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Explain yourself! Investigating roads that help drivers slow down

A search for the most effective forms of speed change management has drawn on international research and local observation to recommend measures with consistent speed-reducing effects.

Inadvertent speeding, where motorists are unaware that they are exceeding the speed limit, is a significant safety issue. It poses a particular problem in situations where speed limits change, either because the motorist is passing from the country into an urban area or because they are entering a specific lower-speed situation, such as a motorway off-ramp or the environs of a rural school.

Many villages and towns, both in New Zealand and overseas, have adopted village gateway or rural–urban threshold treatments (generally referred to as urban thresholds) to reinforce to motorists that they must slow down. Examples might be installing large speed limit and welcome signs, road narrowing, cross-hatching, traffic islands or combinations of all these, but results from the installations have been variable.

While some villages have found that drivers have responded and speed has reduced, others have found that any effect has been temporary until drivers get used to the new look or, worse, that the installations have had the opposite effect and speeds have increased. Even where the threshold treatments are effective, it is not uncommon for drivers to forget about the lower limits once they are safely past the entranceway and for speeds to creep back up.

However, approaches overseas based on self-explaining road principles have been shown to produce significant reductions in vehicle speeds, crashes and injury rates. In 2004, the Ministry of Transport released the National Speed Management Initiative, which states:

The emphasis is not just on speed limit enforcement, it includes perceptual measures that influence the speed that a driver feels is appropriate for the section

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of road upon which they are driving – in effect the 'self-explaining road'.

A research project funded by Land Transport New Zealand, begun shortly before the initiative's release, sought to identify speed management approaches suited to New Zealand along the lines of the self-explaining road initiatives used overseas.

The result has been a set of specific recommendations about road design characteristics that are effective not only to prompt drivers to drop their speeds but to remind them to keep them down, plus recommendations for how sustainably safe and self-explaining roads could be implemented in New Zealand.

Managing the change

A review of the international literature on speed management identified two distinct types of speed-management treatments, with different functions:

- speed-change treatments that indicate to drivers when they need to change speed
- speed-maintenance treatments that encourage drivers to maintain an appropriate speed while they are within a particular speed zone.

The literature also indicated that differing treatments have variable effectiveness depending on how and in what combinations they are used.

In general, it was found that manipulations of lane width, the number of lanes and the use of a central median have the greatest effects on speed maintenance or compliance within a zone.

For speed change areas or threshold designs, what treatments will be effective depends on the speed profile:

- for lower-speed transitions, physical measures employing curb extensions, flat-topped speed humps and changes in road surface texture and colour are the best option
- for transitions at higher speeds, perceptual measures using edge lines, hatching, angle parking and landscaped central islands produce the best results.

Unfortunately, New Zealand data on the effectiveness of various speed-management treatments was not strong, but by combining local observational studies with a survey of international researchers and practitioners, the research team was able to make road design recommendations that would lead to effective speed management.

Identifying effective design

To create roads that were sustainably safe and self-explaining for drivers, road designs needed to:

- manipulate a constrained set of road features
- elicit the correct speeds from drivers
- allow drivers to readily recognise the road category and distinguish it from others
- increase homogeneity of speeds (by minimising differences between individual drivers)
- resist habituation and behavioural adaptation.

The project team has identified the most promising speed-management design features for the New Zealand context. These include designs for:

- speed maintenance for urban and rural through and distributor roads, and access roads
- speed-change management for drivers passing from through to distributor roads, and distributor to access roads.

The features of these designs are summarised in the following tables (see next page) but more detail about them, and guidance on their application, can be found in the full research report.

Overall, the research found that taking a self-explaining road approach to speed management in New Zealand, as envisaged in the Ministry of Transport's initiative, was not only practical but had the potential to save the country substantial amounts of both lives and dollars.

What is a self-explaining road?

Sustainably safe or self-explaining roads take an area-wide (as opposed to a localised) approach to traffic calming and speed management. They aim to reduce and manage speeds in a long-term way, using physical interventions (speed humps, curb extensions, etc), visual treatments (signs, road markings, etc) and drivers' own learned driving habits.

Self-explaining road designs make it clear for drivers what type of road they are on. If used consistently, drivers will recognise and understand the designs, and adjust their driving behaviour (and speeds) accordingly.

This consistency is the key to the success of self-explaining roads – once a combination of features has been selected that brings about the desired driver speed, then this combination needs to be applied consistently across the speed-management area. Over time, drivers learn that every time they see a road that looks a certain way, they need to drive at a certain speed. In that way, self-explaining roads ensure that their effects are long-lasting.

Generalised design characteristics for speed maintenance

Characteristics	Road category				
	Through		Distributor		Access
	Urban	Rural	Urban	Rural	Residential
Design speed	60–70	100–110	50	80	30–40
Number of lanes	2+2	2+1 or 2+2	1+1 or 2+2	1+1 or 2+1	1 or 1+1
Lane width (m)	3.75	3.5	3.5	3.25	2.5
Centre median	Planted median	Barrier	Raised or planted	Barrier	None
Cycle lane	Yes (separate)	No	Yes	No	Shared
Footpath	No	No	Yes	No	Shared
Road surface	Smooth	Smooth	Smooth	Smooth or rough	Coloured and/or textured
Centre line	None (median)	None (median) or double	Dashed	Double or dashed with raised reflective pavement markers (RRPMs)	None
Edge line	Solid	Solid	Solid	Solid	None
Clear zone (m)	1–10	1–10	0–6	1.58–8	0–1.5
Other	Landscaping	Side barriers and RRPMs	Raised zebra crossings	Side barriers and RRPMs	Speed humps

Generalised design characteristics for speed-change thresholds

Characteristics	Threshold type	
	Through road → distributor road	Distributor road → access road
Signage	Static signs	Oversized, both sides of road
Perceptual narrowing	Edge lines, hatching, angle parking, etc	
Physical narrowing		Build-out (curb extension) or chicane
Road surface		Change in road texture and/or colour
Speed table		Speed table
Other	Roundabouts or landscaped central islands	

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Speed change management for New Zealand roads, Land Transport NZ research report 300, $25.00. See page 12 for details about obtaining reports.

Recommendations make road works safer

Truck-mounted attenuators (TMA) are intended to create safe environments for both drivers and road work crews. However, a number of serious accidents in recent years involving TMA, including two with fatalities, have prompted a road industry investigation and new guidelines for best TMA use and design.

A new code for TMA

Clear findings from the research have enabled a set of recommendations to be drafted for TMA design and use.

As a top priority, it is important that, where possible, advance warning systems should be put into use immediately. Advance warning systems are large message boards (carried static or mobile on the back of trucks) that are situated in the road's shoulder and warn drivers that the lane will be closing up ahead. The signs need to be simple for drivers to understand, with large format and strobe lights to attract drivers' attention. The project team felt that, if advance warning signs were used, then there would be no need for a second tail TMA to be used for left-lane closures.

Recommendations are also made for ways to increase the visibility of TMA truck units. Flashing exon halogen strobe lights mounted above the message board and advance warning board, and retro-reflective tape attached to the message board and TMA truck were considered effective. Supplementary warning signs carried next to the message board can also help drivers understand the required lane shift ahead.

Finally, the timing of operations involving TMA is important. Driver recognition and manoeuvrability improves as traffic volumes reduce, and restricting TMA use to off-peak hours would enhance the safety of both road users and workers.

The road industry working group, formed in 2004, set out to investigate driver perception and reaction issues associated with TMA use. Following a review of practice here and overseas, and a research project to test the options, the group has made new recommendations about how TMA should be used and designed.

It is hoped that the recommendations will be incorporated within a new code to be followed by all industry operators who use TMA in the course of their work. This national consistency is a crucial part of the recommendations: adopting a uniform approach will help make TMA messages clear and recognisable for drivers, and hence enhance their effectiveness.

TMA

TMA are trucks that have an energy-absorbing attenuator or crash cushion mounted on their rear to dissipate the impact energy from a rear-end collision. They are widely used in New Zealand for road work sites on state highways and regional roads that carry high volumes of high-speed traffic.

TMA are most commonly used for stationary and mobile short-term road operations such as road marking, road inspections and testing, mowing and spraying, installing road closure signs, safety barrier and pothole repairs, clearing snow and spreading grit.

Usually, two TMA will be used on any job – the shadow TMA sits immediately behind the work vehicle (either stationary for short static operations or moving slowly for mobile operations), while the tail TMA sits some distance behind the shadow TMA, either in the same lane or in the road shoulder, to give drivers advance notice of the lane closure. In either case, the TMA truck needs to be carefully positioned to ensure that workers in front remain protected.

Most TMA used in New Zealand combine the attenuator with a rear message board to warn traffic to change lanes. In the event that a driver doesn't notice the TMA and runs into it, the attenuator not only dissipates the kinetic energy from the crash but also prevents the impacting vehicle from shearing off at the roof and riding under the truck body. Other common features of TMA are warning signs attached to the message boards, eg, the Road Works warning sign, and warning lights and retro-reflective tape on the signs or vehicle.

Mounting concerns

In New Zealand, current practice for use of TMA is set out in Transit New Zealand's *Code of practice for temporary traffic management* (June 2004). Yet, despite this code, there were 39 incidents involving TMA in the five years between July 1999 and July 2004, and two of these involved four fatalities.

In addition to this high incident rate, there is mounting concern within the road industry that the visual enhancement systems (such as signs, lights, tape, etc) being used on TMA

could in fact be adversely affecting safety by providing inefficient messages that divert drivers' attention.

Also of concern is the lack of visual consistency between the various TMA used by road work companies, and differences in when and how TMA are used and where they are placed. This lack of consistency could further confuse drivers, distracting them from the task at hand of avoiding the road works.

The research approach

The research evaluated the visual performance of existing TMA and TMA that had been modified to visually enhance either the TMA or the message board, and their operation during day and night, under actual driving conditions during clear weather.

TMA were monitored and evaluated using recognition distance (the distance at which the TMA could be seen and correctly identified by drivers, and followed by the manoeuvre of changing lanes or indicating intention to) and by the percentage of vehicles that entered the critical zone (distance of road that is shorter than the safe stopping sight distance).

The outcomes were compared to assess the comparative performance of existing TMA and the effectiveness of the modifications made.

Four clear findings emerged from the research:

- the effectiveness of advanced warning systems in improving driver reactions to TMA
- the ability of flashing strobe lights to improve drivers' perception and reaction times, and increase recognition distances
- the importance of using wide retro-reflective tape around the edges of message boards to improve recognition distances
- the effect of traffic volumes on recognition distances, reflected in the better results obtained at night compared to during the day when traffic flow was heavier.

Previous studies and TMA design and use overseas were also looked at, as were the physiological and psychological characteristics that enable a driver to respond and take action in respect of hazard warnings. If TMA were to be effective, they needed to be designed taking these characteristics into account, and the project team's recommendations were made from this foundation.

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Best practice for use and design of truck mounted attenuators (TMA) for New Zealand roads, Land Transport NZ research report 301, $60.00. See page 12 for details about obtaining reports.

Planning for a quieter future

Land use planning is the process of assigning land to different uses, and is increasingly being seen as an effective way to manage the impact of transport noise, both in new developments and established areas. New research points out some of the ways that we can plan now for a quieter future.

Noise from land transport is a growing issue. Traditionally, New Zealand has seen itself as a country with lots of room – we had few people, spacious towns and plenty of open places to explore or find peace in. But this very space, combined with a growing population and our increasing reliance on cars to get us around it, is threatening to shatter our peace.

Trends in New Zealand are consistent with those occurring overseas: the number of vehicles on our roads, the number of movements they make, the speeds they are travelling at and the use of heavy vehicle freight are all on the increase, and all spell more noise.

Yet it is only in recent years that noise has been recognised as an important environmental and social issue that needs to be managed. In the past, it has been treated as an inevitable, and largely acceptable, by-product of development, and from an environmental viewpoint, of much lesser importance than other issues such as air and water quality, and biodiversity.

Nowadays, the impacts of noise on people and communities are better understood. Too much noise can interrupt everyday activities and disturb sleep, leading to stress-type responses and significant health problems. Adverse effects are exacerbated for sensitive land uses such as hospitals, educational establishments and care facilities for elderly people and children.

Concerns about the impacts of excess noise have pushed it up the agenda in many overseas countries and organisations: the World Business Council for Sustainable Development, the Organisation for Economic Cooperation and Development, and the United Nations Economic Commission for Europe have all developed strategies to address transport noise, as part of their work to seek sustainable outcomes for transport.

There are various options available to address transport noise, including:

- technical options that focus on vehicle and infrastructure design
- regulations and controls, such as building controls, to mitigate the noise at the receiving end
- legal methods used to set and monitor noise limits.

Land use planning is just one of these options. However, it is increasingly being seen as a key tool for combating noise, both as part of new developments and within existing urban areas.

How does it work?

Land use planning for noise can occur at a national, district or local level. It is most effective for addressing transport noise in a strategic manner (ie, as a preventative pre-planning tool to create an acceptable noise environment, as opposed to reacting to an already unacceptable one).

Locally, land use planning can include such things as setting rules about building design and orientation, and erecting noise barriers around sensitive sites.

At a regional level, planning occurs through district or regional plans: a common approach is to make land use, growth and transport predictions for an area, then develop land use plans that help to minimise the impact of noise. Examples would be restricting the uses that land bordering major road corridors can be put to, and requiring buildings to be set back from roads. Rules and restrictions on urban design are also effective.

What is land use planning?

In its simplest definition, land use planning is the process of assigning land to different uses. In New Zealand, it is often seen as synonymous with the planning requirements of the *Resource Management Act 1991*.

In recent years, land use planning has evolved from the traditional concept of town planning that provides for infrastructure and services, to a tool for achieving sustainable outcomes. The European Environment Agency defines land use planning as:

The systematic assessment of land and water potential, alternative patterns of land use and other physical, social and economic conditions, for the purpose of selecting and adopting land use options which are most beneficial to land users without degrading the resources or the environment, together with the selection of measures most likely to encourage such land uses.

Land use planning can occur at an international, national, district or local level, and good land use planning involves land users, planners and decision makers. This participatory approach is inherent in the *Resource Management Act 1991*.

How much is too much noise?

Internationally, standards for what is considered too much noise in given situations do vary, although most agree that exposure to any noise over 65 dBA is highly undesirable.

The World Health Organisation recommends maximum noise levels of ≤ 30 dBA in sleeping areas, while for outdoor living areas in residential areas, exposure levels should not exceed 50–55 dBA.

There are currently no national standards for noise exposure in New Zealand (voluntary standards, set by Standards New Zealand, do exist for port and airport noise). Some local authorities include performance levels for noise in their regional or district plans, but there is a lot of variation between the standards set.

Nationally, standards can be set for noise, building controls and urban design, which can then be used by councils to control noise in specific areas.

In New Zealand, the current approach to transport noise management is largely on a localised project-by-project basis. New developments are assessed for environmental impacts, including noise, and mitigating measures may be required.

Although most local authorities have provisions in their district plans about noise, few include specific provisions on transport noise, and there is very little guidance on how land and transport should be developed in an integrated manner. Where provisions do exist, there are difficulties with monitoring and enforcing them, and a common complaint from councils is about the lack of consistent guidance available on exactly what constitutes acceptable standards for noise.

Although there is some strategy and guidance on transport noise in national documents such as Transit New Zealand's *Planning policy manual* and the *New Zealand transport strategy*, this is usually just as a small part of larger transport issues. What is lacking is national guidance, such as a national environmental standard on land transport noise, that can provide consistent direction for planners, developers and individuals. Such standards are possible under the *Resource Management Act 1991*, and are used to set mandatory minimum standards for environmental and resource issues that apply nationally. A standard on noise might include minimum acceptable noise level criteria, which councils could use to set rules for both land use and noise emissions from transport routes.

Taking a national approach

International experience has clearly shown that a national-level centralised approach to managing noise is effective. In addition to providing consistency, national direction sets a baseline for protecting people's health and the environment from noise. A national-level approach also enables decision making about land use, the integration of environmental and transport policies, fostering a sustainable approach and ensuring long-term success.

Six steps to a quieter future

The information in this article draws on research carried out between 2004 and 2005. The research report *Land transportation and noise: Land use planning for a quieter New Zealand* makes six recommendations about how land use planning could be used to good effect to manage land transport noise levels in New Zealand:

- integrate land transport noise controls at a national level – to include policies and actions of various government departments and agencies on land use planning, transport planning, vehicle-based controls, building controls, road design and the retrofitting of on-road noise mitigation measures
- implement a national environmental standard – to provide a mandatory centralised starting point from which to address land transport noise issues
- use the World Health Organisation maximum noise standards as a starting point for New Zealand policy
- establish the preferred criteria for noise measurement – there are some shortcomings in current measures that need to revisited and addressed
- develop effective land use planning objectives, policies and rules in plans
- undertake noise measuring and monitoring.

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Land transportation and noise: Land use planning for a quieter New Zealand, Land Transport NZ research report 299, $30.00.
See page 12 for details about obtaining reports.

New framework for proactive natural hazard management

A research project funded by Land Transport NZ has developed a framework that authorities can use to set performance levels for roads at risk from natural hazards.

The project grew from awareness that there were no criteria available in New Zealand for setting such performance levels.

Natural hazards can cause considerable damage to road networks, creating disruption and cost and increasing risks to people's personal safety. At present, New Zealand roads that are subject to natural hazards tend to be managed reactively, ie, after the event, and in an ad hoc way. By setting and monitoring performance levels for these roads, they can be managed to improve their resilience to natural hazards, enabling important roads to stay open or re-open sooner following an event.

The recently published *Natural hazard road risk management part III: Performance criteria* sets out the framework and is the third part of a research project begun in 2000. The first and second parts of the project developed ways to identify, assess and manage natural hazard risks to road networks, plus key ways to implement these approaches.

The current stage of the project drew on information about the impacts of past natural hazard events, plus consultation with stakeholders from the road and emergency management sectors, to develop the framework.

The first step when using the framework is to establish the factors that influence and constrain performance criteria on any given road network. In doing this, it is important to draw on a range of expertise and interests, through consultation with stakeholders such as road controlling and road transport authorities, road user and community groups, lifeline services and emergency management bodies.

Once the influencing and constraining factors have been agreed on, broad performance measures for the network can be set. A detailed review of the entire road network should then be carried out and levels of service set for the various priority links that make it up. This review should include consideration of the risks, mitigation work required and the wider road network, as well as consultation with other road controlling authorities.

The framework also provides guidance on incorporating performance measures and levels of service, once agreed, into asset management and emergency response plans.

As part of the project, the framework was tested on a section of the Wellington road network to see how the suggested approach worked in practice. No specific performance levels are recommended in the report, however, as individual performance measures and service levels need to be set for each road network. This ensures that levels reflect the actual natural risks that the network is subject to, the constraints that affect its performance, such as costs and resource availability, and the needs of its local communities.

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Natural hazard road risk management part III: Performance criteria, Land Transport NZ research report 296, $35.00. See page 12 for details about obtaining reports.

Image supplied by Environment Waikato.

Recycling a good option for asphalt millings

Asphalt millings look set to gain a new lease of life following recent New Zealand research into their properties. Research on applications of asphalt millings on New Zealand roads found that millings from road pavements being resurfaced or renewed have many suitable uses, including building new pavements or repairing worn ones.

Asphalt is the most recycled material in the world. Internationally, asphalt millings are used extensively in the production of hot mix asphalt, although they also have uses as road sub-base layers or base layers, and in bituminous pavement patching mixes.

The research was carried out on six samples of processed and unprocessed millings, testing each sample's characteristics and mechanical properties. The results showed that the millings' properties were generally as good as, or better than, those of conventional sub-base aggregates. In addition, field studies of two sites where millings were being used, including as a temporary base layer for a busy arterial road in Auckland, found that they had performed well in these applications.

The research found that:

- processed millings are appropriate for use in sub-bases (or lower level applications) in urban and rural road pavements
- processed millings treated with slow-break emulsion are a favourable alternative to unbound aggregates on unsealed roads
- repeated load triaxial tests can be used to determine if millings are appropriate for specific applications
- millings mixed with an organic solvent are a cost-effective and environmentally friendly alternative to plant mix for minor pavement repairs
- pavement designers should consider the potential for achieving reduced permeability in millings layers if the material achieves a reasonable degree of cohesion.

Transit New Zealand has recently recognised the need for road materials to be recycled, for both economic and environmental reasons. From the research, the prognosis looks good for recycling asphalt millings as an important step towards achieving this. Internationally, there have been few detractions aired about the use of asphalt millings, although concerns have been raised in parts of the United States about their environmental soundness, in particular the possibility of leaching.

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Applications for asphalt millings on New Zealand roads, Land Transport NZ research report 298, $35.00. See page 12 for details about obtaining reports.

New research publications

Increasing cycling and walking: An analysis of readiness to change
Research report 294
C Sullivan, Capital Research and C O'Fallon, Pinnacle Research
$40.00

In 2003, Sport and Recreation New Zealand (SPARC) and the Cancer Society of New Zealand commissioned a major nationwide survey to segment adult New Zealanders in terms of physical activity and healthy eating habits. The questionnaire included several transport-related questions. The resulting 'Obstacles to action' database (with responses from over 8000 people aged 16 or over) thus provides opportunities to analyse transport responses with a larger sample size than is usual with New Zealand surveys. This report analyses the database with respect to cycling and walking.

A focus is the 'stage of change' questions, which can be useful for developing and monitoring active transport promotional strategies, given that behaviour change may often first involve a number of process steps.

Current cycling and walking, together with stage of change for cycling and walking, were first analysed for demographic differences (age, gender, ethnicity, level of urbanisation, region, effect of children, work status, household income). Differences between stages of change with respect to motivations, perceived benefits and perceived barriers (physical activity in general) were also briefly considered, as well as readiness to replace car trips with walking and cycling, relevant environmental perceptions and perceived environmental barriers.

Intelligent transport systems: What contributes best to the NZTS objectives
Research report 302
R James, Hyder Consulting Ltd
$45.00

This study documents international experience on the benefits gained from the implementation of ITS, and compares these benefits with the key outcomes sought in the *New Zealand transport strategy* (NZTS) and *Land Transport Management Act 2003* (LTMA).

The NZTS sets out the government's overall vision for transport and is underpinned by series of principles and objectives. The report provides guidance on the ways in which different ITS initiatives can contribute to these objectives.

Using a matrix structure, each application is assessed in terms of the types of benefits produced, considering each benefit area in the context of the scale of overall benefits. Following this matrix-based assessment, each application is summarised, setting out the types and scale of benefits produced by different ITS applications, potential problem areas and conditions in which they are best applied.

The conclusions identify the systems or groups of systems that have the greatest potential to provide benefits in the context of the NZTS and LTMA objectives. The highest-rated applications include a strong focus on travel demand monitoring, management and control, as well as the early detection and management of specific problems, monitoring road weather conditions, prediction of adverse conditions, informing drivers and assisting in more effective response and treatment.

A review of the HDM/dTIMS pavement models based on calibration site data
Research report 303
TFP Henning, SB Costello and TG Watson, MWH NZ Ltd
$25.00

New Zealand started a Long-term Pavement Performance (LTPP) programme on the state highway network during 2000. This report presents the first concrete outcomes from the calibration analysis, undertaken in 2005.

The cracking model, particularly the crack initiation model, is one of the most crucial in the simulation of pavement deterioration. It contributes to many other pavement models, such as roughness and rutting. A comprehensive process of data analysis was carried out, including a traditional calibration coefficient adjustment of the HDM-4 model, adjustment of all HDM model coefficients based on maximum likelihood estimation, linear model regression and logistic model development. The same process was followed for the texture and rut progression model. The simplified model format of the texture model has been calibrated. Reviewing the model format of the rut progression has been less successful due to data shortages, but a path for the next stage of development is proposed.

This research from 2005 highlights the merits of the various calibration and model-development techniques, as well as providing a comparison of the model outcomes. This is done both in terms of their accuracy in predicting crack occurrence on a network and their applicability to networks outside of the development area.

Predicting in-service performance of alternative pavement materials for New Zealand conditions
Research report 304
BT Vuong, ARRB Group and G Arnold, Pavespec Ltd
$30.00

This research proposes a new practical method for predicting the performance of unbound granular materials, including alternative, industrial by-products and recycled materials in New Zealand.

This investigation, carried out in 2005, utilised available field performance data in New Zealand to calibrate/validate available material assessment methods based on laboratory repeated load triaxial testing. The recommendation is that the simple ARRB

performance assessment method, which is based on a reduced set of permanent strain results obtained from the existing Austroads repeated load triaxial test method, be used in material specification.

Further research should be undertaken to improve and simplify general deformation prediction models, which are based on a full set of permanent strain results at various tress levels, to make them suitable for practical use in pavement design.

Assessing the environmental effects of new and recycled materials in road construction: Proposed guidelines
Research report 306
P Herrington, Opus Central Laboratories, I Kvatch, Opus Central Laboratories and K O'Halloran, Landcare Research Ltd
$20.00

Guidelines were developed to assist New Zealand roading authorities, roading contractors and suppliers when deciding whether to approve, or seek approval for, new or recycled materials for road construction. A three-stage process for material evaluation was recommended.

Stage 1 – initial assessment

Existing information should be examined to determine (a) if the material is hazardous and (b) whether or not it needs to undergo approval by the New Zealand Environmental Risk Management Authority. Where sufficient information is not available, stage 2 testing is recommended.

Stage 2 – material screening tests

This stage involves a conservative screening test of the material to determine if it contains environmentally harmful leachable contaminants. Leaching procedures based on the US EPA Method 1311 (TCLP) are suggested. Leachates are assessed by comparison to New Zealand landfill waste acceptance criteria for class B landfills and ecotoxicity criteria.

Stage 3 – comprehensive environment impact assessment

Third stage assessment may be required if stage 2 indicates that the material contains environmentally harmful contaminants that are leachable in significant concentrations. A comprehensive environmental impact assessment is undertaken using data from more realistic leaching tests that include site parameters to model the release, transport and fate of the contaminants over time.

Fatigue design criteria for low noise surfaces on New Zealand roads
Research report 307
T Alabaster and A Fussell, Transit New Zealand
$35.00

Internationally, low-noise porous asphalts are typically laid on top of structural asphalt layers. In New Zealand, structural asphalt is generally prohibitively expensive and porous asphalt is used directly on chipseal-surfaced unbound granular pavements.

Two accelerated pavement tests were undertaken at the Canterbury Accelerated Pavement Testing Indoor Facility (CAPTIF) in 2004–2005. The first test was to develop a horizontal tensile strain versus fatigue life curve and establish a relationship between base-course surface curvature and fatigue life. The second test evaluated the extension of fatigue life by short trafficking before surfacing, rather than using enhanced binders in porous asphalt.

The outcomes of the project suggest that the Austroads Rehabilitation Design Guide is very conservative in predicting fatigue and that deformation leads to surface failure before fatigue of the pavement occurs. Pavements to be sealed with low-noise surfaces could tolerate more deflection if initial trafficking was undertaken.

Environmental impact of industrial by-products in road construction: A literature review
Research report 308
Dr Ross Peploe, Bartley Consultants Ltd
$20.00

The objectives of this project, undertaken 2005/06, were to:

- review the international technical literature on the topic of environmental issues relating to the use of waste and industrial by-products in road construction applications
- recommend a set of guidelines to allow road controlling authorities and environmental agencies to determine if various waste or environmental by-products are appropriate for use in road construction.

The international literature shows that the topic of environmental impact is extremely complex and, by necessity, any assessment strategy needs to be relatively conservative for it to be practical, cost effective and reliable. The study has shown that a number of documents that address the issues of hazardous substances and acceptance criteria for contaminants are currently available in New Zealand.

A new assessment process has been suggested as a result of the literature review. It basically involves a three-tier classification system where industrial by-products proposed for road construction applications are deemed to be inert, notifiable or assessable, depending on their composition, intended use and track record.

Trials of recycled asphalt and rubber materials in hot mix asphalt for New Zealand roads
Research report 309
JE Patrick, SJ Reilly and GK Cook, Opus Central Laboratories
$20.00

This report gives the results of a research project carried out in 2003–2004 with the objective of facilitating the recycling of asphalt mix and ground tyre rubber (GTR) from waste tyres in New Zealand roads.

The report gives the laboratory and field test results that have been used to revise the Transit New Zealand M/10 Asphaltic Concrete Specification to allow the use of 15 percent of recycled asphalt (RAP). Tests included Marshall Stability and Flow, as well as Resilient Modulus tests with up to 40 percent of RAP. Test results from the road trials of the material, laid in 2003 in Manukau City, are also given.

Results of the properties of mixes incorporating GTR and road trials using 3 percent recycled rubber laid in Manukau City in 2004 are discussed. These results have been used to give examples of where the benefits of increased flexibility (fatigue resistance) could make this a cost-effective treatment.

The safety benefits of brighter road markings
Research report 310
VK Dravitzki, SM Wilkie and TJ Lester, Opus Central laboratories
$25.00

A 'before' and 'after' style of analysis was undertaken to identify whether increasing the brightness of existing road markings on unlit rural state highways had resulted in improved safety, measured as the incidence of mid-block injury-causing crashes.

Comparisons were made of average crash rates, crash rates in light conditions to dark conditions, and crashes on curves compared to crashes on straights in light and dark conditions. No evidence of altered rates could be identified.

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