Land Transport NZ
Ikiiki Whenua Aotearoa

research

ISSN 1176-9157

March 2005 Issue 1

PHOTO: PASSING LANE ON SH1, ATIAMURI. ©TRANSIT NEW ZEALAND

Improving passing lane design

The construction of passing lanes on two-lane roads has contributed significantly to congestion relief and a reduction in driver frustration. There is evidence, however, that a better understanding of the impact of lane design on driver behaviour may be needed in order to increase safety during overtaking manoeuvres.

In 2001, approximately 5.8 percent of fatal crashes and 3.3 percent of injury crashes on New Zealand roads occurred during overtaking manoeuvres, including crashes at sites with designated passing lanes.

An analysis of crash reports prepared by the Land Transport Safety Authority (LTSA), now Land Transport New Zealand, between 1996 and 2001 found that at least 292 crashes[1] were caused by overtaking at passing lanes. Of these, 115 crashes included at least one injury while 12 of them included at least one fatality.

Crash data for this period shows the main categories of crashes were: failure to merge correctly (24 percent); one car clipping another other vehicle when changing lanes (23 percent); losing control within the passing lane (23 percent); and using a passing lane for the opposing direction (14 percent).

As the latter often involves head-on crashes and more often results in serious injuries or fatalities, we need to understand more about the conditions under which drivers undertake these manoeuvres. Failing to merge correctly may require a re-examination of the merge area design.

continued on page 3

1 The actual number is probably higher as some of the 4,000 crash reports for overtaking crashes during this period lacked sufficient information to analyse details, while others were scanned illegibly. The figure of 292 therefore represents only a sample of the crashes occurring at passing lanes.

Contents

Your views

Land Transport Research welcomes letters from readers. Letters should be addressed to:

The Editor,
Land Transport Research,
Land Transport NZ,
PO Box 2331,
Wellington,
New Zealand.
www.landtransport.govt.nz

land transport
research

Land Transport NZ contact:
Neil Bennett
Editor:
Eric Turner

Land Transport Research is published quarterly by Land Transport NZ. Its purpose is to report the results of research funded through the Land Transport NZ research programme, and to act as a forum for passing on national and international information to aid collaboration between all those involved – to stimulate inquiry, discussion and solutions concerning road, traffic, safety and land transport problems in New Zealand.

Contributed articles are welcome, and should be typed in double spacing and not exceed 1,000 words. Illustrations may be either black and white or colour, and must be of high quality. *Land Transport Research* reserves the right to edit, abridge or decline any article.

Advertisements of forthcoming conferences and workshops which are within this publication's field of interest may be published free of charge, when space permits.

Articles may be reproduced and reference made to any part of this publication, provided an appropriate credit is given.

Inquiries on specific articles should be made to the author. Otherwise, all general correspondence, and those queries related to conference notices and mailing list requests, should be made to:

Land Transport NZ,
PO Box 2331, Wellington.
www.landtransport.govt.nz
Phone: 04 916 4220
Fax: 04 916 0028

DISCLAIMER

The views expressed *Land Transport Research* are the outcome of independent research and should not be regarded as being the opinion or responsibility of Land Transport NZ.

Editorial

Well, with a new name and new graphics for our research publication, perhaps I should be saying 'welcome' to readers of this issue.

However, the name and graphic style are the only changes and are a reflection of the merging of Transfund New Zealand and the Land Transport Safety Authority into a new organisation (Land Transport New Zealand).

Under the new mantle, the carefully structured and results-focused programme of research continues to meet gaps in our knowledge under seven distinct topic areas, and next year expenditure on research is likely to be bigger than ever.

Noble record

It is worth reflecting that today's significant transport research programme continues a role that was started over 40 years ago, in the early 1960s, by the then National Roads Board, with the production of four research newsletters each year.

As now, a significant amount of research work was also undertaken by non-government engineers and organisations. One early report, known as *TR9* (Transport Recommendation 9), was the very first cost/benefit analysis of roading works and was the forerunner of today's Project Evaluation Manual.

Transit New Zealand took over stewardship of government-funded transport research and published Research Report No. 1, *Use of Non-Standard Road Aggregates from Wanganui and Taranaki Regions*, in 1991. On its formation in 1996, Transfund in turn took control of the research programme and a total of over 260 research reports have been published to date.

Programme continues

Needs change, and it is worth noting that over the coming months the Ministry of Transport will be leading development of a new integrated transport sector research strategy, so the sector can develop comprehensive solutions to the issues it now faces.

In a country where chip-sealing is still the predominant road paving method, aggregates are still under focus today. The report in this issue on an important four-year project studying methods for predicting skid resistance will challenge roading engineers to take a new look at the model currently used for such predictions, and for determining road maintenance programmes.

With ever-increasing traffic levels, construction of passing lanes on two-lane roads in New Zealand continues apace, but is enough understood about the impact of lane design on driver behaviour? As identified in a recently completed project (reported in this issue), there are a number of ways in which both the design of passing lanes and their attendant signage and paintwork can be improved.

I am proud to see Land Transport NZ supporting the continuation of such valuable work.

Wayne Donnelly
Chief Executive

Improving passing lane design

continued from page 1

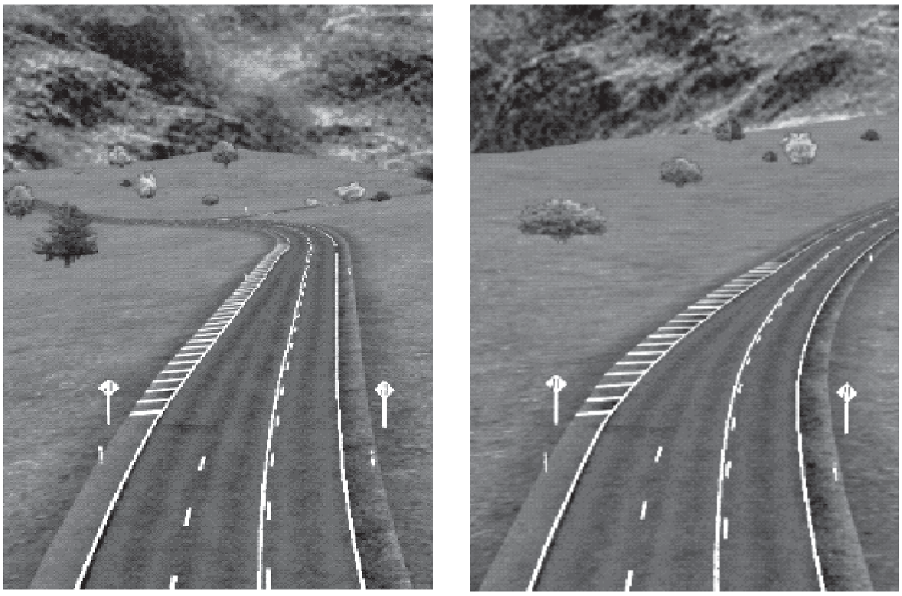
Literature review

A Transfund research project undertaken in 2003 on state highways in the upper North Island of New Zealand was aimed at improving the safety of passing lanes by providing a better understanding of the impact of lane design on driver behaviour. It started with a review of available literature on passing lanes.

The review found, among other things, that research into design aspects such as the length, spacing and road geometry of passing lanes has mostly been based on various quantitative models and simulations of willingness-to-pay considerations. At least as important, however, in reducing crash statistics is the question of driver perceptions and judgments when making decisions about overtaking.

Lerner at al. (2000)[2] found that research from both laboratory simulations and instrumented vehicles indicated that about one-third of drivers *overestimated* the time they had available in which to make a passing manoeuvre, and *underestimated* the time required to pass a vehicle, especially when that vehicle was a truck.

Combining the time-available and time-required judgments, 58 percent of drivers' estimates were safety-negative errors for passing a truck, and 26 percent for passing a car. These findings highlight the importance of passing lane design in helping drivers to make safe overtaking decisions and to limit the need for overtaking on two-lane stretches of road.



LEFT: Oblique scan of simulated standard taper merge design, commonly used in New Zealand. RIGHT: Simulated short taper merge design. Several participants in the simulator-based study commented that they felt more comfortable with the (standard) longer merge design.

Other literature supports this view. As well as basic lane design parameters, signage and road markings have been found to influence driver confidence and decisionmaking. May (1991)[3] found that passing line entrance designs, with continuity lines through the diverge section, can increase the number of vehicles entering the passing lane and the number of passes per passing-lane length.

The design of the merge portion of passing lanes has been found to affect drivers' speeds. In Australia a merge continuity line gives precedence to overtaking vehicles and has the effect of slowing drivers' speeds, reducing headway distances in the merge taper and tending to reduce overall overtaking rates.

In New Zealand a different treatment is used, with lane lines ceasing at the start of the merge taper and hatched run-out lines being painted on the road shoulder at the end of the merge area, tapering back to the shoulder width. This treatment has been found to delay drivers moving to the right lane in the merge section.

Overall, the literature review highlighted the importance of providing drivers with safe and efficient passing opportunities where geometry, lane design and signage work together to reduce uncertainty and maximise safety when overtaking.

Industry consultation and further studies

In addition to the information gathered through literature reviews and crash analyses, roading and transport authorities were questioned about their

continued on page 4

2 Lerner, N, Steinberg, G., Huey, R., Hanscom, F. 2000. Driver misperception of manoeevre opportunities and requirements. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting: 255-258.*

3 May, A.D. Traffic performance and design of passing lanes. *TRB Record 1303.*

continued from page 3

perceptions of the important concerns relating to passing lane design. Engineers and others identified several issues needing further study, including:

- optimising the frequency of passing lanes
- optimising the placement of passing lanes to encourage appropriate driver behaviour
- possible use of continuous double yellow lines at passing lanes, to prevent overtaking in the opposing direction
- placement and design of merge areas and allied signage
- efficacy of the hatched shoulder run-out in the merge area
- consistency of shoulder widths on passing lanes.

These issues were further explored as part of a full environmental survey of 21 crash sites identified by the LTSA Crash Analysis System, as well as simulator-based studies of merge designs. Transit New Zealand regional engineers were also contacted for comments, and a survey of drivers was conducted to test their understanding of the rules relating to overtaking and yellow lines.

In addition, traffic counting tube measurements were collected at two sites with different geometry on SH29, across the Kaimai Range between Waikato and Bay of Plenty.

One site was a 1 km long passing lane on a straight stretch of road, including the merge area. The second site was a 2 km long passing lane located on an uphill stretch close to a summit, with the merge area obscured by a curve in the road.

The results of these measurements, taken over continuous 24-hour periods at each site, provided some useful information about driver behaviour at passing lanes. At both lanes there were several differences in driver behaviour. Although drivers travelled slightly faster throughout the passing lane with the straight merge, their behaviour was more consistent. They made fewer lane changes and maintained a more constant speed. When drivers travelled through the blind merge, their behaviour was more varied with greater changes in speed and more lane changes.

Video analysis of merging behaviour at the same sites also confirmed inappropriate merging behaviour where two or more cars were still overlapped within the merge taper. These instances fell into three categories — vehicles completing an overtaking manoeuvre that was started before the merge; those beginning an overtaking manoeuvre within the merge but pulling back; and those completing an entire overtaking manoeuvre within the merge taper.

Factors affecting passing lane crashes

An analysis of these various studies identified several issues that might contribute to passing lane crashes, particularly opposing direction crashes (ie those where traffic travelling in the opposite direction to that of vehicles in the passing lane crossed the centre-line into the passing lane to overtake vehicles).

Driving simulator configuration (top) and typical simulated road scene (bottom). Subjects' responses to road merge geometry and paintwork treatments were tested using the University of Waikato/TERNZ DS9 driving simulator.

Possible behavioural factors

- Driver attitudes and behaviour — statistics show younger males were more likely to be involved in this type of crash.
- Driver frustration (identified by industry experts as a concern).
- Longer vehicles seemed to be over-represented in crashes of this type, with 47.5 percent of crashes involving drivers attempting to overtake longer vehicles.

Engineering design factors

- A number of sites lacked an 'escape route' if errors in judgment had been made.
- Sealed shoulders were rarely of a width that a driver could move out of the way to avoid a crash.

- Sloping verges, ditches and banks appeared to contribute to the unforgiving nature of these sections of road.
- Sight distances at some sites were found to be inadequate.
- Current criteria for installing double yellow (no-overtaking) lines may not adequately address the factors that occur with overtaking manoeuvres on three-lane sections of road.

Importance of geometric design

The research concluded with a simulator-based study of various merge designs in order to examine the impact of merge design on driver behaviour.

The results suggested that geometric design — correctly placing the merge in relation to road geometry, and allowing an appropriate taper length — is particularly important in promoting appropriate driver behaviour at merges.

Alternative road marking treatments, including the use of herring bone markings and early termination of the passing lane centre-line were also tested. The herring bone markings did promote early merging and were popular with drivers, but resulted in very short headway distances between merging vehicles.

In contrast, the early termination of the lane line (55 m early) was not well-liked by the participants, although it too produced an improvement in merging behaviour, reduced speeds, and actually increased the headway distances between merging vehicles.

The negative reaction of drivers to the early termination of the passing lane centre-line may have contributed to an increased sense of caution and safer merging behaviour, but some additional investigation would be required before implementing this treatment on the road.

The results indicated that geometric design had a greater impact on driver behaviour than the road markings and that with good geometric designs, alternative paint treatments may not be required.

Suggestions for improving passing lane design

The project report contains a number of suggested changes that could be made to passing lane design as a result of the findings. Possible limitations, requiring further research, are outlined in relevant sections of the report.

A summary of suggested improvements, subject to further detailed study, is shown in the accompanying panel.

Contact for more information:

Peter Baas
TERNZ Limited
Phone +64 9 262 2556
Email: *p.baas@ternz.co.nz*

Transfund Research Report No 255, *Impact on Driver Behaviour of Overtaking Lane Design for New Zealand Roads* ($45). See details on page **12** for purchasing copies of reports.

Suggestions for improving passing lane design
Ensure all merge tapers are constructed to current standards, ie with long taper lengths.
Ensure all shoulders comply with the Transit NZ minimum width of 1.5 m.
Widening to a minimum of 2 m is preferred to provide an 'escape route' for drivers involved in potential crashes.
Increase passing lane opportunities to reduce driver frustration and related increased risk-taking.
Consider widening lane used for the opposing lane to provide overtaking opportunities for downhill traffic.
Install wide double yellow lines with Vibraline on high-risk sections of three-lane or multi-lane roads.
Where traffic volumes are high, consider installing a solid median barrier between the opposing lane and the passing lane.
Install warning signage at potentially hazardous areas where some confusion is likely about actual available sight distances, and where there is some uncertainty in which lane vehicles are to travel.
Increase education to the motoring public about safe overtaking.
Install warning signs at locations where poor driving conditions caused by adverse weather, such as icy conditions, occur.
Remove 'pseudo' passing lanes, ie hatched shoulders, or treat the merge of such areas in the same manner as for passing lane merges.

Predicting the skid resistance of New Zealand's chipseal roads

TRANSIT NEW ZEALAND

SCRIM (Sideway-force coefficient routine investigation machine) as used by Transit New Zealand to monitor the condition of state highways.

A Transfund research project aimed at determining how the size, shape and spacing (macrotexture) of aggregate affects the skid resistance of chipseal surfaces has found that the critical factors most affecting performance are the cumulative passes of heavy commercial vehicles (HCVs) and the mean spacing between the tips of aggregates.

The research report highlights the significant in-service effects of aggregate type, stone size and spacing, the contribution of bitumen contamination, and the hysteresis effect of stone shape (see diagram on page 10).

It also brings into focus the need to re-examine the model currently used to predict skid resistance on New Zealand's highways in order to determine maintenance treatment selection.

While the current model takes into account factors including the polished stone value (PSV) of the aggregate and the volume of traffic, researchers now believe that stone size and spacing, and the effect of horizontal tyre forces should also be factored in.

The project resulted in the formulation of a proposed new model that provides a higher degree of certainty of predicted skid resistance, though additional investigations into the relationship between aggregate microtexture and macrotexture will be needed in order to apply the findings to current seal design practice.

Project objectives

The four-year programme of research into the impacts of aggregate size, shape and spacing on the low and high speed wet coefficients of tyre/road friction was undertaken by Opus Central Laboratories between 2000 and 2003 using the following methods:

- field studies of emergency braking tests
- GripTester surveys on public roads
- laboratory-based study of bitumen contamination effects
- statistical modelling studies of aggregate characteristics and skid resistance.

The main aim of the research was to develop a model, validated for conditions found on New Zealand's state highway network, allowing reliable prediction of in-service skid resistance performance of chipseal surfaces. Secondary objectives were to:

- determine relationships between common skid resistance measures employed in New Zealand and the friction coefficient of car tyres derived from emergency braking tests
- gain a better understanding of contamination effects, such as tracked binder film and detritus build-up over dry spells, on skid resistance
- quantify the contribution of macrotexture to skid resistance.

The research concentrated primarily on the skid resistance performance of straight and level sections of state highway, where horizontal tyre forces are at their lowest and least variable. This was in order to avoid complicating effects caused by vehicle manoeuvres that generate higher and more variable tyre forces, such as when accelerating from rest, braking, cornering, and hill climbing.

Field studies

Emergency braking tests involving both four-wheel locked braking and ABS (independent anti-lock braking system on all four wheels) were performed on six different test sites, in order to obtain accurate measurement of wet and dry stopping distances and the associated coefficients of friction.

Four of the sites had chipseal surfaces, while two were paved with asphaltic concrete, and they covered a wide range of microtexture and texture depth levels. This enabled assessment of the contribution of the various aggregates to tyre/road friction.

The emergency braking tests provided evidence that under locked-wheel braking at typical urban speeds, ie up to 50 km/h, wet tyre/road friction reduces as speed increases, though at a slower rate than that predicted by the International Friction Index (IFI).

The reported influence of road surface texture depth on skid resistance was found to be negated by vehicles fitted with ABS braking, and those with adequate tyre tread depth, ie 1.5 mm or greater. In these circumstances, wet tyre/road friction appears to be unaffected by either speed over a 25—100 km/h range or by texture depth.

While skid testers commonly used in New Zealand tend to display differing sensitivities to microtexture and macrotexture properties of road surfaces, their measurements of skid resistance showed significant correlations with both dry and wet friction coefficients derived from locked-wheel emergency braking. In general SCRIM (sideway-force coefficient routine investigation machine) measurements, as used in New Zealand by Transit New Zealand to monitor the condition of state highways, were found to be the most reliable.

The researchers point out that while tyre tread depth has not been regarded as significant in New Zealand for skid resistance prediction in the past, an improved understanding of the inter-relationships between wet tyre/road friction, the volumetric texture depths of tyres and road surfaces, vehicle speed, and water film depth is needed before reliable skid resistance models can be developed.

GripTester surveys also established that skid resistance is highest soon after a period of rain — when tracked bitumen and other surface contamination is washed away — but reduces with time if there is a prolonged dry spell resulting in increased bitumen tracking and/or flushing. This reduction in skid resistance may differ with aggregate type, size and microtexture depth.

Bitumen contamination

In order to quantify the relative contributions of aggregate microtexture and surface texture profile, researchers performed a series of measurements on a range of six chipseal samples, some laboratory-made, others pavement core samples.

The samples selected are listed in Table 1 (see overleaf), which shows the mean profile depth (MPD) of each type — that is, a measure of the macrotexture of the surface — as well as its British Pendulum Number (BPN), indicating the skid resistance. Sample 1 has the lowest skid resistance (BPN=61) in its unweathered condition, while sample 6 has the highest skid resistance (BPN=100).

These road samples were progressively coated with four successive layers of bitumen, from very thin layers representative of tracking contamination through to thicker films such as those found in severe flushing situations. The first three coatings were

continued on page 8

continued from page 7

Table 1: Chipseal samples

Sample No.	MPD (mm)	Sample description	BPN
1	3.0	Worn Grade 3 greywacke chipseal from pavement core	61
2	1.6	Worn Grade 5 greywacke chipseal from pavement core	70
3	3.3	Laboratory-made surface of new Grade 4 greywacke chipseal	81
4	3.5	Laboratory-made surface of new Grade 4 basalt chipseal	94
5	2.2	Laboratory-made surface of new Grade 6 basalt chipseal	93
6	2.8	Laboratory-made surface of new calcined bauxite	100

Table 2: British Pendulum Number (BPN) measurements

Coat	Coat thickness (microns)	Sample no.						Ave.	Change
		1	2	3	4	5	6		
Orig.	0	61	70	81	94	93	100	83	-
A	1	68	69	81	91	92	94	83	0
B	4	70	69	83	90	88	98	83	0
C#	13	73	-	-	-	-	96	-	-
Weathered samples									
C	13	58	51	79	89	80	89	74	-9
D	110	53	55	67	80	65	81	67	-16

Only samples 1 and 6 tested after drying overnight

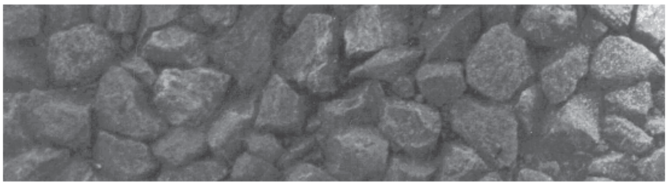
applied using standard hard 40/50 bitumen and the fourth coating, where researchers wanted to mask most of the aggregate microtexture, used a painted coating of 180/200 bitumen emulsion.

Coatings were described as:

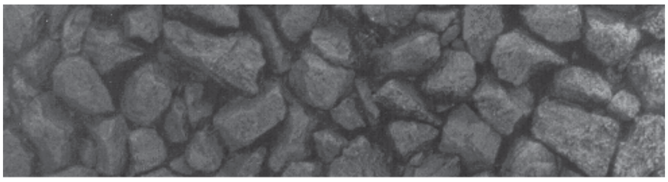
- 1st coat - light stain (bitumen film thickness approximately 1 micron)
- 2nd coat - medium stain (thickness 4 microns)
- 3rd coat - heavy stain (thickness 13 microns)
- 4th coat - severe contamination (thickness 110 microns).

Following each coating of bitumen, the BPN measurements of skid resistance were obtained in the laboratory under controlled conditions at a temperature of 16° C. For each of the first two coatings samples were left to dry overnight before testing. After the third and fourth coatings, the road surface samples were left outside to weather in the sun and rain for four days before testing.

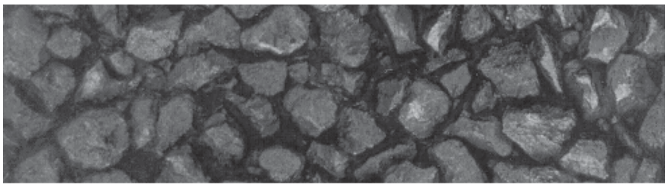
Sample 1, worn Grade 3 greywacke



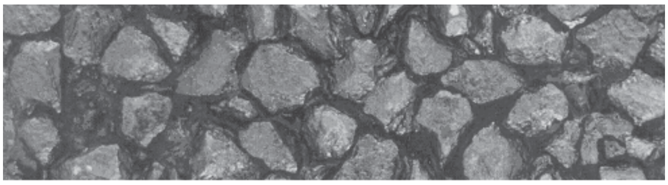
Original surface condition, 3mm MPD



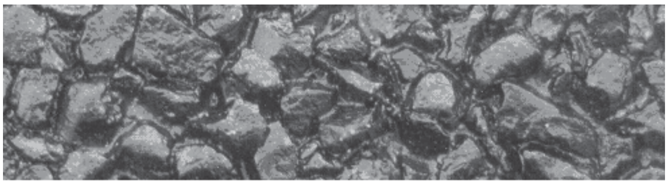
Coating A, bitumen film thickness approx. 1 micron



Coating B, total bitumen film thickness 4 microns



Coating C, total bitumen film thickness 13 microns



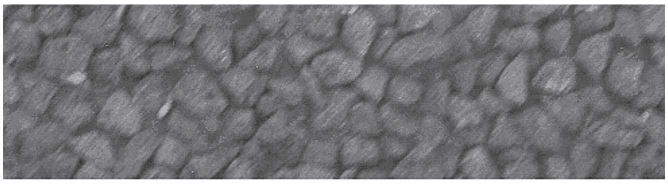
Coating D, total bitumen film thickness 110 microns

After the first coating there was little change in the BPN for four of the samples, while sample 1 showed an increase and sample 6 showed a reduction in BPN. Subsequent coatings of the unweathered samples showed little additional change in BPN, but for the weathered samples, following the third and fourth coatings, there were significant reductions in measured skid resistance as the coating thickness increased. Table 2 shows the detailed measurements.

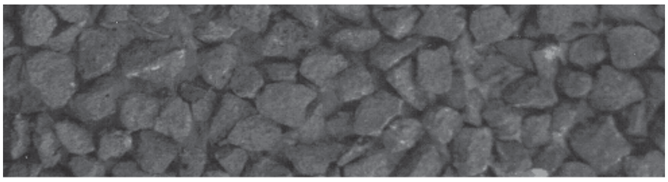
Implications of bitumen tests

The measured skid resistance was influenced by several factors, including the thickness of the bitumen film, weathering of the film, and the initial road surface. While generalised comments about the influence of any one of these may be misleading, the measurements showed that:

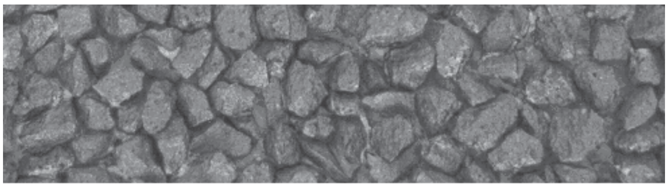
Sample 4, new Grade 4 basalt



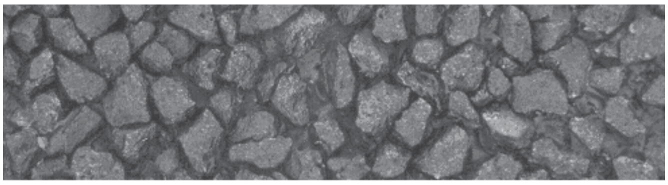
Original surface condition, 3.5 mm MPD



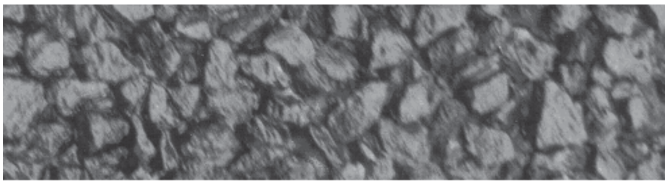
Coating A, bitumen film thickness approx. 1 micron



Coating B, total bitumen film thickness 4 microns



Coating C, total bitumen film thickness 13 microns



Coating D, total bitumen film thickness 110 microns

- aggregate microtexture contributes between 8 BPN (worn surface) and 28 BPN (new surface) to the overall skid resistance of the road surface sample, corresponding to 13 percent and 30 percent respectively
- the contribution of macrotexture to overall skid resistance is comparable to that of aggregate microtexture — this was an unexpected result and suggests that for chipseal surfaces, the hysteresis and adhesion components of friction are similar in magnitude
- the relative contribution of aggregate microtexture to the skid resistance of a surface increases as the macrotexture of the surface decreases
- the presence of bitumen film on chipseal road surfaces can result in reductions of skid resistance of between 20 and 30 percent in situations where the contamination is severe, ie bitumen film thickness of around 0.1 mm. However, the resulting level of skid resistance is still significantly greater — at least three times — than that provided by a smooth, bitumen-only surface. This suggests that chipseal surfaces in a flushed condition pose a greater safety hazard to motorists in wet conditions than chipseal surfaces that have been blackened by tracked bitumen.

Researchers recommended that to assist in the formulation of skid resistance models and to identify any significant anomalies, the relative contributions of aggregate microtexture and macrotexture to skid resistance should be investigated for alluvial-sourced and hard rock-sourced aggregates of the types commonly used in New Zealand. (This is presently being undertaken through a separate research contract, Improving Aggregate Utilisation, scheduled for completion by end of June 2005.)

They also recommend that road network managers should target the elimination of flushed sections of chipseal surfaces wherever they occur at locations of high friction demand, such as mid-curve, and wherever the continuous length of flushed surface in a wheel path is 20 m or longer, to prevent potentially hazardous braking manoeuvres.

Statistical modelling

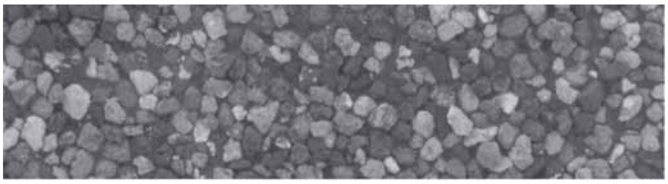
The final phase of this project involved performing a regression analysis to investigate the sensitivity of in-service skid resistance performance (of chipseal surfaced sections of state highway) to aggregate and texture characteristics under different traffic loadings.

The analysis was performed on a specially assembled database comprising SCRIM-based skid resistance data from annual surveys undertaken since 1998, and 18 different standard measures of surface texture derived from stationary laser profilometer measurements made on 47 straight and level test sites on state highways.

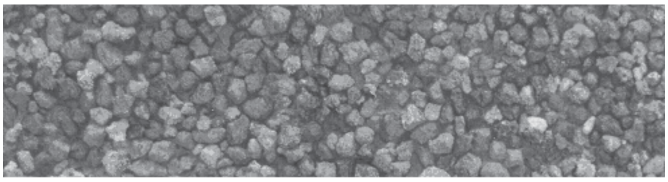
The regression analysis revealed that the current model used for relating skid resistance, aggregate PSV, and HCV traffic gave skid resistance predictions that correlated poorly with the measured in-service skid resistance of the 47 test sites. The model tended

continued on page 10

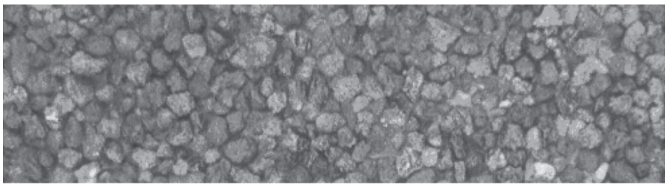
Sample 6, new calcined bauxite



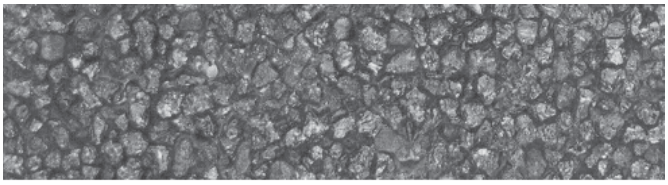
Original surface condition, 2.8mm MPD



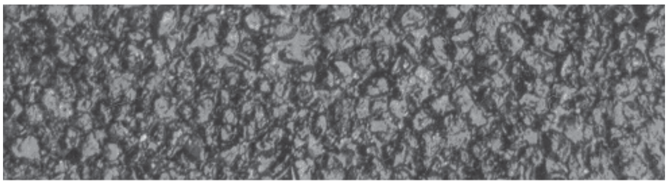
Coating A, bitumen film thickness approx. 1 micron



Coating B, total bitumen film thickness 4 microns



Coating C, total bitumen film thickness 13 microns



Coating D, total bitumen film thickness 110 microns

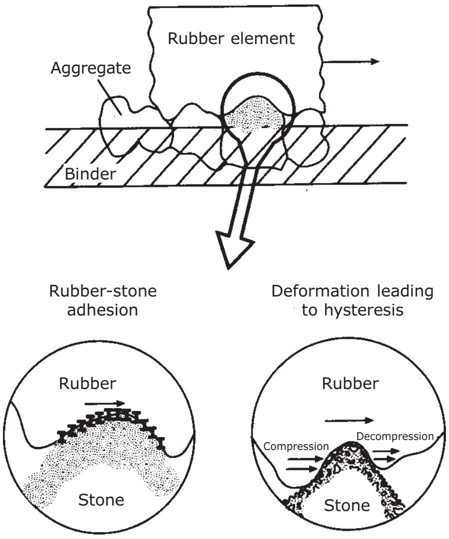
continued from page 9

to overestimate the level of skid resistance, which is a concern.

Other findings of the analysis included:

- the critical determinants of in-service skid resistance performance of straight chip sealed road sections were identified as cumulative HCV passes and the mean spacing between tips of the aggregates (the smaller the spacing, the higher the skid resistance)
- a threshold value of cumulative HCV passes exists, beyond which there is no further reduction in skid resistance over time due to traffic wear - this threshold value is approximately 1 million HCV passes

Schematic of adhesion and hysteresis mechanisms *(courtesy of ARRB Group)*



- the regression model formulated by researchers, displaying the best compromise between ease of application and accuracy, represents a definite improvement over the skid resistance model currently in use in New Zealand. The model is relatively simple and is detailed in full in the report (see details at the end of this article)
- preliminary indications are that selection of 'rounded' alluvial aggregates for skid resistant surfaces should be predicated on PSV as is current practice, but that selection of 'angular/ sharp-edged' hard rock aggregates should be predicated on size (the smaller the better) and ability to withstand tip- and edge-wear caused by HCV traffic.

Recommendations

The statistical modelling showed that for a given speed, the greater the area of contact between the tyre and the road, the higher the skid resistance. For vehicle speeds expected on rural state highways, a mean spacing of 5 to 15 mm between tips of aggregates is considered necessary to satisfy both hysteresis and drainage requirements.

While Grade 2 to Grade 5 sealing chips are currently in dominant use, the researchers believe that a move to confine chipseal surface construction to Grade 3 to Grade 6 sealing chips would lead to more efficient provision of skid resistant roads.

They also recommend that aggregates need to be tested for their ability to maintain their shape under the wearing action of HCV traffic.

Measuring more surface texture variables than mean profile depth (MPD) during annual high speed condition surveys should also be considered, so that additional information can be provided on amplitude, spacing and shape characteristics of the road surface profile. This would lead to improved knowledge on the wearing properties of surface macrotexture as a result of seasonal effects and exposure to traffic.

Contact for more information:

Peter Cenek
Opus Central Laboratories
Phone +64 4 587 0600
Email *peter.cenek@opus.co.nz*

Transfund Research Report No 256, *Prediction of Skid Resistance Performance of Chipseal Roads in New Zealand* ($40). See details on page 12 for purchasing copies of reports.

Comment from Transit New Zealand

We asked Transit New Zealand to comment on the findings of this project. The following is their response.

'Transit New Zealand's current skid resistance policy has demonstrably reduced wet road crashes. In fact, most overseas techniques for the measurement of skid resistance are benchmarked against what has been adopted on the New Zealand state highway network. However, enhancements to improve the safety record further, at affordable cost, are constantly being evaluated. The issues raised by this research will be considered as part of this process.'

Dave Bates
National Asset Manager
Transit New Zealand

The New Zealand Road Innovation Award

Transit New Zealand and Works Infrastructure are partners in sponsoring The New Zealand Road Innovation Award.

This award is presented annually for the best paper on roads presented at any conference in New Zealand or overseas, in the previous 12 months. The prize is a sum of $2,000 and a framed certificate.

Judging criteria

1. Value of the paper, including:

- the extent of guidance for future improved road practice, be it planned, technical or construction
- research, or practical developments and testing of innovative concepts
- economic, technical, safety or quality benefits accruing from the recommendations
- the concepts are attractive to road and transportation practitioners.

2. Quality and presentation of the paper:

- paper layout, format and structure
- content
- the development of concepts in the paper from objectives to summary and/or recommendations
- technical detail and presentation aids (photos and graphics)
- readability and viewer interest
- clarity of the synopsis/summary (whichever is appropriate).

Objectives of the award

- Encourage innovation in roads in New Zealand.
- Strengthen continuous improvement in the road industry.
- Support excellence in research.

To be considered for this award, the author(s) must be New Zealand residents or citizens.

Nominations close 30 June 2005.

Nominations for the award must include a copy of the paper as presented, a covering letter of up to 100 words explaining why the paper should be considered, and should be addressed to:

Douceline Van Arts,
International and Business Services Manager,
Transit New Zealand,
PO Box 5084, Wellington 6040.
Fax: 04 496-6608
Email: *douceline.vanarts@transit.govt.nz*

New research publications

Strategic Environmental Assessment: Application to Transport Planning in New Zealand

Research Report No. 261

Jessica Wilson & Martin Ward. Ward-Wilson Research, Wellington.

Price $25

This report was prepared to identify opportunities for the application of strategic environmental assessment (SEA) to transport planning in New Zealand. SEA is widely used in transport policy development and planning in Europe and North America. It is recognised as a valuable means of analysing and addressing the potential environmental and social impacts of transport policies and plans.

In focusing attention on the environment, SEA also serves to highlight the importance of environmental sustainability in transport planning. To date, experience of SEA in New Zealand has been limited. However, recent changes to New Zealand's transport policy and legislative framework provide the opportunity to develop a more systematic approach to SEA. The introduction of the *New Zealand Transport Strategy* and the Land Transport Management Act 2003 has significantly enhanced recognition of the environmental and social impacts associated with transport.

Importantly, the provisions of the Act also incorporate a number of elements of effective SEA. These include the Act's sustainability focus, its requirements for early and full consideration of alternatives, and for early and full opportunities for public participation in land transport planning. The use of SEA approaches in the development of transport strategies and programmes could provide a valuable means of delivering on these obligations.

Employer Travel Plans in New Zealand

Research Report No. 262

John Bolland. Booz Allen Hamilton, Wellington.

Price $20

A research project was undertaken in 2001—2003 to investigate the application of employer travel plans in New Zealand. The project's focus was the identification of the most appropriate travel plan method that could be used by New Zealand organisations, and its likely impact on travel modes for the journey to work. Case study employer travel plans were facilitated at two New Zealand organisations as part of this project. The research project involved three main components:

- a review of international practice and experience with employer travel plans
- facilitation of case study employer travel plans at the Auckland Central branch of the New Zealand Police, and the Civic Offices of the Christchurch City Council
- assessment of the results of the employer travel plan case studies.

The case studies demonstrated that the standard employer travel plan process can be applied in the New Zealand context. Issues did arise in the implementation of this process that were similar to those experienced internationally. Travel behaviour changes similar to those achieved internationally were observed.

TRANSIT NEW ZEALAND ARARAU AOTEAROA

WDM

First International Conference on Surface Friction: Roads & Runways

Improving safety through assessment and design

1-4 May, 2005, Christchurch

Hosted by Transit New Zealand and WDM Ltd of United Kingdom, this first-ever conference on surface friction has attracted engineers from all over the world.

Across the developed world 40 percent of road crashes occur when it is wet. Most of these crashes could be avoided if suitable surfaces were laid. A key role of the road engineer is to try and anticipate where crashes might occur and use the best stone, together with the best design, to minimise the risk of crashes.

This important conference is an opportunity for engineers to share their knowledge and skills in order to identify cost effective solutions.

Speakers include experts from England, New Zealand, Australia, United States, Norway, Canada, Northern Ireland, Iran, Israel, and Gambia.

Registrations $950+GST before 10 April, $1,100+GST from 10 April onwards.

Online registration and full programme of papers, forums and workshops from ***www.surfacefriction.org.nz***

Obtaining research publications

Research publications of Land Transport NZ, Transfund New Zealand, Transit NZ and the former National Roads Board can be ordered direct from Land Transport NZ, Southern Regional Office, PO Box 8498, Christchurch.

Phone: +64 3 341 6012
Fax: +64 3 341 6014
Email:
research@landtransport.govt.nz