ROAD MAINTENANCE – WHAT DRIVES US?

Michael Chadderton, Australasian Manager, A J Broom Road Products NZ Ltd, New Zealand

Abstract
The fundamental driver of road maintenance is the "Maintenance Intervention Strategy" but who is driving the Road Maintenance Intervention Strategy?
When did we, as an industry or a local owner, take a hard look at the maintenance activity and relate it, or its problems, to the maintenance intervention strategy? If we took a hard look would we continue to do what we do now?
This paper reviews a years road maintenance records and looks at the alignment between the strategy and the activity on the network. It looks into what the records tell us about our network operations behaviour. It looks at why these behaviours may be present, and offers suggestions on how to improve the strategy, to improve the operational behaviour, to achieve a better outcome.

Key Words: Road maintenance intervention strategy, Integrity of the seal coat

Introduction

Road Maintenance – What drives us?
As Roading Engineers involved in managing road maintenance, what should be driving us, is the Road Maintenance Intervention Strategy.
The Road Maintenance Intervention Strategy is the Asset Owners communication tool designed to inform and guide us in our decision making. We would hope that the strategy has been designed to achieve optimal performance from the road network, or at least the performance the Owner can afford within the risks he is willing to accept. Therefore the strategy is of utmost importance.
This paper reviews a years road maintenance records and looks at the alignment between the strategy and the activity on the network. It looks into what the records tell us about our network operations behaviour. It looks at why these behaviours may be present, and offers suggestions on how to improve the strategy, to improve the operational behaviour, to achieve a better outcome.

Road Maintenance Records

The road maintenance records were provided by three Road Controlling Authorities in New Zealand. (Hutt City Council, Porirua City Council and Franklin District Council) They were chosen because they provided a subtle variation in network character and a large variation in geology. All three Network Managers agreed to provide the data as long as commercial integrity was maintained. A total of four competitively tendered road maintenance contracts were included in the data and these contracts were held by three National Contracting Companies.
The Councils were a mix of urban (2) and urban/rural (1) communities.

	Population	Road length	Urban / Rural
HCC	100,000	477 km sealed	Urban
PCC	50,300	237 km sealed	Urban
FDC	43,000	1380 km sealed	
	Urban/Rural	242 km unsealed	

Financial allocation for Road Maintenance activities. (Annual budgets)

HCC	Corridor Maintenance	$2,380,000
	Rehabilitation	$2,479,000
	Resurfacing	$2,531,000
	Total	$7,390,000
PCC	Corridor Maintenance	$1,040,000
	Rehabilitation	$1,100,000
	Resurfacing	$1,045,000
	Total	$3,185,000
PCC	Corridor Maintenance	$4,874,000
	Rehabilitation	$4,900,000
	Resurfacing	$3,800,000
	Total	$13,574,000

Corridor Maintenance by work category (extrapolated from sample area for FDC)

HCC	Corridor Maintenance	$2,380,000
	Admin	$ 123,000
	Pavement	$1,192,900
	Drainage	$ 462,000
	Emergency	$ 0

	Other	$ 602,000
PCC	Corridor Maintenance	$1,040,000
	Admin	$ 125,000
	Pavement	$ 277,104
	Drainage	$ 128,774
	Emergency	$ 87,300
	Other	$ 422,000
FDC	Corridor Maintenance	$4,874,000
	Admin	$ 366,000
	Pavement	$2,434,000
	Drainage	$ 668,000
	Emergency	$ 67,000
	Other	$ 1,339,000

Total spend on sealed pavement maintenance $3,904,004

Existing Intervention Strategies

All three Road Controlling Authorities had sound, logical and time proven strategies that related to their networks age, condition, rate of deterioration and surrounding land development activities. (Land development is controlled by the local District Plans) The strategies also related to available funds which over time had proven sufficient to support the strategies. However, it should be noted that network growth demands and inflation have in many areas of New Zealand put significant strain on the road maintenance budgets.

The road maintenance strategies were very similar in principal and reflected the uniform approach adopted in New Zealand based on the criteria set by the New Zealand Government, which subsidises road maintenance. The ten year forward works programme allocates the section of road a treatment category based on historical records current condition and a forecast rate of deterioration. The ten year forward works programme is revised annually to confirm previous assumptions and the current condition of the road section.

- Treatment Category (10 year plan revised annually)

Resealing; based on the age and condition of the seal coat. (waterproof and texture)

Rehabilitation; based on the condition of the pavement and maintenance costs.

- Maintenance strategy

Pre Surfacing; Maintenance work is carried out to a high level to ensure all pavement and drainage repairs are done before the reseal.

Holding; A minimum amount of work is undertaken for the two years preceding the rehabilitation. A “keep safe” strategy is adopted.

Other; Other network locations are inspected at regular intervals, defects identified, treatment selections agreed, prioritised and scheduled to fit within the budgets allocated.

Pavement Maintenance Analysis

Where was the money spent in 2007/2008? This data is derived from the combined total for all three networks which protects the commercial integrity of the information provided by the Councils. The annual work activity has been summarised into four work items (potholes, cracking, surface repair and structural repair) because they represent the life cycle of the defect. (from loss of waterproofness through to structural failure)

Financial (Actual expenditure)

The average unit rate per item

Pothole	$ 30.23 ea
Crack	$ 7.03 m
Surface repair	$ 28.00 m2
Structural repair	$ 42.45 m2

The average quantity of each treated defect

Pothole	1.0 ea
Crack	57.0 lm
Surface repair	7.9 m2
Structural repair	28.95 m2

The average cost per repair = average cost x average area

Pothole	$ 30.23
Crack	$ 400.71
Surface repair	$ 221.20
Structural repair	$ 1,228.93

The total number of defects repaired

Pothole	7,435
Crack	145
Surface repair	585
Structural repair	2,482

The total quantity of defects repaired

Pothole	7,435 ea
Crack	8,253 lm

Surface repair	4,624 m2	(= 6.4% of structural repair area)
Structural repair	71,847 m2	

The total annual expenditures (2007/2008) were...

Pothole	$ 224,758	5.8%
Crack	$ 58,023	1.5%
Surface repair	$ 129,471	3.3%
Structural repair	$3,049,895	78.1%
Other	$ 441,857	11.3%
Total	$3,904,004	100.0%

the total expenditure on pavement maintenance for the year.

Commentary

What is this information telling us about the network management behaviour?

Three important behaviours are apparent from this information.

1. Crack sealing accounted for 1.5% of the pavement maintenance expenditure and a total of 145 sites were treated. This reflects a very casual attitude towards maintaining the integrity of the seal coat.
2. Defects are left too long before an intervention action is deployed. The majority, by far, of all maintenance work is left until the pavement requires structural repair. In this work activity the defect size (area requiring repair) is the largest, and the rate the most expensive, making the structural repair the most costly defect type to repair.
3. Preventative maintenance is not aggressively pursued. Preventative maintenance (crack sealing and surface repair) accounts for only 4.8% of the total expenditure.

There is nothing to indicate that this activity contravenes the road maintenance intervention strategy. The strategy may in fact encourage these behaviours because..

a. The “Pre-surfacing” Category – heavy maintenance regime places a lot of emphasis on preparing the road for resealing. This is a high priority and treatment selections are critical (are they overly conservative?) to ensure the pavement survives the life of the reseal.
b. The strategies are more focused on preparation for cyclic activity such as resurfacing and rehabilitation, rather than on the cost effective intervention strategy relative to the defects life cycle.

Why are these behaviours present?

Intervention strategies for road maintenance have been driven by the reseal and rehabilitation programmes. The road sections identified in these categories are maintained to clear guidelines. The road sections not covered by these categories fall into the “other” category that is given little focus beyond being “inspected at regular intervals” and “scheduled to fit within the budgets allocated.”

Retaining the “integrity of the waterproof surface at all times” has not had a focus under existing road maintenance practices. The intention of the reseal programme is to maintain the waterproof surface but for the years in between the resealing no mention is made of retaining the integrity of the sealed surface.

For road maintenance, measure and value contracts are the main type of contract used to engage a Contractor. This type of contract does not encourage the review of cost effectiveness with respect to decision making. Typically managing budgets, meeting response times and completing pre-seal preparation in time are the key performance indicators.

The tools available to road maintenance crews have not supported alternative behaviours. The quantities of work completed reflect the industries ability to respond. Over the last 40 years little progress had been made in providing effective tools to the front line staff to engage in preventative maintenance work. It was as late as 2008 that the BRP Road Patch was introduced into New Zealand which enabled a maintenance crew to waterproof a road as a front line activity without the support of expensive specialised equipment.

The benefit of changing our maintenance strategy.

From the data collected it is possible to re-evaluate the costs if a change to the intervention strategy was implemented.

Financial

If we look at the data and change the intervention of one defect in five to the previous defect category.

The total number of defects repaired

Pothole	7,435
Crack	262
Surface repair	964
Structural repair	1,985

The average unit rate per item

Pothole	$ 30.23 ea
Crack	$ 7.03 m
Surface repair	$ 28.00 m2
Structural repair	$ 42.45 m2

The average quantity of each treated defect

Pothole	1.0 ea
Crack	57.0 lm
Surface repair	7.9 m2
Structural repair	28.95 m2

The five main defect categories were...

Pothole	$ 224,758	6.6%
Crack	$ 104,986	3.1%
Surface repair	$ 213,237	6.2%
Structural repair	$2,439,421	71.2%
Other	$ 441,857	12.9%
Total	$3,424,259	100.0%
Previous total	$3,904,004	
Saving	$ 479,745	

If we look at the data and change the intervention of two defects in five to the previous defect category.

The total number of defects repaired

Pothole	7,435
Crack	379
Surface repair	1,343
Structural repair	1,489

The average unit rate per item

Pothole	$ 30.23 ea
Crack	$ 7.03 m
Surface repair	$ 28.00 m2
Structural repair	$ 42.45 m2

The average quantity of each treated defect

Pothole	1.0 ea
Crack	57.0 lm
Surface repair	7.9 m2
Structural repair	28.95 m2

The five main defect categories were...

Pothole	$ 224,758	7.6%
Crack	$ 151,869	5.2%
Surface repair	$ 297,072	10.1%
Structural repair	$1,829,873	62.1%
Other	$ 441,857	15.0%
Total	$2,945,429	100.0%
Previous total	$3,904,004	
Saving	$ 958,575	

Other benefits

- Earlier intervention consumes less resources per task (labour, plant and materials) resulting in a more efficient service delivery provider.
- Road user satisfaction increases because the defects are repaired when they are smaller and less obvious to the public.
- Safety increases as the occurrence of unsealed defects on the network decreases.
- The cost to the environment decreases as less fossil fuel is consumed per repair site, and traffic is disrupted for shorter periods allowing for a more efficient flow of traffic.

The key to gain these benefits is to intervene in the defects life cycle. There is a flaw to merely looking at reducing the average size of the repair, i.e. reducing the average area of a structural defect repair from the existing 28.95m2 to say 15m2. By using the existing repair methodology, the reduction in area of a repair will result in an increase in the cost per square metre. Therefore, to half the repair area may well double the cost per unit and gain no financial benefit. This is merely an equation relating to the outputs that can be achieved by the resources employed. Physical works become cheaper per unit (m or m2) as the size increases and the converse also applies.

Options for a different future.

If a change is to be made to current practice three areas need to be addressed.

A new strategy – Pavement Waterproof Strategy.

A Pavement Waterproof Strategy is required and should be given equal importance to the Pre-surfacing and Holding Strategy. A Pavement Waterproof Strategy may include treating the observed defect at the most cost effective point of the life cycle (i.e. when it is first observed) then analysing the root cause of the defect. If further treatment is required it is selected and programmed according to the best whole of life cost principals.

Delegated authority to act.

Because the defects need to be treated as soon as possible after they are identified, the most cost effective time is at the time of identification. It is quite common now, for road maintenance work crews, to have a range of delegated authorities so this step is not perceived to be difficult to implement.

Appropriate Treatment Selections

The treatment selection or tools available to the front line road maintenance crews need to reflect the expectations and demands of the Pavement Waterproof Strategy.

New treatment options for road water proofing need to be considered. Attributes need to include, availability or accessibility for front line staff, require no specialised equipment and can be applied 12 months of the year.

Conclusion

This paper has reviewed a years road maintenance records and looked at the alignment between the road maintenance strategy and the activity on the network. It has confirmed that the current activity is aligned with the road maintenance strategy.

It looked into what the records told us about our network operations behaviour. From this information it was apparent that an opportunity existed to improve the maintenance management regime resulting in significant financial, safety and environmental benefits.

To capitalise on the benefits available from this opportunity, change has to involve all parties involved in the process of maintaining the road network. To ensure success a team approach is necessary because the actions required, involve Strategy, Process and Physical Works. The team must all share the vision and commitment to...

1. Review the Pavement Maintenance Strategies to ensure that maintaining the integrity of the seal coat between reseals is a high priority.
2. Implement management process to allow the strategy to succeed. (Including the delegated authority to act, and the review of defects repaired to identify root causes and future treatment options)
3. Introduce the tools to the front line road maintenance crews that will allow the outcomes to be realised.

The benefits are lower costs, improved safety and reduced impact on the environment. A true win / win / win scenario for all parties involved in the roading industry, and on three major road industry monitored indices'.

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Autobiography

Michael has been in the New Zealand road maintenance industry for more than 30 years. Like many other Roading Engineer's he started his career with the Ministry of Works. Having spent time in Policy, Consultancy and Contracting roles he has developed a holistic approach to his work. His interest in road maintenance has seen him manage and maintain many road networks including forestry, Transit (State Highways) and Local Body roads. His passion for people development lead to recognition from the New Zealand Government for the programmes put together with Infratrain and delivered to his staff producing a remarkable development of core skills in a large workforce.

Michael is a Director and Manager of A J Broom Road Products NZ Limited and through this role remains committed to improving the roading infrastructure in New Zealand.

Contact details
Michael Chadderton
A J Broom Road Products NZ Ltd
40 Furlong Cres
Churton Park
Wellington 6037
New Zealand
Email: mchadd@xtra.co.nz
Tel: + 64 (04) 478 4133
Mobile: + 64 (0) 021 802 491
Fax: + 64 (04) 478 4133
www.brp.co.za