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# Chipsealing in New Zealand

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Chipsealing in New Zealand is a distillation of information from at least 80 years experience in New Zealand, compiled by chipsealing experts from throughout New Zealand. Many years of experience based on research and backed up by references have contributed to this book.

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# Chipsealing in New Zealand

Transit New Zealand, Road Controlling Authorities & Roding New Zealand

2005

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Cover: Chipsealing the Milford Road, on the approach to Homer Tunnel below Mt Talbot (2117 m), South Island, New Zealand. This road within Fiordland National Park is a show piece for tourism and care of the environment.  
Photo courtesy of Les McKenzie, Opus

## Foreword

In New Zealand we have long been at the forefront of chipsealing technology in the international arena. In 1935 New Zealand's F.M. Hanson was the first to present a scientific approach to the design and construction of chipseals. The principles presented by Hanson in his paper to the Conference of the New Zealand Society of Civil Engineers promoted a rational approach to chipsealing that remained unchallenged for the next fifty years.

Today, Transit New Zealand, Roothing New Zealand and Road Controlling Authority engineers have recognised the need to take a new snapshot of the current state of the art regarding chipseals. This project has been a basis for capturing our collective intellectual property regarding chipseals and gives us a base on which to build future improvements.

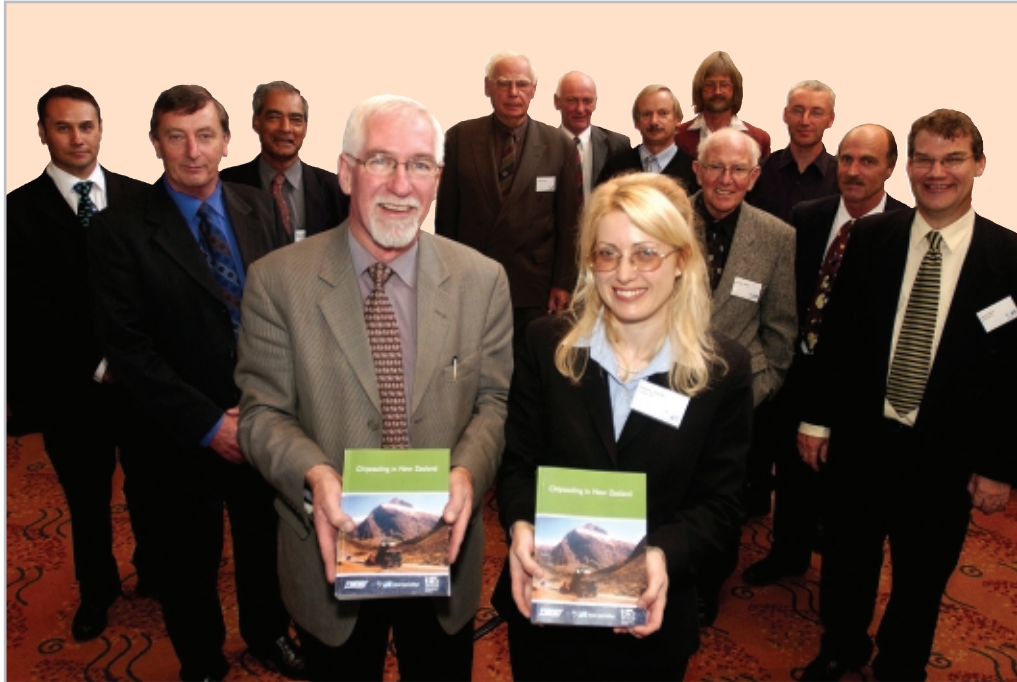
The book will be a resource, not just for those currently in training, but as a valuable guideline for roading practitioners around the country, and internationally.

New Zealand's 60,000 kilometres of chipsealed roads are a valuable but fragile asset and therefore documenting best practice is a significant project. Those involved in developing this book believed it was important that the New Zealand chipsealing industry feels that it has ownership in this book and has had an active participation in its development. As shown by the impressive list of names in the acknowledgments section, it is pleasing to see that representatives from the stakeholders, Transit, Road Controlling Authorities, contractors and consultants, have been represented at every level in the development of this book, including authorship of its various sections and as peer reviewers.

I am pleased and proud of the immense effort that has gone into the production of this book and recommend it to all involved in the chipsealing industry.






**Rick van Barneveld**  
*Chief Executive*  
Transit New Zealand



The book "Chipsealing in New Zealand" was launched by the Honorable Harry Duynhoven, Minister for Transport Safety, at the Road Controlling Authorities Forum held in Wellington, New Zealand, on 22 April 2005.

Pictured are (left to right): Greg Arnold (Transit NZ), Graham Taylor (Transit NZ), Deven Singh (Wellington City Council), John Dawson (Retired), John Patrick (Opus), Philip Muir (Works Infrastructure), Alan Stevens (Roading NZ) (rear), Norman Major (Retired) (in front), Peter Mumm (Hutt City Council), Gordon Hart (Transit NZ Napier), Chris Olsen (Roading NZ). In front with proof copies of the book: Hon. Harry Duynhoven (Minister for Transport Safety) and Joanna Towler (Transit NZ).

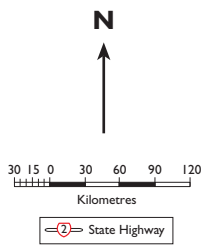
## CONTENTS

	Foreword	iii
	Preface	vii
	Chapter 1 History of Chipsealing in New Zealand	1
	Chapter 2 Safety in the Chipsealing Industry	23
	Chapter 3 Introduction to Chipsealing Technology	37
	Chapter 4 Typical Chipseal Performance	91
	Chapter 5 Road Asset Management	135
	Chapter 6 Chipseal Selection	159
	Chapter 7 Preseal Preparation	221
	Chapter 8 Chipsealing Materials	257
	Chapter 9 Chipseal Design	327
	Chapter 10 Chipsealing Plant	377
	Chapter 11 Chipseal Construction Practices	415
	Chapter 12 Chipseal Failures and Repairs	459
	Epilogue	483
	Glossary	485
	Index	511



# New Zealand, showing the State Highway Network

Map as at October 2004



## Strategic Hierarchy Classes: Vehicles per day (vpd)

Class	Definition	Color
M	Motorway/Expressway	Dark Blue
U	Towns	Light Blue
R1	Rural, >10,000 vpd	Grey
R2	Rural, 4,000 to 10,000 vpd	Red
R3	Rural, 1,000 to 4,000 vpd	Brown
R4	Rural, <1,000 vpd	Yellow

## Preface

This book has been compiled by chipsealing experts from four of the stakeholders who operate, maintain and build the roads in New Zealand. They are Transit New Zealand, Local Authorities, Contractors and Consultants. Many years of experience based on research and backed up by references have contributed to the concentrated work to create this book. It is a distillation of information from at least 80 years experience in New Zealand, Australia, the United Kingdom and the United States.

The experiences drawn on to write this book range from the 1920s to 2005, from the time when chipsealing was almost an 'art form' and largely guess work to its present 'technological form'. Over this time experience and research have uncovered reasons why chipseals behave the way they do under different conditions. Chipsealing techniques differ from the north to the south of New Zealand as the country is long, crossing subtropical to near-subantarctic conditions over its 2000 km length. New Zealand is narrow too, and many of its roads pass quickly from coastal plains to mountainous passes. These extremes of climate and landscape impose many constraints on road surface performance and present challenges to be overcome.

Thus there is no 'correct' or only way for a chipsealing operation to be carried out. For this reason experience and research are presented in this book so the reader can make their own informed decisions when using chipsealing technology.

Authors of the chapters are all experts in their own fields of chipsealing. They have worked on their own and collectively, discussing methods and techniques that have evolved over the years, which ones give the best results, the longest lives, and most economical returns.

This book is intended for those studying road engineering at polytechnic and university level, for those already in the chipsealing industry who want to broaden their knowledge, or those from another line of engineering to understand chipsealing for a particular project.

References are provided throughout for more in-depth reading. Its twelve chapters include topics such as safety in the industry, the main chipseal surfacings used in New Zealand, their performance, programming, and design. The materials, the plant and machinery used for chipsealing are described, as well as how to prepare for and carry out the sealing operation. The final chapter explains how to identify failure modes early before they become a major problem, and how to keep a road alive.

We hope you enjoy this book and find it informative. Comments and suggestions for future editions are welcome and should be emailed to [chipsealing.textbook@transit.govt.nz](mailto:chipsealing.textbook@transit.govt.nz)

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## Acknowledgments

A joint team representing Roothing New Zealand, Transit New Zealand, Road Controlling Authorities, and Consultants' groups has prepared this book to capture the New Zealand experience with chipsealing.

An industry organisational structure was developed to manage the process, and is based on the Roothing Information Management System (RIMS) model for developing documents. All levels have representatives from Transit, local authorities, contractors (through Roothing New Zealand), and consultants (through IPENZ and ACENZ). The levels of management in the industry organisational structure are:

- Steering Group
- Technical Group
- Project Manager
- Subject Matter Experts (Authors)
- Peer Reviewers

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## Abbreviations & Acronyms

AADT	Annual Average Daily Traffic volume	HCV	Heavy Commercial Vehicles
AC	Asphaltic Concrete	HDM-III	Highway Design & Maintenance Standards model Version III
ACENZ	NZ Association of Civil Engineers	HDM-4	Highway Development & Management model Version 4
ADT	Average Daily traffic	HDPE	High Density Polyethylene
AGO	Automotive Gas Oil	HMA	Hot Mix Asphalt
AGD	Average Greatest Dimension	HSD	High Speed Data
ALD	Average Least Dimension	HSE	Health & Safety in Employment Act 1992
AM, AQ, AS	Anionic emulsions	HSNO	Hazardous Substances & New Organisms Act 1996
AP	All Passing (aggregate)	Hz	Hertz
APP	Atactic Polypropylene		
ARRB	Australian Road Research Board, NSW	IPENZ	NZ Institute of Professional Engineers
AS	Australian Standard	ISO	International Standards Organisation
ASTM	American Society for Testing & Materials	ISSA	International Slurry Sealing Association
AWPT	Area-wide Pavement Treatment		
		K&C	Kerb and Channel
B, dB	bel, decibel	km	Kilometres
BC, BCR	Benefit/Cost ratio	km/h	Kilometres per hour
BCA	Bitumen Contractors' Association		
BPN	British Pendulum Number	ℓ	Litres
BPT	British Pendulum Tester	LA	Local authority
		LCV	Light commercial Vehicles
CM, CQ, CS	Cationic emulsions	$L_{eq}, L_{max}, L_{10}$	Sound levels
CMA	Calcium magnesium acetate	LDPE	Low Density Polyethylene
COP	Code of Practice	LGA	Local Government Authorities
COPTM	COP for Temporary Traffic Management	LL	Liquid Limit
cSt	Centistoke	LTMA	Land Transport Management Act 2003
		LTSA	Land Transport Safety Authority
dBA	adjusted decibel		
dTMS	Deighton's Total Infrastructure Management System	MC	Moisture Content
		MDD	Mean dry density
e	Surface correction factor	MHB	Main Highways Board
elv	equivalent light vehicles	min	minute
EMA	Ethylene Methyl Acrylate	MOW	Ministry of Works
ESC	Equilibrium SCRIM Coefficient	MPD	Mean profile depth
EVA	Ethylene Vinyl Acetate	MSSC	Mean summer SCRIM coefficient
		MTD	Mean Texture Depth
FWD	Falling Weight Deflectometer	MWD	Ministry of Works and Development
GC	Graded Crushed aggregate	NAASRA	National Association of Australian State Roads Authorities
		NDM	Nuclear Densometer
$H_{fe}, H_{fh}$	Heating factor for emulsions, hot bitumen	NES AQ	National Environmental Standard for Air Quality

NRB	National Roads Board	RoAR	Road Analyser & Recorder machine
NZ	New Zealand	RPM	Raised Pavement Marker
NZIE	NZ Institute of Engineers	RRPM	Reflectorised Raised Pavement Marker
NZIHT	NZ Institute of Highway Technology	rpm	revolutions per minute
NZ PBCA	NZ Pavement & Bitumen Contractors' Association	RRU	Road Research Unit
NZQA	NZ Qualifications Authority	RTFO	Rolling Thin Film Oven test
NZRF	NZ Roadmarkers Federation	RWIS	Road Weather Information System
NZS	NZ Standard		
		SAM	Stress Absorbing Membrane
OGA	Open Graded Asphalt	SAMI	Stress Absorbing Membrane Interlayer
OGEM	Open Graded Emulsion Mix	SBR	Styrene-Butadiene Rubber
OGPA	Open Graded Porous Asphalt	SBS	Styrene-Butadiene-Styrene
OMC	Optimum Moisture Content	SC	Sized or Sealing Chip
Opus	Opus International Consultants Ltd	SCRIM	Sideway-force Coefficient Routine Investigation Machine
Pa	Pascal	SFC	Sideway Friction Coefficient
PAH	Polyaromatic hydrocarbons	SIS	Styrene-Isoprene-Styrene
PAP	Premium All Passing	SLP	Stationary Laser Profilometer
PBCA	Pavement & Bitumen Contractors' Association	SMA	Stone Mastic Asphalt
PBD	Polybutadiene	SNZ	Standards New Zealand
PCC	Portland Cement Concrete	SRA	State Roading Authority (Australia)
PE	Polyethylene		
pen.	Penetration grade	t	tonne
PI	Plasticity Index	T <sub>d</sub>	Texture depth (mm)
PL	Plastic Limit	T <sub>f</sub>	Traffic factor
PMB	Polymer Modified Binder	TMP	Traffic Management Plan
PME	Polymer Modified Emulsion	TNZ	Transit New Zealand
PMS	Pavement Management System		
PPE	Personal Protective Equipment	UK	United Kingdom
pph	parts per hundred	US, USA	United States of America
psd	particle size distribution	UV	Ultraviolet light
PSV	Polished Stone Value		
PTR	Pneumatic-tyred roller	V <sub>air</sub>	Volume of Air
PVC	Polyvinyl chloride	V <sub>b</sub>	Volume of Bitumen
PWD	Public Works Department	V <sub>e</sub>	Volume of Chip Embedment
		V <sub>s</sub>	Volume of Stone (chip)
QA	Quality Assurance	V <sub>v</sub>	Volume of Voids
		v/l/d	vehicles per lane per day
R	Residual binder	vpd	vehicles per day
RAMM	Road Assessment & Maintenance Management	VTI	Swedish Road & Traffic Research Institute
RAP	Reclaimed Asphalt Pavement		
RCA	Road Controlling Authorities	WBOP	Western Bay of Plenty
RIMS	Roading Information Management System	WC	Water Content
RMA	Resource Management Act 1991	WW1	World War 1 (1914-18)
RNZ	Roading New Zealand	WW2	World War 2 (1939-45)
		4WD	Four Wheel Drive vehicle

