been shift in transport and land use policy, both in New Zealand and overseas, to increasingly value road space in terms of the movement of people and person journey time, as opposed to vehicle numbers and efficiency.

Road space reallocation is the practical expression of this policy. It aims to cater for all users of street environments, by shifting more road space to provide for a range of transport activities (including walking, cycling and other sustainable modes of transport), rather than just for cars.

Road space reallocation is, in part, a response to the predominant land use policies of past decades, which, while they have increased people's mobility, have also tended to create environments that do not encourage social interaction or a sense of community or place.

However, although at their heart road space reallocation policies aim to provide better access and more equitable space allocation for all users in shopping areas, they often face significant opposition from retailers, who see them as potentially bad for business. Behind the opposition, is the widespread belief that ease and proximity of parking is crucial for attracting customers – good parking is good for business.

Research overseas is increasingly demonstrating that this is not the case. The role of good street design in creating economic benefits for retailers; the broader benefits for the community of reallocating road space to other modes of transport than the car; the tendency for retailers to over-estimate how many customers use cars to get to their shops; and the disparity between retailers and shoppers in how important parking is perceived to be, are just some of the findings to have emerged from studies overseas.

Tracy Fleming says that, 'Although these studies have provided useful evidence indicating that the impact of car trips and the need for associated nearby on-street parking is overestimated, we still need to provide local evidence to support the results of these international studies.'

continued on page 2

HOW TRANSPORT USERS SPEND

Beca's study of nine shopping areas along arterial corridors and in central city locations in Wellington, Christchurch and Auckland aimed to provide this local evidence by assessing the economic impact (spending levels and trends) of the users of various transport modes who frequented the centres. This was supported by an investigation into how road space allocation and street design influenced these users.

There was evidence to show that sustainable transport users were making a higher proportional economic contribution (at 40% of the total spend in the shopping areas surveyed) than their mode share (which was 37%). This suggests that, in many cases, the benefit of encouraging more sustainable transport journeys to shopping centres outweighs the cost of reallocating space and improving the urban design in those centres.

One of the other interesting findings to emerge was that, unlike their counterparts overseas, New Zealand retailers tend to have a good understanding of how important sustainable transport users are for their businesses.

Tracy says, 'The retailers we talked to tended to slightly over-estimate the proportion of their customers who were travelling to the shopping centre by foot or bike, and slightly underestimate the proportion arriving by car. This is the reverse of the situation overseas, where retailers tend to significantly underestimate the numbers of sustainable transport users frequenting their businesses, and conversely over-estimate the number of car users.'

Also of interest was that, although shoppers arriving by car (as drivers or passengers) had a higher average spend than shoppers using sustainable transport modes, the difference was not huge ($46 per trip for car users; $34 per trip for users of sustainable modes). Vehicle users had a better ability to bulk buy and this partially accounted for their higher average spend. However, sustainable users were more likely to spend more time in a shopping area and to return more frequently.

Tracy says, 'While sustainable transport users tended to spend less per trip than car drivers and passengers, they visited shops more frequently and made significant contribution to the ongoing economic vitality and viability of those shops.'

The disparity in spending between the users of the different travel modes was greater in New Zealand than had been found in international studies. This is probably attributable to the fact that overseas cities were better set up to cater for sustainable transport modes. In addition, a larger proportion of people with higher disposable incomes use sustainable transport modes overseas than is currently the case in New Zealand: a trend that the study authors expect to see mirrored here over time.

THE BALANCE BETWEEN PARKING, DESIGN AND SHOPS

The survey results showed that although shoppers and retailers had different perspectives on the relative importance of parking, they came together on the need for safe and attractive street environments.

While retailers tended to consider that nearby on- and off-street parking was a priority for attracting customers, most shoppers accepted that parking outside the shop they intended to visit was not critical to their decision to visit the area. If there was off-street parking nearby, they were happy to use it, but overall they were more interested in being able to cross the road with ease, and in feeling comfortable and safe while getting around a shopping area. Many shoppers indicated that they would be happy to walk further from their car park to the shop, if it meant having a more pleasant shopping experience once they arrived.

Retailers also accepted the need for wide footpaths and safe crossings, although were loath for these to be provided at the expense of on-street parking.

However, one of the crucial outcomes from the study was the finding that the availability of certain shops was the primary consideration for most shoppers. The research found that transport and design considerations were secondary for shoppers, compared with the type of shop. 'If the shops provide a service that is required, the shoppers will come,' says Tracy.

'Although this finding wasn't a fundamental part of our research, it does show that a comprehensive approach is required in order to develop economically successful shops. The provision of high-quality transport and urban design features alone will not contribute to the economic vitality of shopping areas.'

Interest in the impacts and benefits of road allocation is expected to increase, both within New Zealand and internationally. The findings from Beca's research will make a valuable contribution, adding to the growing body of evidence on the impacts that transport and urban design have on economic activity in retail areas.

The study also gives local practitioners a toolkit they can use to engage with communities when embarking on individual reallocation schemes.

Reallocation of road space, NZ Transport Agency research report 530

Available online at **www.nzta.govt.nz/resources/research/reports/530**

MAKING ROAD CONDITION DATA FIT FOR PURPOSE

Research has recommended improvements to how visual road condition data is collected, to make it more accurate and suitable for the many purposes it is currently used for.

The project investigated the effectiveness of the current visual road condition rating system, aiming to improve the data that road condition surveys collect, so it can be used confidently to support asset management decisions and comparison of the condition of networks using the New Zealand version of Deightons Total Infrastructure Management System (NZdTIMS) modelling. As a result of the research, the project team has proposed changes to the RAMM Road condition rating and roughness manual (PFM 6).

Visual condition surveys of New Zealand roads are conducted by road controlling authorities (RCAs) on portions of their road networks, every one or two years. The surveys collect data about pavement and surface defects, which is used to assess the condition of the road and whether there is a need for any resurfacing or rehabilitation work.

Originally, data from the surveys was used to run the treatment selection algorithm in the road asset and maintenance management (RAMM) database. The algorithm generated a list of road sections that were potentially in need of resurfacing or rehabilitation. This list was then validated in the field and a works programme developed.

Over time, visual condition rating data from the surveys has come to be used for many other pavement and surfacing performance modelling purposes, including:

- the surface condition index and pavement condition index, which are used to describe the trend in the condition of the surface and pavement, the effectiveness of resurfacing and rehabilitation works and the need for works to maintain condition
- forecasting the future condition of surfaces and pavements as they deteriorate and the impact of potential resurfacing and rehabilitation works programmes on surface condition, using NZdTIMS modelling
- prioritising investment in resurfacing and rehabilitation programmes.

The data also feeds into key performance indicators (KPIs) and levels of service measures for RCAs' maintenance programmes. In future, the NZ Transport Agency wants to extend the use of these KPIs to compare the performance of different RCA networks.

Mike Tapper of Beca who, together with researchers from the University of Auckland, conducted the research says, 'Obviously, the role of the visual condition rating derived from the surveys of the roads is now significantly different from the role it was developed for. The survey and data collection process needs to be improved to make it fit for its current and future purposes. There is also a need to improve data accuracy and consistency, so that RCAs and other users have more confidence in it and the KPIs it informs.

'Our project looked at how the visual rating process is currently undertaken and whether this is appropriate for its current and future uses. From this we were able to recommend improvements to data collection methodology, training given to those who conduct rating surveys, quality auditing, survey stratification, and the sampling methodology and procurement.'

THE CURRENT APPROACH

At present, RCAs carry out visual road ratings to collect data about pavement and surface defects that indicate the condition of the road. Different RCAs use varying sample sizes for their ratings: for rural and state highway networks, rating is generally undertaken on 10% of the network (ie 50m of every 500m is rated); for urban networks, much more of the network is rated (with some authorities rating the entire network) and sections tend to be shorter as a result of the network layout.

The PFM 6 provides guidance on how the visual rating should be conducted and sets out the acceptable limits of variation (tolerance) for the defect values recorded, when checked through a quality assurance audit process.

Annual training courses are run for those conducting the rating surveys (known as road raters), with the aim of creating some consistency in how raters nationwide identify and measure defects. All raters must attend a refresher of this training every two years. However, there is currently no industry guidance on how to provide quality assurance checks on the data collected, and as a result this varies from contract to contract, with some authorities conducting no quality checks at all.

The research project structured its enquiries around this process, addressing obvious gaps (such as the variability in quality assurance approaches) and areas where the method was most likely to impact on data accuracy and consistency. In particular, the research looked at:

- the impact of the rating data on current and future KPIs, levels of service and forward works programming
- the appropriateness of the guidance given in the PFM 6 to achieve data accuracy and consistency
- the effects of the sampling regime on data accuracy and consistency including sample size, time of year and speed of survey
- the effectiveness of the annual rating course
- methods to provide quality assurance in the data.

CONCLUSIONS AND RECOMMENDATIONS

The research team looked at the impact that each of the visually rated defects (parameters) used in the rating surveys (alligator cracking, potholes, pothole patches, shoving, rutting, flushing and scabbing) have on the various ways the data is used.

The team was able to recommend ways that data collection for various parameters could be enhanced to reduce current variations in how they were detected and measured. For example, although the team found that visual rating surveys were the best method for identifying alligator cracking, they also found there was substantial variation in how raters assigned values to this defect.

Mike says, 'This type of variation undermines confidence in the survey data, especially when it is being used to measure comparative performance. We recommend ways to improve the accuracy of this parameter, including tightening the acceptable levels of variation in measurement between raters, with tolerances set according to how the data will be used. We also suggest greater guidance on the identification and capture of this type of fault, which could be achieved by updating the PFM 6 and by placing greater emphasis on this fault at the annual rating courses.'

The team makes similar recommendations for most of the other parameters that raters currently survey, including the use of automated high-speed data capture for some of the parameters.

Overall, the team makes a number of recommendations to improve the accuracy and consistency of the road condition rating data, including an assessment of the impact of the recommendations on survey costs. In summary, the main recommendations are as follows.

- Changes to the PFM 6 – update the manual to improve guidance on fault definition, including photographs of fault types. Establish a new category for the fault types with a high influence on the outputs for which they are used (alligator cracking, shoving, rutting and flushing) and tighten the limits of variation for these fault types.
- Rater training – tighten assessment criteria so that raters complete the training course with a consistent approach to rating. Improve opportunities for feedback to raters, potentially through limiting the numbers attending courses. However, the team also stresses that the consistency of survey results should be achieved through the application of effective quality assurance systems during the surveys in the field (rather than initial training) and that this is the responsibility of RCAs.
- Quality assurance procedures – improve the PFM 6 to include quality assurance practice guidelines on the implementation of a common rating sample, used to identify consistent under- or over-reporting. Implement an independent validation service to achieve a better consistency across networks.
- Stratification and sampling – implement a maximum sample length of 200m, ie inspection lengths at a maximum of 200m centres. Sampling smaller sections at more frequent intervals made a significant improvement to the accuracy of the results compared with a 100% coverage. Stratification of coverage could be undertaken by annual surveys for higher level roads, or increased sampling at 20% or 100% against 10% sampling for lower level roads. Using high-speed data capture on higher level roads could also be utilised.
- Procurement – implement multi-year contracts with a preference for weighted attributes over lowest price conforming type evaluation. Specification of quality assurance requirements is recommended with a sample specification included in the research. These contracts also benefit from a combined contract across several RCAs to gain economy of scale savings.

Improvement of visual road condition data, NZ Transport Agency research report 528

Available online at **www.nzta.govt.nz/resources/research/reports/528**

NEW FRAMEWORK PROPOSED FOR ROAD PAVEMENT MONITORING

A review of the NZ Transport Agency's current performance monitoring framework has tested the limitations of historic performance measures and introduced a fleet of new ones.

The Transport Agency and its transport providers use performance indicator analysis and levels of service reporting to help with their investment decisions, assessment of network performance and the achievement of past investments against target.

Accurate reporting on the performance of road networks supports decision-making by:

- detecting and monitoring trends to show the health of an authority's road network (whether it is in good shape or at risk) and to validate whether work programmes are appropriate
- enabling benchmarking and relative comparisons between similar networks to assess the relative cost effectiveness of investment programmes and to set benchmark targets
- informing the development of investment programmes that reflect and respond to the socio-economic and population characteristics of an authority's area, the number of vehicles using its networks, and other factors affecting the levels of service it provides.

The indicators that the Transport Agency has historically used have struggled to give an absolute measure of spending efficiency or network health. To address this, the Transport Agency funded research to completely review its current performance framework, including assessing the effectiveness and limitations of certain performance measures (notably the surface condition index, smooth travel exposure and pavement integrity index) and suggesting improved and new measures that would better meet its needs.

The research was undertaken by Beca Ltd and the University of Auckland. Because of the scope of developing a complete network condition performance framework, the research initially focused on operational performance measures that were able to provide condition monitoring of pavements (surfaces and pavement structures), economic efficiency of maintenance work, and monitoring of bridges and other asset groups (traffic services). Some areas, including gravel roads, road safety monitoring, road capacity and flow, and customer satisfaction, were specifically excluded from the research.

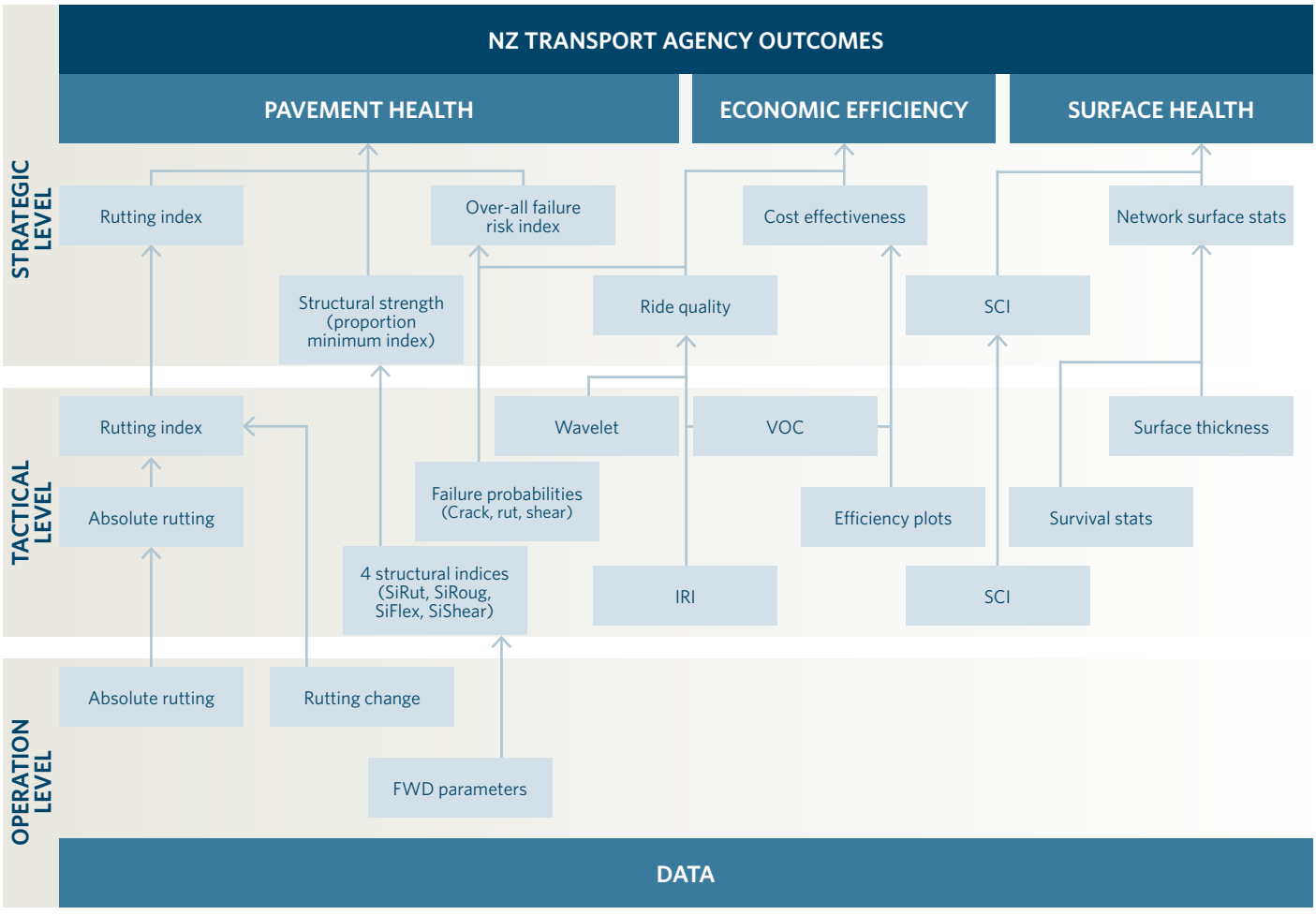
The research developed a suite of indicators for road pavements, as set out in the table below. The research report documents each indicator's background and how it was developed. All indicators were tested on networks to ensure their robustness.

RECOMMENDED PERFORMANCE MEASURES FOR ROAD PAVEMENTS

PERFORMANCE AREA	PERFORMANCE INDICATOR	NOTES/RECOMMENDATION
Pavement structural health	Rutting index (RI)	A combination of the actual rut depth and the change in rut depth during the past three years. Testing of the index revealed that it is sensitive to the network change; however, appropriate weightings for the index need confirmation following intensive use.
	Wavelength	The wavelength spectrum energy levels can be reported in terms of their absolute value and the incremental change over time. Both reporting mechanisms displayed useful result for the understanding of the profile changes. The results also highlighted that roughness changes were different for different speed environments. This needs to be incorporated into future reporting, especially relating to STE.
	Roughness (IRI)	The limitations of the IRI are well understood. However given the significant historical context of the IRI its use should continue. The use of NAASRA should cease.
	Smooth travel exposure (STE)	STE is used for exception reporting and should therefore be supplemented with a distribution plot of IRI. Additional recommendations include: • STE should be reported separately for different speed zones • an STE for trucks should be used on the basis of the truck ride index.
	Pavement integrity index (PII)	The PII should be phased out as soon as the other pavement indices are adopted.
	Structural indices (SIs)	Four SIs are recommended. These represent the four main failure modes of New Zealand pavement types including: • SIRut – based on a subgrade failure criteria • SILflex – based on cracking characteristics of the pavement • SIShear –based on the shear properties of upper pavement payers • SIRough –based on the differential deflection longitudinally to the road. The research demonstrated both the robustness of these indices and their value in performance monitoring. Good correlations were established with actual performance and explainable results were obtained on network level. It should be noted though that the SIs are contextual indices as they neither indicate actual performance nor do they take traffic loading into account.

PERFORMANCE AREA	PERFORMANCE INDICATOR	NOTES/RECOMMENDATION
Pavement structural health *continued*	Failure risk index	A probability of pavement failure was developed for three condition items including rutting, cracking and shear. Pavement strength, physical carriageway and pavement composition plus current condition date are considered for determining the failure index. Positive testing results were obtained from this index. Further work is required to refine the index, especially on urban networks.
Surface health	Surface condition index (SCI)	The current SCI was reviewed on the basis of other research findings. It was also assessed on the basis of network results. In conclusion, there are no recommended changes to the make-up of the SCI. However, some improvement to the index may result from improvements to the data collection –manual rating system. In addition the SCI should report separately on asphalt and chip sealed roads. Significant cracking exists on asphalt compared with chip seal surfaces and reporting the results together skews the results.
	Survival curves	In order to identify the poor performance of surfaces, the use of survival curves is recommended as a comparative measure between networks. This overcomes the limitation of considering either the distribution of current seal or the past performance of surfaces in isolation.
	Total surface thickness	Top surface reporting is an effective way to monitor the resurfacing practices of councils. Total surface thickness above 40mm may be prone to flushing which warrants the monitoring on a network level. It is recommended to use this index on a tactical level only.
Economic efficiency/ economic measures	Efficiency frontier	Efficiency frontier can be developed for any of the performance measures. By normalising the condition parameter and plotting it against the cost of addressing a particular performance measure, one can plot an efficiency frontier that summarises the gains realised for a given investment level.
	Vehicle operating cost index (VOCi)	The VOCi is a ratio between the vehicle operating cost and the VKT travelled on a network. It is therefore a normalised index that indicates the relative cost of travelling on different networks. Testing of this index has revealed that it is very effective in assessing the efficiency of network investment in terms of reductions in user costs.

RECOMMENDED PERFORMANCE MONITORING FRAMEWORK FOR PAVEMENTS

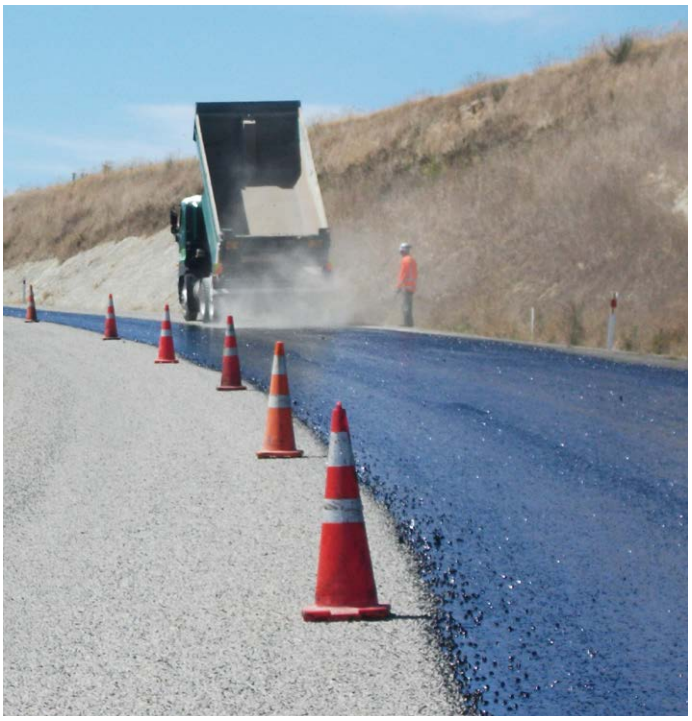


Together, the indices provide a complete monitoring framework for pavements. The framework is divided into the three main areas of pavement health, surfaces and economic efficiency, and organised using a three-tier approach – high level/strategic level, mid-level/tactical level, and low level – with a suggested target audience that will be interested in the indicators at each level. Together, the indices provide a complete monitoring framework for pavements. The framework is divided into the three main areas of pavement health, surfaces and economic efficiency, and organised using a three-tier approach – high level/strategic level, mid-level/tactical level, and low level – with a suggested target audience that will be interested in the indicators at each level.

For bridges and traffic services, the research was restricted to recommending a data framework, as at present there is only limited performance data available for these asset types.

Mike Tapper of Beca says, 'The new framework and associated performance measures will significantly improve the status quo. It will be valuable for all road asset managers, as it can be applied at both local and national levels.

'The real challenge will be in adopting the new performance monitoring concepts, and road authorities' comfort with them. Most of the concepts are new and we have relatively little experience of them. They need to be used, refined and changed as required. We've recommended the establishment of a forum, which could take ownership of the monitoring process, capture the learning from it and make any required changes. Obvious potential members would be road controlling authorities and the Road Information Management Support Group.'



Performance indicator analysis and applying levels of service, NZ Transport Agency research report 529

Available online at **www.nzta.govt.nz/resources/research/reports/529**

MODEL WILL EASE INVESTMENT DECISIONS

A new modelling tool will make public transport investment decision-making easier, by clarifying the economic relationship between prices, service levels and patronage.

The aim of this research project was to develop an economic modelling tool which would help the transport sector in making public transport investment decisions. Developed between 2011 and 2013 by Nick Allison of Logic Partners, in association with David Lupton and Associates and Ian Wallis Associates, the model was tested on bus public transport in the Waikato region, then detailed in an Excel workbook, which can be expanded to include other regions and public transport modes.

The result is a theoretical model that can be used for estimating optimal regional public transport fares and subsidies. The model is built into a flexible software platform that incrementally models the expected changes to regional public transport services (for example, to demand and patronage) as a result of changes to prices (which includes both fares and subsidies).

THE APPROACH

The research team's approach to developing the model assumed that public transport subsidies should be invested in a way that ensures society gains the greatest overall net benefit from public transport (known as allocative efficiency).

Nick Allison says, 'The policy justification for subsidising public transport is generally about achieving allocative efficiency; that is, subsidies are justified on the grounds they are needed if society is to gain the most benefit from public transport, be that for social or economic reasons. Economic reasons might include redressing the imbalance in favour of cars that results from the true cost of road use not being passed on to drivers, or the need to use subsidies to boost public transport patronage in order to achieve economies of scale.

'Government investment in public transport can be justified in this way if the optimal fares or prices, from an economic or social perspective, are different from the average cost of providing the service. The latter approach, of average cost pricing, is what you would use if you were seeking to achieve full cost recovery for providing public transport services.'

From this starting point (that subsidies should achieve allocative efficiency), the model was developed by using the following factors to estimate the optimum fares, and from this the implied subsidy levels, for urban public transport services:

- demand for each mode (ie person trips, person-kilometres: for bus and car)
- marginal costs (including externalities) of each mode, estimated from previous research
- price (charges) for car travel
- price elasticity of demand for each public transport mode and the cross-price elasticity of demand between public transport and car travel.

The result is an economic model that incorporates the interactions between prices, service levels and patronage for public transport (bus initially) and private car, and associated performance indicators.

The model is presented in two formats to make it more useful for formulating investment policy. It can be used to:

- identify the optimum fare for each market segment (eg education or work trips) and time period
- show the effect that a one cent change in fare will have on subsidies, bus users, car users and the environment.

A useful feature of the model is that it allows local authorities to test the effect that different policies will have on their public transport networks.

Nick says, 'The model, and the estimates of optimal fares that it generates, are quite sensitive to the policy responses that a user adopts. Users can select a number of policy responses to changes in patronage, including changes in service frequency, route density, vehicle size and occupancy, and combinations of these factors. Rather than providing an absolute result, the fare generated by the model will vary according to the selection. This makes it a very useful tool for testing many different policies and evaluating their likely outcomes.'

The model also shows the distribution of the benefits from a change in fares or charges, making it particularly useful for guiding investment decisions. In particular, it shows how benefits and costs will be redistributed across users of different transport modes and public transport customer segments, including existing and new passengers. At present it applies to bus and car users, but can be adapted to include rail, where this is a public transport option.

Nick says, 'The investment model complements an investing for outcomes approach by providing guidance on where to invest additional public transport dollars, and by how much.' In an investing for outcomes approach, the primary policy objective is to ensure that subsidies are allocated to areas and transport modes where the national benefits flowing from an additional dollar of subsidy investment will be the greatest.

However, in its current form as a regional model the model is likely to have limited use at a national level.

'Further work on calibrating the transport models would be needed before the results could be used with confidence for guiding national public transport investment decisions,' says Nick.

'Our intention was always to provide a flexible platform capable of being extended to meet future policy requirements. Fruitful areas for further research include the possibility of extending the model to other regions, incorporating rail (Wellington and Auckland), interfacing with regional network models within regions, and incorporating other additional modelling capabilities, such as service levels.'

The model could also be developed in a way that would enable it to be used in benchmarking exercises.

In its present format, the model contains a range of input measures, including patronage, passenger-kilometres travelled, occupancy and operating costs, all of which are relevant to benchmarking both across and within regions. In future, it could be configured in a way that enables these measures to be used as performance indicators.

Development of a public transport investment model, NZ Transport Agency research report 524

Available online at **www.nzta.govt.nz/resources/research/reports/524**

Composite ladder deck bridge – Gilchrist Bridge, Te Rapa bypass, near Hamilton

COMPREHENSIVE GUIDE PUBLISHED FOR COMPOSITE BRIDGE DESIGN

A new report offers guidance for both novice and experienced bridge designers on designing cost-effective steel–concrete composite bridges.

Steel–concrete composite bridges are an efficient and cost-effective form of bridge construction. A recent NZ Transport Agency funded research report provides an extensive guide for New Zealand bridge designers on two of the most common types of composite bridges.

The report includes guidance on the preliminary and detailed bridge design process, as well as verification of the design's structural adequacy, in accordance with the latest edition of the Transport Agency's Bridge manual, together with the relevant design and material standards. It describes the determination of design forces, identifies key features relating to the design of the different structural components and gives structural detailing advice. It also provides additional guidance on cost-effective design philosophy and durability design.

Intended for use by both novice and experienced bridge designers, the guide assumes that the user is familiar with the general principles of limit state design and has some knowledge of structural steelwork.

The two types of composite bridge covered by the guide are: the typical multi-girder steel–concrete composite bridge, which consists of a number of steel girders with bracing in between and a slab on top; and the ladder deck bridge, which consists of two main girders with a number of secondary cross girders in between that support and act with a deck slab.

Both types of bridge provide a cost-effective solution and the choice between them depends on economic considerations and site-specific factors, such as the form of intermediate supports and construction access.

Other types of steel–concrete composite bridges are also presented within the report.

BENEFITS AND RISKS OF STEEL–CONCRETE COMPOSITE CONSTRUCTION

Steel–concrete composite bridges are constructed using steel girders, with reinforced concrete slabs on top. By combining the tensile strength of steel in the main girder with the compressive strength of concrete in the slab, the bending resistance of the materials is greatly increased and larger bridge spans become possible.

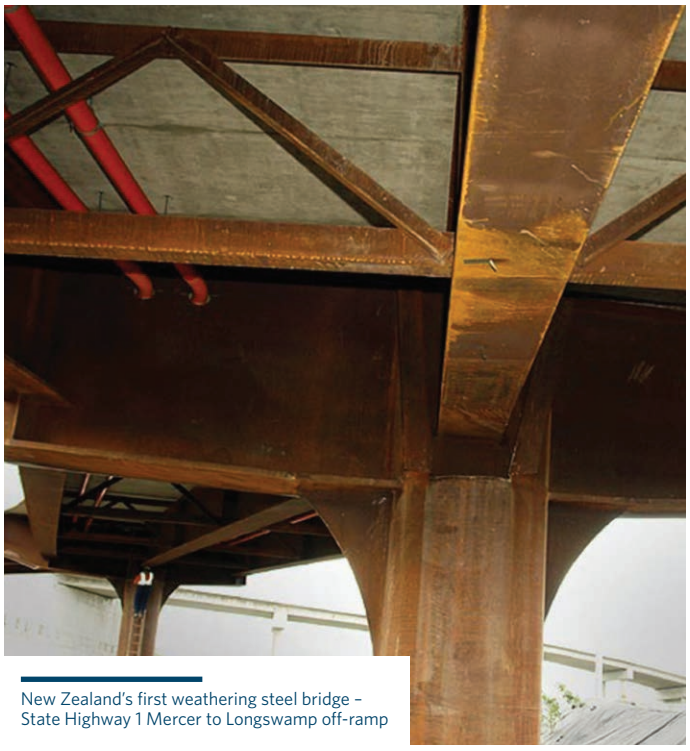
At present, most short span bridges in New Zealand (and elsewhere around the world) with spans up to 30m have been built in concrete. Steel bridges are commonly used for medium spans (between 30m and 80m) and longer spans (greater than 80m). However, a well-designed steel–concrete composite bridge, comprising steel girders and reinforced concrete decks, will also provide an economical and sustainable solution for short, medium and long span structures.

Specific benefits of composite bridges can include strength (combining steel and concrete in a single composite structural member enhances its strength and stiffness); sustainability (both steel and concrete are readily available in New Zealand and increasingly recyclable); and economic factors (composite bridge designs can offer cost-effective design options for bridges of all lengths).

As with any bridge, there are risks if composite bridges are not designed and constructed properly. The research report gives detailed guidance on these risks, and how to mitigate and manage them; including considerations that designers will need to take into account when designing and constructing composite bridges.

In particular, the importance of specifying the correct corrosion protection systems for steel elements is emphasised as, not only do the steel reinforcement bars in the concrete slab require appropriate cover, but correct coating application and inspection, and an effective maintenance programme are crucial aspects of composite bridge design construction and management.

'Durability design of steel and concrete must be considered by designers, and is an important aspect of a successful cost-effective design of any bridge structure,' the report states.



New Zealand's first weathering steel bridge – State Highway 1 Mercer to Longswamp off-ramp

Steel–concrete composite bridge design guide, NZ Transport Agency research report 525

Available online at **www.nzta.govt.nz/resources/research/reports/525**

NEW RESEARCH REPORTS

Improving the cost-benefit analysis of integrated PT, walking and cycling

NZ Transport Agency research report 537

Available online at www.nzta.govt.nz/resources/research/reports/537

This research project developed an evaluation framework for estimating the cost-benefit analysis of integrating public transport with walking and cycling.

The research was based on a review of the available international evidence of public transport access and egress behaviour. Where evidence was available, analysis of trip chains from the New Zealand Household Travel Survey highlighted patterns of public transport access and egress in a New Zealand context and, importantly, provided an indication of the mode shift and trip generation impacts of improved access to public transport.

This research report is accompanied by a spreadsheet evaluation tool, which can be employed to estimate the dollar value of improvements to the integration of public transport, walking and cycling. The research compared the monetary appraisal values from international business case guidance with the NZ Transport Agency's Economic evaluation manual, and the evaluation tool is consistent with this guidance.

The report includes a review of how walking and cycling at either end of a public transport trip is represented in data collection, transport planning and modelling, and makes practical recommendations to aid integrated planning in the future.

A new vehicle loading standard for road bridges in New Zealand

NZ Transport Agency research report 539

Available online at www.nzta.govt.nz/resources/research/reports/539

This research report proposes a new vehicle loading standard for the design and evaluation of road bridges and other highway infrastructure in New Zealand. It is based upon a literature review of current traffic loading and bridge evaluation specifications in New Zealand and overseas, as well as a review of studies into the economic aspects of bridge design loadings and the economic benefits of increasing the mass limits of heavy vehicles in Australia and New Zealand.

The development of a new design loading standard took into consideration the future freight need and likely configuration of vehicles to meet that need, as well as analysing the loading from current traffic. Weigh-in-motion data, responses to an industry questionnaire on desired vehicle configurations, loading effects from a range of legally loaded vehicles, permit application vehicles and mobile cranes were all considered in determining the recommended design vehicle loading standard. New evaluation loading standards are recommended for Class 1 and HPMV vehicle loading.

The report also includes recommendations on axle and wheel loading, lane widths and number of lanes, multiple presence, dynamic load allowance, horizontal loads and load factors.

Customers' requirements of multimodal travel information systems

NZ Transport Agency research report 540

Available online at www.nzta.govt.nz/resources/research/reports/540

The purpose of this research was two-fold: 1) to provide evidence-based recommendations that identify the Transport Agency's customers' key information needs, and 2) to provide best-practice guidance on ways the Transport Agency can best offer and 'push' the delivery of multimodal travel information that is tailored to individuals.

The research was carried out in three stages between November 2012 and June 2013:

1. Literature and best-practice review of current travel information provision, both in New Zealand and internationally
2. Focus groups/structured interviews to examine key traveller information needs and to conduct a practical assessment of the usefulness of the various delivery systems in a New Zealand context
3. Online interactive survey to provide a quantitative assessment and priority ranking of travellers' information needs.

This report describes the above work and provides recommendations for future actions.

Driver risk from blood alcohol levels between 50mg/100ml and 80mg/100ml

NZ Transport Agency research report 541

Available online at www.nzta.govt.nz/resources/research/reports/541

The goal of the research was to evaluate the effects of alcohol on the performance of New Zealand drivers across 0.05% and 0.08% blood alcohol concentration (BAC) levels. An experimental test was conducted with 61 participants assigned to one of two alcohol dose conditions or a placebo control group. Comparison of alcohol doses showed that a BAC of 0.08% produced a level of impairment significantly worse than the placebo control. Impairment included edge and centre line crossings in the driving simulator, disinhibition of reactions to vehicles at intersections, and errors learning and recalling a computer-based maze. Moderate alcohol (BAC of 0.05%) produced some performance decrements, but not to the same degree as a BAC of 0.08%.

An analysis comparing the impairment associated with peak and post-peak intoxication revealed that while some aspects of performance (eg motor coordination and response inhibition) showed acute tolerance, other measures (eg maze learning and recall errors, edge and centre line crossings, and maximum speeds) showed acute protracted errors. Finally, participants were not able to accurately judge how much alcohol they had consumed or their level of intoxication (particularly the high dose group), and subjective ratings of intoxication were not a reliable indicator of their performance impairment.

Pavement design for specialist surfacings

NZ Transport Agency research report 543

Available online at www.nzta.govt.nz/resources/research/reports/543

Leutner shear tests to measure bond strength and flexural beam tests to measure flexibility were conducted on specialist surfacing resins used in New Zealand for coloured and high-friction surfacings. The flexural beam tests found the specialist surfacing resins, except for one, to be very flexible at 5 and 20 degree test temperatures. This flexibility showed that the specialist surfacing resins should be able to cope with high pavement deflections and rut depths up to 20mm and the underlying asphalt would crack before the specialist surfacing did. Leutner shear tests showed one out of five resins tested on fresh asphalt cores achieved full bond strength (the same as the asphalt mix shear strength) and all resins achieved the full bond strength when the asphalt surface was water cut before applying the specialist surfacing resin.

NEW RESEARCH REPORTS

The relationship between crash rates and rutting

NZ Transport Agency research report 545

Available online at www.nzta.govt.nz/resources/research/reports/545

This report details research carried out in Wellington, New Zealand, during the period 2012–2013. The broad aim was to develop relationships between rut depths and crashes on New Zealand's state highway network.

A literature review suggested that deep ruts could either:

- increase crash rate because of reduced vehicle control, or
- reduce crash rate as drivers reduced speed in order to keep their vehicle under control.

A method of predicting pond depth on New Zealand's state highway network using New Zealand databases was developed. Comparisons of predicted flow path length with measured data were encouraging.

Key findings of statistical studies of the relationship between crash rates and rutting on New Zealand's state highways were:

- very little of the network has 10mm–30mm rut depths
- crash rates decrease slightly as rut depth increases over the normal range of rut depths, particularly for dry crashes
- water accumulating on the road surface may have an effect on crash rates because of poor run-off.

Due in part to the paucity of ruts in the 10mm–30mm range, statistically robust benefit-cost ratio estimates could not be calculated. However, for shallow ruts, the statistical modelling indicated that filling could not generally be justified.

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

DID YOU KNOW...

That there is a spreadsheet on the Transport Agency website listing all published Transport Agency research reports?

The spreadsheet is searchable by several criteria and can be found at **http://www.nzta.govt.nz/planning/programming/research**

The spreadsheet has two worksheets; the first worksheet lists research reports with associated key words and the second lists research reports with the report abstracts.

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?

We would like to hear from you at research@nzta.govt.nz if you wish to update your name or address details, or to alter the number of hard copies of NZTA research you'd like to receive.

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NZ TRANSPORT AGENCY WAKA KOTAHI

New Zealand Government