NZTA research

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WAKA KOTAHI

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Your views

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Pedal-powered trains join foot-based buses

A 'walking school bus on bicycle wheels' is how the authors of a new report funded by the NZ Transport Agency (NZTA) describe the latest school transport initiative they have developed guidelines for – the cycle train.

We have grown accustomed to the sight of walking school buses – orderly groups of children, with an 'adult conductor' at their head, making their way to and from school on foot, picking up new passengers en route. Introduced in the late 1990s, walking school bus networks have since been set up for hundreds of New Zealand schools, with more setting out all the time.

Yet despite this, a significant number of children are still being driven to and from school, with the perennial crush on roads around the school and at the gate a headache for drivers and parents alike.

Research into school travel on the North Shore of Auckland in 2002 showed that parents were open to the idea of their children cycling to school, if this happened in an organised group with adult supervision.

Carolyn O'Fallon from Pinnacle Research and Policy explains how, from this feedback, came the idea of developing a cycle train model, adapted for New Zealand conditions.

Carolyn says, 'One of the limits of walking school buses as a meaningful school travel alternative is that average route lengths tend to be around 1 km, with a maximum length of 2.25 km, which precludes a lot of children and families. Cycle trains

On 1 August 2008 the functions of Land Transport New Zealand and Transit New Zealand were combined to form one new organisation – the NZ Transport Agency (NZTA).

The new organisation will provide an integrated approach to transport planning, funding and delivery.

You may continue to see our old names around for a while. If you have any questions regarding the NZTA's research programme, please email research@nzta.govt.nz.

had the potential to appeal to families living further away from schools who still sought a non-car-based way to get to and from school, as well as to slightly older children.'

The cycle train concept works in much the same way as the pedestrian model. Adult volunteer conductors cycle along a set route to school, collecting children from designated 'train' stops along the way.

Cycle trains are already set up in parts of the United Kingdom, and popular in Flanders, Belgium, where 317 cycle trains involving 2390 children were operating in 2004/05. A similar concept (bicycle pools) is operating in the United States for adults, who club together to commute to and from work. Guidelines on establishing cycle trains were therefore available from overseas.

Working out the best way forward

Draft guidelines for setting up and running cycle trains were trialled in Nelson in 2005 and 2006, after consultation with key government stakeholders, other regional agencies and councils.

A survey was sent out to parents of children from one intermediate and four primary schools to gather information about potential users and parents willing to volunteer as conductors. A cycle train coordinator worked out routes, schedules and conductor rosters, and both conductors and children received training sessions about how the train would operate, cycling safety and train rules.

The trains were ready to hit the roads in September 2006. Six trains from four schools launched initially, with a seventh train set up two months later. So popular were the trains that most of them proved to be 'self-sustaining', with kids getting back on their bikes and rejoining the train after their two-month summer break. In the new year, a fifth school set up a train, and two more trains were added by the original trial schools.

Checking up on the process

When the trial was evaluated in November 2006, the response from participants was positive. The evaluation focused on how well the process for setting up and operating the trains had worked, and what participants thought about them. (Ideally, the trains would have been evaluated for their impact as an alternative means of getting children to and from school, and for reducing traffic congestion, but the Nelson trial was too small for this to happen.)

Nearly two percent of the children at participating schools used the trains regularly. A number of these children had previously been driven to and from school. Parents and children alike were enthusiastic about the trains, saying they enjoyed the friendships, sense of community and exercise involved. Another benefit identified by parents was knowing that children were getting safely to school and back, while getting to practise skills and learn good cycling habits and road safety rules in the process.

One of the 'issues' to come out of the evaluation was the age limit of '10 years or older' for participating children, as stated in the draft guidelines. In fact, most of the children who ended up riding in the trains were 8 or 9, with some 7 year olds also taking part, and parents felt the older age limit overly restricted participation. Interestingly, the '10 years or older' limit had been added to the guidelines later on in their development.

Carolyn says, 'The NZ Transport Agency's guidelines *Being roadsmart for school* (which are endorsed by ACC, the Ministry of Education and the New Zealand Police) recommend that children under the age of 10 should be accompanied by an adult when riding on the road.

'At the start of the research, we had envisaged that cycle trains might be a good way to prepare younger children for solo on-road riding once they were old enough, but we later increased the age of participants in response to concerns by key stakeholders about participants' safety.'

What the trial, in fact, showed was that trains are useful for younger children as well, and the revised guidelines that were produced after the evaluation lowered the recommended age to eight years or older, provided the children could demonstrate good cycle skills.

Another good suggestion to come out of the evaluation was that trail-gators (devices to connect a child's bike to an adult's bike) and bike trailers could be made available to parents with small children to increase the potential pool of train conductors and participants.

Carolyn adds, 'Overall, we think that cycle trains will be a useful addition for schools' travel plan toolkits, appealing to older children and those living further from school than walking school buses go.'

The revised guidelines that were produced following the evaluation are in the form of a user-friendly toolkit. While these are more complex than similar guidelines for walking school buses (due to the more complex safety issues involved), they have been designed for use by all schools, communities and parents interested in setting up a cycle train in their area.

Resources in the toolkit include a letter and a survey for gauging interest, guidelines on how cycle trains operate, information about building and checking safe routes, outlines for training sessions, and promotional materials for launching a train.

How to set up cycle trains: Help for schools and communities is freely available at www.pinnacleresearch.co.nz or in the appendix of the full research report (see below).

Contact for more information

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Developing school-based cycle trains in New Zealand
Research report 338
Freely available online at www.landtransport.govt.nz/research/reports/index
Hard copy $30.00 – email research@nzta.govt.nz to order.

Training kids to ride the train

Before their first ride, a professional cycling trainer took a session with the children who would be catching the train at each school.

Topics covered included bike and helmet checks, bike control issues (such as how to start off safely, use gears and ride in single file), road rules (signalling, passing, intersections and roundabouts, etc), on-road cycling as a train (including what to do in an emergency, such as a child being knocked over or getting a flat tyre), and a discussion about the correct clothes and shoes to wear for safe cycling.

Although the children did not ride the school route as part of their training, this will become a standard feature of training when larger numbers of children join the trains.

Making the count towards more informed funding

Decisions about whether or not new cycling facilities should be funded are based on cost-benefit ratios, which are in turn based on what the predicted future demand for the facilities are. But with no established method available for calculating demand, how can we be sure that the right facilities are being built? A research project funded by the NZ Transport Agency set out to fill the gap, providing tools for estimating cycling demand, both on and off the road.

Researchers Andrew McDonald (MWH New Zealand Ltd) and Andrew Macbeth (ViaStrada Ltd) say, 'With no standard method being used to estimate future demand for facilities, there is a danger that less worthy projects will get funding ahead of better projects, for which there is real demand.

'We set out to develop a tool for estimating demand on new cycle facilities that could then be used by practitioners in their applications for funding from the NZ Transport Agency. The project has achieved this and we now have tools for estimating on-road and off-road cycle demand.

'The tools we've come up with can be applied in a consistent manner, use readily available or obtainable data, and are simple to use and evaluate. We're recommending that they should be incorporated into the NZ Transport Agency's *Economic evaluation manual* and become a standard part of funding applications.'

Development where it counts

In developing the tools, the project looked at sites where new cycling facilities had recently been built, choosing a variety of locations and facility types. Ideally, sites with historical cycle count data or funding application information would have been selected, although this proved harder than anticipated, a difficulty Andrew McDonald attributes to the general lack of cycle count data that has historically been collected in New Zealand.

Ten facilities (five on-road and five off-road) were selected and cycle counts (using pneumatic tube counters similar to those used for motor vehicle counts) were collected for two-week periods between November 2006 and May 2007.

Analysis of the funding application data showed that a wide variety of methods had been used by road controlling authorities to estimate existing and future cycling demand. Often, the methods used did not involve collecting cycle count data to support the estimates.

Andrew Macbeth says, 'For the research team, this highlighted the need for a consistent method to be developed that practitioners can use when seeking to estimate future volumes and growth on new facilities. From the test sites, there was also considerable variation in the amount of cycle traffic growth that happened after a new facility was built. What's obvious is that a lot more research is required before we have sufficient knowledge in this area and before a more robust analysis can be carried out.'

Yet despite these restraints, the research was able to compare new data collected about cycle traffic flows after facilities had been constructed with predictions and actual cycle traffic flows before they were built, and use the results to develop the estimation tools.

In future, the tools will enable consistent estimates to be made about cycle traffic volumes on proposed new facilities and the cycle traffic growth rate for subsequent years. In addition, the research has generated guidelines for accurately collecting cycle count data using automatic tube counters.

As Andrew McDonald adds, 'The tools enable us to make a much overdue start on estimating cycling demand. We're recommending that cycle count data should form a compulsory part of all funding applications for new facilities, and we can refine the estimation tools as more "before and after" data come to hand.'

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Estimating demand for new cycling facilities in New Zealand
Research report 340
Freely available online at www.landtransport.govt.nz/research/reports/index
Hard copy $25.00 – email research@nzta.govt.nz to order.

The cycle demand estimation tools

Drawing on the data collected at the reference sites, the research developed tools for estimating cycle traffic demand for both on-road and off-road facilities. The tools produce an estimate of the numbers of cyclists who would use a new facility and the annual growth rate in cycle traffic on the facility.

On-road

The on-road tool estimates that the number of extra cyclists using a new facility, such as a cycle lane, immediately after it is built is 20 percent of the number of cyclists who used the road before the facility upgrade.

The annual growth rate of cyclists using the new facility can be estimated from analysis of the growth experienced by on-road cycling facilities studied during the research (calculated as 8 percent per year), moderated by census 'trip to work' cycling trends for the area where the new facility is planned.

Off-road

The off-road tool is intended for use where a proposed off-road facility will run parallel with an existing road. The tool assumes that there are no existing cyclists for the off-road path and that the number of new cyclists can be estimated by using a formula based on the following variables:

- the average annual daily traffic volume of cyclists using the road parallel to the proposed facility
- census 'mode split' data for the trips to work by cycle for that area
- the average annual daily traffic volume of motor vehicle traffic on the adjacent road
- the ratio of the average trip length taken by cycle and by motor vehicle (currently 1:3.44 according to the New Zealand Travel Survey).

The annual growth rate of cyclists using the new facility can be estimated from analysis of the growth experienced by off-road cycling facilities studied during the research (calculated as 14 percent per year) and from census 'trip to work' data trends for the area where the new facility is planned.

Coming to grips with a pavement's life

A study to develop a model to accurately predict the remaining life of New Zealand pavements raised as many questions as it answered. It did, however, produce several models for predicting maintenance costs, as well as models for predicting the decision to rehabilitate sections of pavement. These models will be useful starting points until further data becomes available.

Internationally, a lot of attention is being paid to predicting remaining pavement life – what factors do we need to take into account and how do we accurately model these to predict when a pavement will need to be rehabilitated? Most of these overseas efforts, though, do not concentrate on unbound granular pavements with chipseal surfacing, the main form of construction used in New Zealand.

What the current project hoped to achieve was a model to define the end of life conditions for a pavement. Coupled with this was a need for a model to predict pavement maintenance costs.

One of the main drivers for the research was the fact that, at present, the primary justification for most decisions to rehabilitate particular New Zealand pavements is the significant increases in their expected future maintenance costs, making it more cost-effective to rehabilitate them. What is not known, however, is if these anticipated cost increases are associated with cracking, deformation, material breakdown or unstable surfaces. The research aimed to gain an understanding of the factors behind the cost increases, and from that understanding to develop models to better predict the conditions that would lead to increased maintenance costs.

To achieve this, the project had two objectives.

- The first was to develop criteria to define the end of life condition of pavements. These criteria could then be used in pavement performance modelling to get a more robust measure than is currently available of the remaining life of pavements.
- The second objective was to generate a new model for reliably predicting increases in maintenance costs.

The new model could then be combined with existing models for roughness and rutting to define a distress level at which rehabilitation should occur. In the new combined model, an algorithm would be used to predict the time that an existing pavement section would take to exceed predefined performance levels for roughness, rutting or maintenance levels. The pavement's remaining life would be the lesser of the time it took to exceed one of these levels.

Unfortunately, none of the models developed for the project enabled maintenance costs to be reliably predicted based on pavement characteristics. This was potentially because the data was incomplete, the length of time that records had been kept was insufficient, or because the factors significant to maintenance costs were not contained in the database.

However, the maintenance cost models to come out of the project represent an improvement on previously available models and have been adopted for use by dTims.

A logit model was also developed to predict pavement rehabilitation decisions and this proved more successful. Using the model, 72 percent of the pavements included in the project that had been rehabilitated were predicted as requiring this rehabilitation. While 28 percent of the pavements that were predicted as requiring rehabilitation had not in fact been rehabilitated, it would be interesting to see which of these will be rehabilitated over the next couple of years.

The models generated by the research will be useful tools until better models can be developed. However, users of the models should realise that the models will need to be refined as more data becomes available.

Of significance is the very interesting question posed by the research of why most decisions to rehabilitate pavements continue to be based on anticipated increases in maintenance costs, rather than on roughness or rutting levels, when these costs can't currently be accurately modelled. More work is needed if we are to ensure that rehabilitation happens when it is really needed – at the end of a pavement's life and not before.

The NZTA recently awarded further funding to extend the work of the project and to investigate factors that are potentially not being recorded but that influence the pavement life and maintenance costs.

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The prediction of pavement remaining life
Research report 341
Freely available online at www.landtransport.govt.nz/research/reports/index
Hard copy $25.00 – email research@nzta.govt.nz to order.

New research publications

Performance tests for road aggregates and alternative materials

Research report 335
Dr G Arnold, Pavespec Ltd; Dr S Werkmeister, University of Canterbury; David Alabaster, Transit New Zealand (now the NZ Transport Agency)
Freely available online at www.landtransport.govt.nz/
Hard copy $25.00 – email research@nzta.govt.nz to order.

Aggregates used as base materials in thin-surfaced granular pavements common to New Zealand contribute at least half the wheeltrack rutting and roughness seen at the surface. Currently, no reliable cost-effective measure of an aggregate's resistance to rutting in specifications exists. Several test methods using the repeated load triaxial (RLT) apparatus were investigated for use in specifications for basecourse aggregates. Rut depth prediction methods and pavement finite modelling were applied to the RLT results to determine traffic-loading limits for the aggregates tested. It was found that the average slope from the six-stage RLT test was the best predictor of traffic-loading limit and this test was recommended for use in basecourse specifications.

Deterioration of prestressed concrete bridge beams

Research report 337
SM Bruce, PS McCarten, SA Freitag, LM Hasson, Opus International Consultants
Freely available online at www.landtransport.govt.nz/
Hard copy $20.00

A routine inspection revealed significant corrosion of the prestressing strand on a concrete road bridge built in 1966 to a standard design used in about 117 state highway bridges in New Zealand. To identify the cause of the deterioration and how many bridges of this design might be affected, the conditions of 29 similar bridges on New Zealand state highways were evaluated by site investigation. The research, carried out in 2005–2006, found that although the concrete quality in the bridge beams was generally good, the combination of cover depths of less than 25 mm and exposure to salt spray had increased the likelihood of corrosion in bridges of this design in the B2 (coastal frontage) exposure zone. Bridges in the B1 (coastal perimeter) and A2 (inland) zones are less likely to be affected, although the concrete in some of the beams contained chlorides added during construction. The risk associated with prestressing corrosion in this beam design is higher than in current designs because the prestressing strand is poorly confined and the cover depth is low. Bridges of this design in the B2 zone will probably need some form of intervention to achieve a 100-year service life.

Measurement valuation of public transport reliability

Research report 339
M Vincent, Booz Allen Hamilton (now Booz and Co)
Freely available online at www.landtransport.govt.nz/
Hard copy $25.00 – email research@nzta.govt.nz to order.

Reliability in public transport is important for operators and passengers alike. Reliability can affect users in one of two ways: as a delay when picking up the passenger and as a delay when the passenger is on the service. Reliability measures are typically used within performance regimes to evaluate the quality of service of public transport providers.

This research, carried out in 2007, aims to find a method of measuring the value placed on public transport reliability in different contexts in New Zealand. As part of this project, a stated preference survey was designed and implemented to collect information about passengers' current public transport usage, their attitudes to reliability and how they valued reliability.

Using these stated preference surveys, four initial models were estimated: a disaggregate model, a mean model, a variance model and a mean-variance model. The preferred approach, based on ease of use and comparability to international measures, was the mean delay model.

A value of time was determined from the departure stated preference survey. Values of time ranged around $8/hour. The surveys also found that rail users consistently had a value of time almost twice that of bus users, which is consistent with international findings.

Contaminant characterisation and toxicity of road sweepings and catchpit sediments: Towards more sustainable reuse options

Research report 345
Craig Depree, National Institute of Water and Atmospheric Research (NIWA)
Freely available online at www.landtransport.govt.nz/
Hard copy $25.00 – email research@nzta.govt.nz to order.

In 2006/07, 35 road-derived sediments (RDS) consisting of street sweepings and catchpit (ie sump) sediments were collected from Auckland, Hamilton and Christchurch. The concentrations, mobility and toxicity of contaminants were determined in order to assess the suitability of RDS for certain reuse applications. The current situation in New Zealand is that all RDS must be disposed of in landfills. The RDS were analysed for total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs) and the heavy metals, lead, copper and zinc – with respective median (n=35) concentrations of 1220, 6.3, 122, 67, 422 μg/g. Comparisons with soil guideline values for ecological protection (Dutch and Canadian) and reuse of biosolids for land application (New Zealand) indicated that zinc will be the most problematic contaminant with respect to mitigating environmental risks in

any reuse applications of RDS in New Zealand. Selected RDS freshwater leachates were toxic to the alga *Psuedokirchneriella subcapitata* at zinc concentrations of ca. 22–150 µg/L (EC50). However, leachate toxicity was reduced up to 225-fold when amended, or 'stabilised', with 10 percent compost. Based on the results and potentially applicable guideline values, the reuse of RDS may be limited to applications that either physically (ie incorporation into concrete or asphalt) or chemically (ie addition of a 'stabilising' agent like compost or phosphate) immobilise problematic heavy metal contaminants, namely zinc.

Characterising pavement surface damage caused by tyre scuffing forces

Research report 347
Neon Taramoeroa and John de Pont, TERNZ Ltd
Freely available online at www.landtransport.govt.nz/
Hard copy $25.00 – email research@nzta.govt.nz to order.

The transverse shear forces generated by multi-axle groups depend on many factors, including turn geometry, vehicle type, axle weights, tyre size and configuration, suspension geometry, and the number and type of axles. This study quantifies the impact of some of these parameters on the transverse pavement shear forces or scuffing forces generated during constant low-speed turns.

- A field trial on an unbound granular pavement structure with chipseal surfacing assessed the level of scuffing force that caused visible wear on the pavement surface. A computer model of a tandem simple-trailer was used to simulate the forces observed in the field.
- Computer models were used to assess the effects of axle load, axle group spread, wheelbase and turn geometry on peak scuffing forces, and to simulate various low-speed turns and identify the relative impact of the peak scuffing forces for the different vehicles.

This study provides data on the level of peak scuffing forces generated by heavy vehicles in New Zealand, and the interrelationship between scuffing forces, directional stability, lateral load transfer and rollover stability. This is fundamental to vehicle size and weight regulation, and to the design of pavements and turn geometry at intersections.

The development of gravel deterioration models for adoption in a New Zealand gravel road management system

Research report 348
TFP Henning, GJ Giummarra and DC Roux, MWH Ltd
Freely available online at www.landtransport.govt.nz/
Hard copy $25.00 – email research@nzta.govt.nz to order.

This report provides the outcomes from research based on the Land Transport New Zealand gravel road monitoring programme that commenced during 2002 and included the cooperation of 51 local authorities. These sections were monitored on a six-monthly basis and all relevant data (such as maintenance, rainfall where available and evaporation) were incorporated into a national database.

This research project included the provision of practical guidelines for the construction and maintenance of gravel roads. In addition, the gravel road data were analysed and outcomes are presented. The resulting models are effective indications of gravel loss on a network scale but further research would be required for more detailed models. This can be achieved by collecting more information on the impact of routine maintenance, such as blading.

One of the main outcomes from this research is the addition of a key performance measure that indicates the change in cross profile or shape over time.

Distractive effects of cellphone use

Research report 349
Samuel G Charlton, TERNZ Ltd, Auckland and University of Waikato, Hamilton
Freely available online at www.landtransport.govt.nz/
Hard copy $20.00 – email research@nzta.govt.nz to order.

The research systematically compared the driving performance and conversational patterns of drivers speaking with in-car passengers, hands-free cellphones and remote passengers who could see the driver's current driving situation (via a window into a driving simulator).

Driving performance suffered during cellphone and remote passenger conversations compared with in-car passenger conversations and no-conversation controls in terms of their approach speeds, reaction times, and avoidance of road and traffic hazards. Of particular interest was the phenomenon of conversation suppression, the tendency for passengers to slow their rates of conversation as the driver approached a hazard. On some occasions, these passengers also offered alerting comments, warning the driver of an approaching hazard. Neither conversation suppression nor alerting comments were present during cellphone conversations. Remote passengers offered some alerting comments but did not display conversation suppression. The data suggested that conversation suppression is a key factor in maintaining driving performance and that visual access to the driver's situation is not sufficient to produce conversation suppression.

A second experiment investigated whether a cellphone modified to emit warning tones could alleviate some of the adverse effects typically associated with cellphone conversations. The modified cellphone produced discourse patterns that were similar to passenger conversations and driving performance nearly as good as that of drivers who were not conversing.

The effectiveness of incident management on network reliability

Research report 346
G Koorey, S McMillan and A Nicholson, University of Canterbury
Freely available online at www.landtransport.govt.nz/
Hard copy $25.00 – email research@nzta.govt.nz to order.

This report summarises preliminary research undertaken in New Zealand during 2006/07 to investigate the ability of intelligent transport system (ITS) treatments, such as adaptive signal control (eg SCATS) and variable message signs (VMS), to detect and respond to serious traffic incidents, and to determine the most appropriate traffic management strategies (in terms of overall network reliability) when such incidents are detected. The study involved a literature review of techniques and software/systems currently used to manage traffic congestion and respond to incidents, and an exploratory microsimulation study modelling incident detection and response in an urban network.

The research found few attempts to bring together research in the three areas of incident detection/management, ITS methods such as adaptive signal control, and network reliability measures. There is also a lack of robust incident detection available at present in New Zealand. Preliminary modelling found that SCATS can be modified to better meet additional demand due to diversions after an incident, and modelling can help to identify which particular journey paths benefit most from such incident management interventions. The findings highlighted the need for more work to be undertaken in this area in New Zealand.

Personal security in public transport travel in New Zealand: Problems, issues and solutions

Research report 344
D Kennedy, Booz Allen Hamilton (now Booz and Co)
Freely available online at www.landtransport.govt.nz/
Hard copy $45.00 – email research@nzta.govt.nz to order.

This research project explores concerns about personal security by users of public transport. The findings from an international literature review are used, and the concerns of public transport users in three New Zealand cities (Auckland, Wellington and Christchurch) that have significant public transport patronage streams are explored.

Personal security concerns were found to discourage existing patrons from using public transport, and more so after dark. A number of security measures preferred by patrons are outlined. However, the project also found that only a small proportion of patrons actually noticed the presence of security measures that had been installed.

Obtaining our research reports

These research reports are freely available online at www.nzta.govt.nz/research. They can also be purchased in hard copy. To order any of these reports, or for questions regarding the NZ Transport Agency's research programme, please email research@nzta.govt.nz.

NZTA research

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Contributed articles are welcome, and should be typed in double spacing and not exceed 1000 words. Illustrations may be either black and white or colour, and must be of high quality. *NZTA research* reserves the right to edit, abridge or decline any article.

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New Zealand Government

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