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NZTA research

NZ TRANSPORT AGENCY
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WORKING SMARTER TO RAISE HCV COMPLIANCE

Strategic electronic monitoring of heavy commercial vehicles (HCV) offers a cost effective option for reducing overloading.

The government wants safer and more efficient freight movements in order to drive economic growth. At present, around 70% (by tonne-kilometre) of New Zealand's internal freight is carried by road, and the volume of this freight is predicted to double by 2040. It follows that this increase will mean more trucks and more truck trips to move New Zealand's freight task.

Recently completed research indicates that for some HCV operators there is a consistent pattern of non-compliance with safety and overloading requirements. Because of the increasing numbers of trucks on the road, current investigation and enforcement methods and systems are limited in what they can do to address the problem. NZ Transport Agency (NZTA) statistics suggest that around 10% of all HCV trips in New Zealand are overloaded, while over 20% of heavy vehicles are operated with some type of safety defect. There are also issues surrounding licensing and ensuring the correct payment of road user charges.

With increasing numbers of trucks on the road, along with increasing weights of these vehicles, it is timely to look at how HCV monitoring, enforcement and compliance could be enhanced – to improve both safety and freight efficiency. The need to look at compliance has become even more important with the introduction of high productivity motor vehicles in 2010 (allowing heavier and longer trucks on permitted routes), the development of the Operator Rating System and the new Road User Charges Act 2012.

Research on smarter monitoring and enforcement was commissioned by the NZTA and undertaken by the Wellington branch of the Traffic Design Group. The resulting research recommends the introduction of a carefully designed and strategically placed network of fully automated monitoring and enforcement sites. This would improve the efficiency and effectiveness of the compliance process for both transport operators and enforcement staff alike. The outcomes would be improved national productivity, improved road safety, reduced network maintenance cost and a fairer economic environment for compliant operators.

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ILLEGAL OVERLOADING – A WEIGHTY PROBLEM

Cormac McBride of the Traffic Design Group says, 'Overloaded HCVs cause significant extra wear and tear to the road network, both pavements and bridges. The additional maintenance costs are made worse because those overloading illegally are not paying for the asset deterioration they are causing. Instead, the cost of additional and unplanned maintenance is passed on to other road users and ratepayers (as local roads are co-funded between road users and local ratepayers). In some cases, the overloading can be so serious that it actually damages road assets. In a worst case scenario this could potentially lead to failure with serious economic and safety implications'.

The weight limits that apply to HCVs are intended as safe network-wide maximums, capable of being carried by most of the country's bridges, and form the basis for calculations of road asset wear. Where routes have higher carrying capacity, operators are now able to apply for a high productivity motor vehicle permit to allow them to legally carry higher mass, so long as the truck they are using is suitable to carry those heavier loads.

An HCV's maximum permitted gross weight is also used to determine the road user charges that the operator must pay, thus linking the vehicle's weight to the cost of the wear and tear it is likely to cause. This user pays model is at the heart of the road user charges system.

The reasons for some operators' non-compliance with safety, revenue, licensing and weight requirements may be related to a perceived increase in profitability if they cut corners. Non-compliant operators may evade road user charges, operate vehicles with known defects, deliberately overload their vehicles and require drivers to exceed work-time limits, in order to reduce their operating costs and so unfairly undercut their competition.

The current enforcement system is the responsibility of the NZ Police's Commercial Vehicle Inspection Unit, which inspects around 90,000 individual heavy vehicles each year. Each of these inspections takes around 20 to 30 minutes to complete, with most of the inspected vehicles found to be compliant. The disruption to delivery schedules and attendant loss of productivity to the compliant operators is substantial. The economic value of this lost time has significant national economic impacts in terms of lost productivity.

Yet figures show that the instances of non-compliance captured through the enforcement process are just the tip of the iceberg. (At one NZTA automated weigh-in-motion site in Drury, South Auckland, around 110,000 overloading offences are detected annually, for statistical purposes only.) The probability of an HCV undergoing a Commercial Vehicle Inspection Unit roadside inspection is once every two years, or 44,000km, which means that for every 10km trip taken, the probability of being inspected is a mere 0.02% (1 in 4400). For routine offenders, this enforcement rate offers scant incentive to ensure that their vehicles comply with weight limits.

It is difficult to make the current system more effective, given the time-consuming nature of the inspections, the limited number of staff available to carry them out and the number of additional staff required to significantly change the inspection ratio.

'Yet the ongoing presence of the Commercial Vehicle Inspection Unit is considered an essential element in increasing the compliance rate', says Cormac.

A NEW WAY OF DOING THINGS

The research looked into the possibility of using automated strategic electronic monitoring of HCVs to provide a cost-efficient and effective detection and enforcement system.

Cormac says, 'Any compliance model we developed needed to specifically target the minority of operators who are the most evasive, systematic and deliberate in their non-compliance. Those who deliberately offend with the intention of improving their profits are unlikely to respond to education alone. To achieve the desired outcomes we need more than dedicated hard-working Commercial Vehicle Inspection Unit staff; automated detection and enforcement could deal effectively and continuously with the majority of non-compliance, while stronger economic incentives for operators to comply would speed up the process of eliminating non-compliance'.

To this end, the study proposes a strategic network of automated electronic monitoring and enforcement sites, potentially capable of continuously detecting a variety of offences, primarily while vehicles are still moving. Compliant vehicles will be automatically detected in advance of traditional weigh stations, and potentially allowed to bypass an on-site inspection, so that their freight schedules are not disrupted.

The research offers the potential for operators with non-compliant vehicles to be held accountable, even when no enforcement staff are present. When staff are present, their work will be made much more efficient, as the system will automatically detect and process much of the required information, leading to a much higher capture rate of non-compliant vehicles, and reducing staffs' remaining workloads and the time required per vehicle.

As part of the research, the study identified the technologies currently available for monitoring HCVs and assessed how suited each one was to the New Zealand environment.

'What we were after was a simple robust system that provided plenty of information and was capable of operating autonomously and continuously for most enforcement tasks,' says Cormac. 'To be successful, any new system would also have to make the compliance process simpler, and still achieve the minimum business requirements of all end users, including HCV operators, the police, local authorities, freight terminals and the NZTA.'

Technical recommendations for future monitoring sites, looked at by the study, included an evidential-grade high-speed weigh-in-motion system, 3D cameras front and rear of the site, 2D cameras for side views and automatic number plate recognition, under-vehicle thermal-imaging and high-resolution cameras for use at lower speed weigh stations, and a site controller to gather and store all data for transmission.

Any system would need to be modular and interoperable so that it could be easily scaled up if needed, and capable of readily exchanging data with other systems. The locations of the monitoring sites would also be crucial to the system's success, with maximum effectiveness gained from sites where it is uneconomic or impossible for drivers to detour, and systems set up to detect evasion (with appropriate penalties available).

The full research report makes recommendations for how trial sites could be developed and piloted, and the supporting policy, legislation, data sharing and system changes that would needed to support full implementation. The report notes that the system would require new technology, but the physical placement of the sites and the architecture of the information systems would be the most important factors.

It also recognises that, while introducing strategic electronic monitoring for HCVs would require a substantial investment (a ballpark figure for installing one site is around $250,000, with additional one-off set-up costs for a national data processing office), early analysis shows that an electronic approach would quickly deliver substantial benefits in terms of reducing asset wear, and improving safety, the environment and health.

'As well as the financial investment, setting up sites will require an equally significant shift in thinking,' says Cormac. 'What we're proposing represents a new paradigm for how we approach HCV compliance and enforcement in New Zealand.' The NZTA is now looking into the study's recommendations as part of its work on improving freight efficiency.

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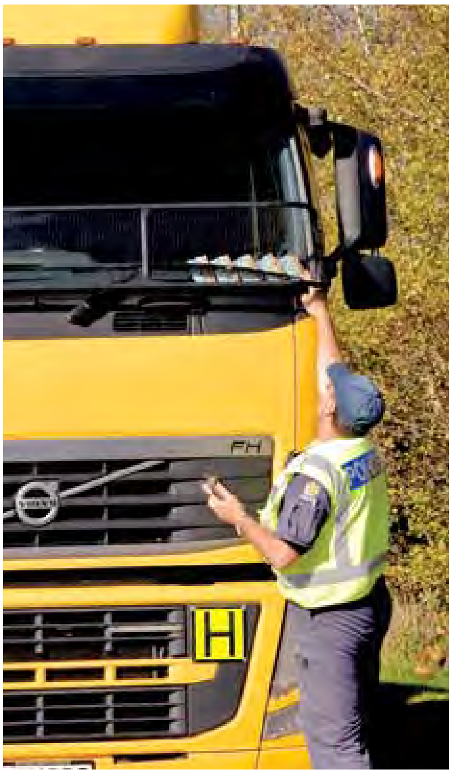
Strategic electronic monitoring and compliance of heavy commercial vehicles in the upper North Island, NZ Transport Agency research report 500

Available online at www.nzta.govt.nz/resources/research/reports/500



OPPORTUNITIES TO REDUCE TRANSPORT COSTS FOR BUSINESSES

Transport costs for New Zealand businesses are generally considered to be high. Why this is, and what can be done about it, were the questions behind a recent case study based research project undertaken in 2011/12.

The study, conducted by Australian company NERA Economic Consulting and Wellington-based Pinnacle Research and Policy, quantified the proportion of business costs that could be attributed to transport for three separate industries and identified opportunities to reduce these costs.

The three industries looked at were the logging, flower and grocery industries. They were chosen because transport (and its associated cost) is a major input for all of them. They also incorporate a wide range of operating conditions, types of goods and segments of the supply chain.

By focusing on industries, rather than goods, the study was able to gain insights into, and make recommendations about wider opportunities that exist to reduce transport costs for businesses in New Zealand.

THE IMPORTANCE OF TRANSPORT

Transport is crucial to the efficient production of goods and services, and ultimately to New Zealand's economic growth and productivity. Good transport systems enable goods and services to be delivered cost effectively between producers, suppliers, retailers and consumers, across New Zealand and for export.

The transport costs of New Zealand businesses are generally considered to be high compared with their international competitors. Previous estimates have put the average transport costs for New Zealand businesses at 8.8% of their total input costs. Our remote location, difficult geography and the nature of the goods that our industries produce and the markets they serve, all contribute to these proportionally high costs.

SIGNIFICANT VARIATION

The research aimed to build a more accurate picture of what these costs were for particular industries, and whether there were opportunities to reduce them. The team conducted interviews and collected data from businesses within each of the three industries, using this information to estimate the proportion that transport costs represent of the industries' overall operating costs and revenue.

What has emerged is the significant variation between the industries. For logging, the industry with the highest transport costs, this proportion ranges between 25% and 30% of business costs, and 15% and 25% of revenue. For the grocery industry, the proportion is much closer to the 8.8% average cost of the earlier study, although there is still significant variation within the industry. Transport costs as a proportion of both revenue and operating costs range from 1% to 12% between the individual businesses studied. Insufficient information was available to develop a clear picture of the proportion that transport costs represent for the flower industry.

There is also significant variation between the nature of the transport needs and activities undertaken within each industry.

For the logging industry, where most transport activity involves carrying felled trees to mills, processing plants and ports for export, transport is generally provided by third-party operators using heavy vehicles (although rail is also occasionally used).

The grocery industry's transport activities are much less uniform, involving the transfer of a wide variety of goods between suppliers, distribution centres and retail shops. Most of this activity is done by road, although some rail and coastal shipping is also used, where cost effective. In some instances, particularly for perishable goods, the supplier is responsible for transporting the goods directly to the store, while in others the distribution and retail shop owners provide the transport.

Flowers are mainly delivered by light commercial vehicles, with business owners making use of their own vans and those of third-party suppliers (couriers). The delicate nature of the goods being transported means there are limited opportunities to use other means of transport or to reduce costs within this industry (other than by reducing road congestion).

EFFICIENCIES AND CHALLENGES

Overall, the study found that transport operations in all of the industries are mostly efficient. Within both the logging and grocery industries there are already effective measures in place to reduce costs and transport goods efficiently. The flower industry is limited, by the nature of the goods it produces, in the approaches it can take.

However, within all the industries there are also challenges, not all of which are within the businesses' control.

For logging, the variability of the loads that trucks are called on to carry (due to differing log sizes) means that it is not always cost effective to use high productivity trucks, even when these create efficiencies by reducing the number of trips needed. This could be managed by relaxing load tolerances for these vehicles, enabling logging companies to make greater use of them. Another difficulty is that roads in areas where logging occurs are not always capable of carrying these larger vehicles, although extensive work has already been done towards identifying and developing suitable routes.

High productivity trucks also have promise for reducing costs in certain segments of the grocery industry (notably bread), again by allowing more goods to be carried on a single vehicle and trip.

Another challenge for the logging industry is the limited capacity for ports to unload and store logs, creating added costs for logging companies through delays and provision of off-site storage. The issue is of particular concern to the industry, given that most anticipated growth in log production over the next few years is expected to be for export.

OPPORTUNITIES TO REDUCE COSTS

Opportunities to reduce transport costs in the three industries studied revolve around policy changes to reduce transport costs for all New Zealand businesses, and steps that businesses themselves could take to reduce costs by making better use of vehicles.

In the latter case, impediments to making better use of vehicles include the limited ability of many businesses to influence transport prices, and information shortfalls about the factors that affect transport costs, so that businesses have little incentive to change their practices.

An example is the lack of opportunities that most businesses have to examine how improved coordination along the supply chain could reduce costs. By coordinating the times that businesses receive goods, suppliers could improve routes and vehicle use, and minimise unloading delays. Any associated cost savings could then be passed on to consumers through lower prices. However, many businesses do not proactively seek out ways to lower transport costs, because transport costs are simply bundled in with the total cost that suppliers charge to businesses. Greater transparency about the transport costs included in the price of goods is an important first step to achieving transport cost savings. .

Policy opportunities include further investigation into the cost, benefits, risks and practicalities of increasing the use of high productivity trucks, and measures to boost the availability of skilled drivers (identified by a number of interview participants as an ongoing concern). Future research could focus on the cause of the shortage and how it might be addressed.

The final policy option relates to congestion, and the adverse effects it has on both business productivity and the wider community. Particularly in the grocery industry, current business practices are adding to congestion in areas around stores. Greater transparency around who is carrying the cost of this congestion (generally not the businesses) would encourage businesses to re-examine their practices.

Further investigation is also needed into the effect that local authority after-hours restrictions on heavy vehicle movements have on businesses, and what the trade-off would be between business productivity and community concerns, if these restrictions were relaxed.

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Transports' proportion of total costs for New Zealand businesses, NZ Transport Agency research report 495

Available online at www.nzta.govt.nz/resources/research/reports/495

SUMMARY OF KEY FINDINGS FROM THE STUDY

Industry	Findings
Logging	Increased transport and handling costs for the logging industry are likely as export log growth places increasing pressure on existing log storage facilities at ports. Opportunities to reduce direct transport costs are limited. Some opportunities might exist to improve utilisation of logging vehicles by modifying vehicles so they can provide services to other industries.
Grocery	The shift to greater reliance on just-in-time delivery directly from suppliers to grocery retailers is likely to be contributing to urban congestion and so increasing transport costs for the sector (offset by lower inventory and other costs). The use of rail is increasing, particularly for non-perishable goods, and further opportunities are available. Improving the coordination and utilisation of vehicles (particularly for the daily bread-delivery sector) could result in lower transport costs.
Flower	The industry is efficient in its use of third-party transport operators, and given the small volumes of product transported (relative to other sectors) there is limited opportunity for transport costs to be actively managed.
All industries	Improved coordination along the supply chain could provide opportunities for businesses to seek out cost savings where feasible. Consideration should be given to impediments to the greater use of high productivity motor vehicles (HPMVs) including considering the appropriateness of current weight tolerances and processes for the programming and funding of HPMV route extensions. Consideration should be given to addressing the shortage of skilled drivers. Consideration should be given to mechanisms (including pricing) to ensure that transport decisions take into account costs imposed on the wider community.

MEDIA FILTRATION DEVICES FOR STORMWATER COME UNDER THE SPOTLIGHT

Research co-funded by the NZTA and Auckland Council has enabled local information to be gathered about the effectiveness of media filtration treatment devices for stormwater, leading to recommendations about their adoption and use in New Zealand.

The study evaluated the performance of three commercially available treatment devices, developed in the US and increasingly used here. Overseas research confirmed that the devices were effective for removing suspended solids, copper and zinc from road runoff, but this had not yet been backed up by independent local performance information.

To this end, the study evaluated the performance of the three devices at sites in the Auckland region. Devices included an up-flow filter device (installed in a standard manhole and configured so that stormwater is hydraulically forced up through the filter module), and two radial cartridge devices (consisting of one or more filter cartridges installed in a chamber). All three devices can treat a certain flow rate of stormwater, but once this is reached, excess water is discharged without treatment through an internal or external bypass.

KEEPING UP WITH THE RUNOFF

Contaminants commonly found in road runoff include suspended solids, and a number of metals and hydrocarbons. Suspended solids come from wear and tear of the road surface, vehicle tyres and components, and material deposited onto the road from other areas (such as soil). Copper and zinc, the two metal contaminants focused on in the study, come from wear and tear of vehicle brake linings (copper) and tyres (zinc). Contamination occurs when stormwater runoff picks up these contaminants from the road surface and carries them into receiving water bodies (streams, rivers and harbours etc).

At present, catch pits and stormwater ponds are common means used in New Zealand to reduce the amount of contaminants carried by road runoff. While such measures are effective for catching coarser solids, they are less so for finer particulates and dissolved chemicals. Yet it is arguably more important (in environmental terms) that these more elusive contaminants are captured, as they are more readily taken up by many forms of aquatic life than coarser solids and are hence potentially more damaging.

Overseas, innovative means of catching finer particulates and dissolved chemicals have been developed and used to good effect, with promising results reported from field and laboratory trials. The potential for these devices to be used in certain situations in New Zealand has been recognised (for example, where contaminant loads are high, space is limited or road runoff is being discharged to sensitive receiving environments). Yet their uptake may be hampered by a lack of locally derived information about their effectiveness and best-practice use.

HOW THE DEVICES PERFORMED

For the study, monitored media filtration devices were located next to a state highway (carrying around 35,000 vehicles a day); a shopping mall carpark; and a main arterial road (carrying about 38,000 vehicles per day). Influent (stormwater flowing into the device) and effluent (filtered stormwater flowing out) samples were collected during 15 storm events at each site, and subsequently analysed for concentrations of suspended solids, and total and dissolved copper and zinc. Some samples were also analysed for concentrations of organic solids and particulate size distribution.

The study demonstrated the impact that field conditions have on how well a device performs. None of the three devices achieved the expected contaminant removal rates (based on those reported from evaluations overseas), but neither were the conditions of these previous studies met.

Jonathan Moores of NIWA says that it is important to take into account the quality of the influent that is likely to be present at a given site when assessing a device's effectiveness.

'At all three sites we monitored, relatively low concentrations of suspended solids in the runoff meant that none of the devices reached the reported contaminant removal rates,' says Jonathan. 'This didn't mean that the devices weren't working; rather that their effectiveness couldn't be measured against a target removal rate when there weren't enough contaminants present to make those rates achievable. A more complete picture of effectiveness can be gained by comparing the levels of contaminants in the treated effluent against the relevant water quality guidelines. This can show whether the devices are working to protect receiving water bodies against contaminated stormwater runoff.'

Another issue involved the impact of stormwater bypassing the devices when the rate of runoff grew too much for them to handle. As would be expected, the quality of the effluent during storms where bypass occurred was lower than when the device had been able to treat all of the influent, with a corresponding negative impact on contaminant removal rates. Bypasses were found to be relatively frequent during the height of storms, and in some cases contaminants that had already been filtered by the device were re-suspended when large flows of influent entered the device and subsequently discharged through the bypass. This raised questions about the adequacy of current specifications for the sizing of devices, as well as their design (using internal bypasses, instead of ones external to the device).

Despite the monitored devices failing to achieve targets, the study found that filtration treatment devices are a promising tool for managing the quality of road runoff, especially at sites where the concentration of contaminants in the runoff is known to be high.

Jonathan says, 'At the site we monitored next to the state highway, where there were relatively high concentrations of suspended solids compared with other Auckland roads, the filtration device markedly reduced the level of solids in the effluent, as well as the copper and zinc concentrations. The study did raise questions about whether filtration treatment devices are justified in situations where suspended solids concentrations are known to be low, for example the shopping centre carpark we monitored. However, we didn't have enough information on the potential benefits for treating other contaminants that we didn't monitor to state decisively the situations where this would be the case.'

The report suggests further monitoring to answer this and some of the other questions raised in the study, and to explore the possibility of addressing the device design issues highlighted by the research (for example, capacity and bypass issues).

The usefulness of media filtration devices for capturing hydrocarbons from runoff is another area that Jonathan says is worthy of further research. A large number of hydrocarbons (from oil, grease and fuel leaks and spills, and vehicle emissions) make their way onto the road surface and from there into stormwater runoff. They were omitted from the current study due to the known difficulties of sampling and analysing them in road runoff and, as a result, Jonathan says the ability of media filtration devices to capture hydrocarbons 'remains an unquantified but potentially important consideration.'

Despite these limitations, the full report of the study contains broad guidance and makes a number of recommendations relating to the use of media filtration devices for treating road runoff. These cover:

- device design and sizing
- operation and maintenance
- approaches to performance evaluation.

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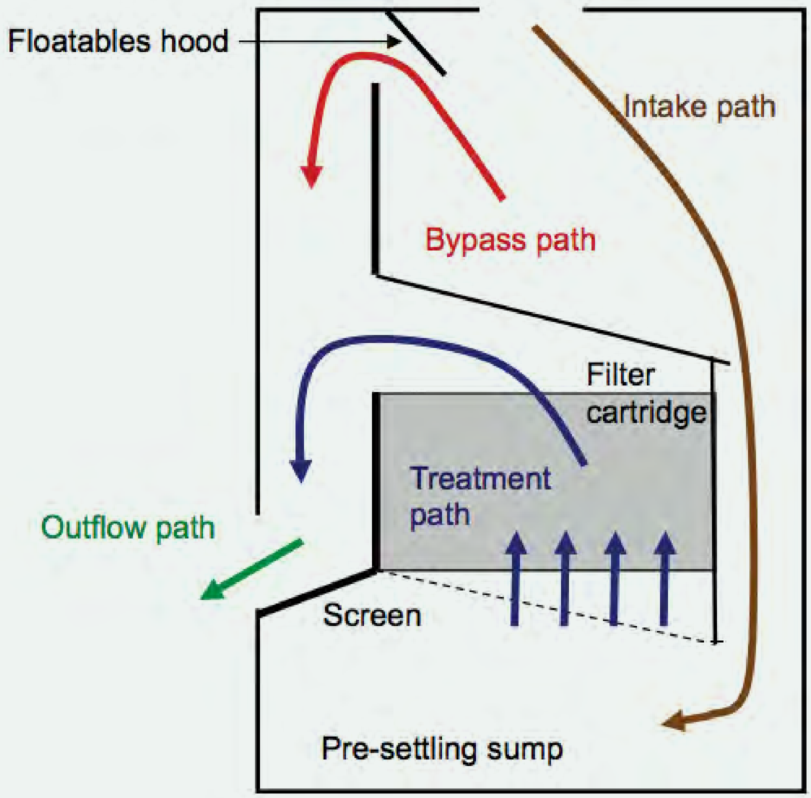
Field evaluation of media filtration stormwater treatment devices,
NZ Transport Agency research report 493

Available online at www.nzta.govt.nz/resources/research/reports/493

FLOATABLES HOOD: FIGURE 2.2

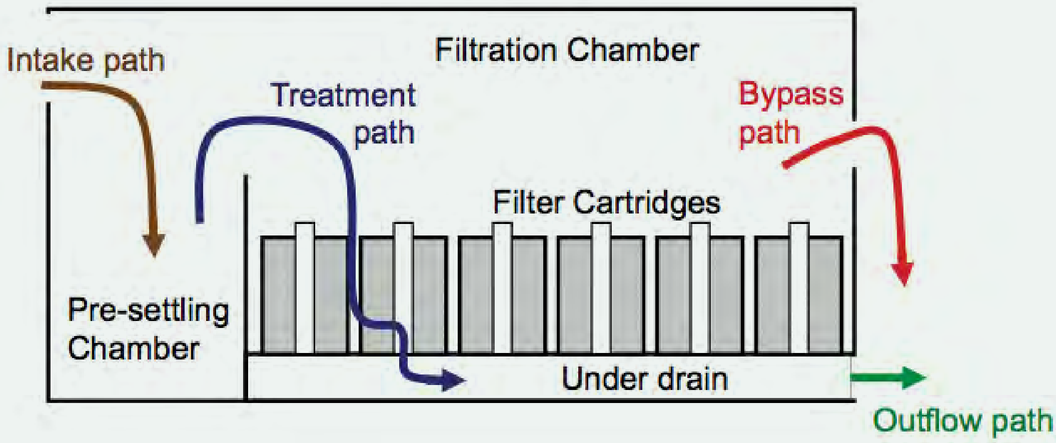
Simplified schematic showing the design and operation of an up-flow filter device (not to scale)



Source: Annette Semadeni-Davies.

FILTRATION CHAMBER: FIGURE 2.4

Simplified schematic showing the design and operation of a radial cartridge filter device (not to scale)



Source: Annette Semadeni-Davies.

EXTREME VARIATIONS IN TRAFFIC LOADING REQUIRES BETTER MODELLING

Pavement deterioration models show promise for predicting the effects that sudden increases in traffic loading are likely to have on pavement condition and potential failure, but they need more work.

Research by Opus Central Laboratories (now Opus Research) has looked at whether various pavement deterioration models, currently used in New Zealand, could be modified to predict the condition of a pavement after it has been exposed to extreme traffic loading.

Extreme traffic loading occurs when a change in activity in an area brings sudden increases in the numbers of heavy vehicles using local roads. Examples are when forestry or mining starts up, dairy tanker routes change, or general traffic is detoured on to roads not designed for the purpose. In New Zealand in recent years there have been several instances where low volume, low strength state highways and local authority roads have failed prematurely due to significant increases in heavy vehicle traffic.

Being able to predict the effect that extreme traffic loading, whether planned or otherwise, is likely to have on a particular stretch of road would be a useful tool for road authorities.

Indications from the research are that pavement deterioration models are probably the best option for conducting this analysis. However, current models used in New Zealand have not been designed for this purpose, and are not particularly effective for simulating sudden increases in traffic loading and their effects over short lengths. As a result, a pavement's premature failure due to increased loading can go unpredicted, leading to unexpected expenditure on rehabilitation works.

Peter Cenek of Opus Research says, 'The other option we looked at as part of the study was using historical RAMM data to see if the consequences of overloading would be reflected in the maintenance cost or pavement condition data. But what we found was that extreme traffic loading had to be sustained for a long time to show up in these datasets.

'This finding was a key, as it confirmed that pavement deterioration models probably offered a more productive analysis option. The research was also clear, though, that these models will need more work, if they are to better reflect the localised pavement damage that has been observed to result from extreme traffic loading.'

To this end, the research team suggested that a wider range of sites should be monitored, which are either already exposed or are going to be exposed to extreme traffic loading. Some sites were monitored as part of the research by taking falling weight deflectometer measurements. Further monitoring will give a clearer indication of whether existing models are adequately predicting the relationship between a pavement's structural strength and its subsequent failure under extreme loads, If not, the additional data gathered through the monitoring can be used to develop more responsive models. There is a particular need to develop a robust edge break model as this is the failure mode most often associated with increased traffic loads on rural roads.

THE CURRENT MODELS STUDIED

Several pavement deterioration models are already used in New Zealand, and incorporated into the New Zealand Deighton's Total Infrastructure Management Systems (NZ-dTIMS) and the Highway Design and Maintenance Model 4 (HDM-4) used by national and local road authorities.

Models considered as part the research included the roughness progression models contained in NZ-dTIMS and HDM-4, as well as the Cenek–Patrick roughness model and the 'Ball' alligator cracking model. Each was assessed to gauge its sensitivity to changes in traffic volume, traffic volume growth and the percentage of heavy commercial vehicles. The assessment had two stages:

1. Sensitivity analyses were performed in relation to traffic loading variables – this revealed whether the model was capable of recognising significant changes in loading.
2. The models were retrospectively applied to pavements that had previously been exposed to intense traffic loading – this showed the model's accuracy in modelling the effects of extreme loading on pavement condition.

The assessment showed that the roughness pavement deterioration models had varying degrees of sensitivity to changes in traffic loadings, with most performing better to model changes in roughness over longer pavement lengths (≥300m), than shorter ones. The rut depth model analysed showed less sensitivity, with no increase in rut depth (beyond what would normally be expected) over the time that the roads were monitored, suggesting that it was not suited to modelling rut depth caused by extreme traffic loading.

As a result, the study recommended that any investigation into the use of pavement deterioration models for roads subject to extreme loading should focus on the relationship between the pavement's structural strength and its roughness. Other recommendations included further work to understand the relationship between average and maximum roughness (all of the models studied performed better in modelling the former), and average and maximum rutting.

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Modelling extreme traffic loading effects, NZ Transport Agency research report 499

Available online at www.nzta.govt.nz/resources/research/reports/499

THE ROLE OF SPEED IN SAFE SYSTEM APPROACHES TO ROAD SAFETY

The International Transport Forum of the OECD has encouraged all member nations to adopt a Safe System approach to road safety. New Zealand has done so through the Ministry of Transport's Safer Journeys (2011) road safety strategy, which guides national efforts towards adopting a Safe System approach to road safety.

A literature review by Opus International Consultants looks at the role of speed under the Safe System approach, addressing specific questions about the relationships between speed, road classifications, crashes, fuel consumption, emissions and the economic valuation of these factors.

WHAT IS THE SAFE SYSTEM APPROACH?

The Safe System approach to road safety focuses on creating safe roads, safe speeds, safe vehicles and safe road use. The aim is to create a road system where serious and fatal injury crashes do not occur, and where all necessary measures are taken to achieve this.

However, the approach accepts that, despite the best of measures and intentions, crashes will happen, and to this end advocates controlling speeds in such a way that, if a crash does occur, it does not cause fatalities or serious injury.

There is a well-established relationship between vehicle speed and the severity of crashes – in most cases, increased travel speed will lead to increased trauma – so speed control measures form an integral part of any Safe System approach.

THE LITERATURE REVIEW

After examining what the international literature had to say about the relationship between speed and road-user casualties (and confirming the relationship between them), the study turned its attention to what the literature says about speed thresholds. It examined the different thresholds proposed by various authors for different types of crashes, finding considerable agreement among them.

From this, the study concluded that thresholds for specific road situations were 'similar to':

- 70km/h for head-on collisions
- 50km/h for front impacts with a tree or pole
- 50km/h for vehicle-to-vehicle side impacts (at intersections)
- 30km/h for side impacts with trees or poles
- 30km/h for impacts with a pedestrian or cyclist.

Approaches to calculating the value of various factors used in economic analysis were then examined. Factors included reductions in crashes and casualties (safety), travel time savings, fuel consumption savings and road traffic emission reductions. Valuation approaches adopted in New Zealand and overseas were all considered.

Findings included that the approaches used in New Zealand for valuing both safety and time were similar to those prevalent overseas. For safety values, this was conservative willingness to pay, augmented by damage and treatment costs etc. For time-saving values, New Zealand (and many other countries) use different multiples of wage rates for different types of journeys at a fairly aggregated level.

KEY QUESTIONS ADDRESSED BY THE LITERATURE REVIEW

1. What are the alternative ways of classifying roads across the road network, which are compatible with the Safe System approach in relation to speed?
2. What is the relationship of speed to crashes, fuel consumption and emissions?
3. With respect to economic valuation:
   a. What values are currently being placed on the cost of serious and fatal crashes in the developed world?
   b. What values are currently being placed on travel time in the developed world?
   c. What values are currently being placed on fuel consumption savings in the developed world; and how on a macroscopic scale can these economic values be translated into greenhouse gas emissions savings?
   d. How do these values relate in the context of cost–benefit analysis under a Safe System approach to speed?

The study raised questions about this aggregation, and the associated lack of discounting for values assigned to savings of small time periods (generally considered to be too hard to calculate), and stated that there was evidence that discounting might be appropriate in some circumstances. In particular, it queried whether continuing this essentially liberal approach to valuing time was justifiable in economic appraisals for safety projects under a Safe System approach, given that the valuation of safety used in such appraisals was a conservative one.

With respect to fuel consumption (where there are well-defined links between vehicle travel speeds and their consumption rates), the study found that any changes in speed resulting from the adoption of a Safe System approach could be readily converted to fuel consumption changes, and from there transformed to greenhouse gas emission costs for use in economic analysis.

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Economic evaluation of the impact of safe speeds: literature review,
NZ Transport Agency research report 505

Available online at www.nzta.govt.nz/resources/research/reports/505

NEW RESEARCH REPORTS

The effect of road roughness (and test speed) on GripTester measurements

Research report 523

D J Wilson, W Chan – University of Auckland
B Jacobsen – Clearway Consulting Ltd

Freely available online at www.nzta.govt.nz/resources/research/reports/523

This research investigated the effect of road roughness, macrotexture and testing speed on GripTester measurements.

Field tests were conducted by the GripTester at various test speeds on sites with varying road roughness in South Auckland. The variables – road roughness, texture and test speeds – were measured and plotted against each other along with the grip number (GN) as obtained from the GripTester. Tests with the DF Tester were also carried out at one site and directly correlated with GripTester results at various towing speeds. It was found the GN might not be dependent on test speeds while testing at speeds lower than 75km/h; however, an inverse relationship occurred at higher speeds on a limited number of test sites. Road roughness was found to have no effect on GripTester measurements and texture appeared to be a minor factor.

In conclusion, the explanatory variables on the GN are test speed and perhaps texture. However, unaccounted factors that are specific to test sites proved to have some degree of effect. Future research recommendations include searching for better controlled test sites and larger samples to clarify the effect of texture on the GN and to expose unidentified factors that can influence GripTester output.

Stability of motorcycles on audio tactile profiled (ATP) roadmarkings

Research report 526

N Jamieson, W Frith, T Lester and V Dravitzki – Opus Research

Freely available online at www.nzta.govt.nz/resources/research/reports/526

New Zealand has adopted the raised-profile type of audio tactile profiled (ATP) roadmarkings. This research was undertaken in 2011/2012 to help address gaps in available international literature on the stability of motorcycles when travelling on or across ATP roadmarkings.

The research investigated the stability of motorcycles when travelling on ATP roadmarkings, through evidence of traffic crash reports from motorcycle crashes at locations where ATP roadmarkings were present, a review of associated international literature, and simulation of motorcycles interacting with ATP roadmarkings via full-scale physical testing and computer simulation testing.

This research found no evidence that ATP roadmarkings as currently used in New Zealand create any significant instability issues for motorcycles.

Improvement of visual road condition data

Research report 528

MSP Tapper, KD Dunn – Beca, Tauranga

TFP Henning – University of Auckland

Freely available online at www.nzta.govt.nz/resources/research/reports/528

The objective of this research, which was carried out between 2010 and 2012, was to investigate the effectiveness of the current road condition rating system with a view to improving the accuracy and confidence in the data collected. This in turn will build confidence in key network performance indicators.

The use of visual road condition rating data in New Zealand has evolved from its original purpose of identifying carriageway sections on a network level for treatment and from being employed in the development of a forward works programme. Visual rating data is now used as an input into a series of performance measures and other pavement/surfacing performance modelling. This research project looked at how the visual rating process is currently undertaken and whether this is appropriate for its current and future uses. With the move towards using the data to compare road controlling authority networks, confidence and consistency in the data is paramount.

The research recommends improvements to data collection methodology, rater training, quality auditing, survey stratification and sampling methodology and procurement.

Performance indicator analysis and applying levels of service

Research report 529

TFP Henning, SB Costello – University of Auckland

M Tapper – Beca, Tauranga

Freely available online at www.nzta.govt.nz/resources/research/reports/529

The NZTA has been using performance indicator analysis and levels of service reporting for some years to assist with funding allocation, monitoring the application of funds and ensuring these are spent appropriately. Undertaking performance reporting assists in the funding decision process by utilising:

- trend monitoring to show the network 'health' of an authority
- benchmarking/relative comparisons with similar networks, as trend monitoring by itself cannot establish the appropriateness of funding levels.

Historical indicators, however, have struggled to give an absolute measure of spending efficiency or network health, ie is the network in good health or at risk. This report presents the outcome of a NZTA research project that included a complete review of the current performance framework. It assessed the limitations to performance measures such as the surface condition index, smooth travel exposure and the pavement integrity index.

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NEW RESEARCH REPORTS *cont*

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It also introduced new performance measures including structural indices, a rutting index, longitudinal profile wave lengths and a failure risk index. The value of the performance framework is demonstrated using a network level example. This report will be of value for all roading asset managers, as it provides a framework for condition performance monitoring that can be applied at both local and national levels.

Obtaining NZTA research reports

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

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

Supplementary issues of the NZTA research newsletter

The significant number of research reports published in recent years has resulted in the need for supplementary issues of NZTA research, which are in addition to the standard March, June, September and December quarterly editions.

In 2011 and 2012, three supplementary editions were published in May, August and November. Similarly, there will be three supplementary editions published in May, August and November this year, in addition to the standard quarterly editions.

This is the August 2013 supplementary edition.

A NOTE FOR READERS

NZTA research newsletter

NZTA research is published quarterly by the NZ Transport Agency (NZTA). Its purpose is to report the results of research funded through the NZTA'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 NZTA'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.

Enquiries on articles should be made to the authors of research reports whose details are listed at the end of the articles. Otherwise 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 NZTA website at www.nzta.govt.nz/resources/nzta-research/. Back editions are available online only.

Disclaimer

Email alerts of newly published research reports

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

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