COMPARISON OF MAINTENANCE COSTS OF HEAVY DUTY PAVEMENTS

Arvo Tinni
Tinni Management Consulting
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Introduction

It is often overlooked that the estimation of maintenance costs for long periods, as is required for Life Cycle Cost comparisons for optimum pavement selection or for budgeting purposes is an academic exercise with quite a meaningless, or at the best a very inaccurate, end result.

This paper demonstrates the serious shortcomings of the methods of doing this and demonstrates that for a reasonable accuracy of the total cost commitment, the only way is to carry out a detailed historical long term cost study for different pavements. Such exercises are seldom undertaken.

Section A demonstrates the inaccuracy of the current methodology in Australia. The input parameters vary from State to State as do the detailed quantities and action timings nominated in the Maintenance Diaries. Hence, it can be manipulated to suit the selection of any (preferred) pavement type.

Section B provides details of an actual pavements maintenance study that was carried out by Roads and Traffic Authority of New South wales, Australia.

SECTION A

Current Maintenance (Planning) Methodology used for Estimation

A1 Routine Maintenance

Routine maintenance activities form the major portion of maintenance planning, but not necessarily the costs. This is because the requirements and actions are driven by the outcomes of various types of inspections, distress evaluation and recording and the management of Response Times as would be specified in the Codes of Maintenance Standards.

As most routine maintenance requirements are dynamic, constantly varying and cannot be predicted for long time spans, of necessity the programming of the work is generally over short periods of time, with the following two weeks in draft form to record overflow items from the program being compiled.

In the State of NSW the Roads and Traffic Authority has issued representative rates for use in Life Cycle Cost analyses for different pavement types. All this does is that it ensures that all estimators use the same ground rules that may or may not be accurate

Pavement type	Annual routine maintenance cost c/m2/year			
	1-10 y	11-20 y	21-30 y	21-40y
Deep Lift Asphalt - DLA	10	25	60	60
Deep Strength Asphalt on Lean Mix Concrete	25	25	25	25
Plain Concrete Pavement - PCP	15	15	15	15
Continuously Reinforced Concrete Pavement - CRCP	10	10	10	10

Hence, routine maintenance of concrete pavements is about half of that of the flexible

A2 Repetitive Maintenance

These are other routine maintenance activities that are undertaken in a regular or cyclic fashion. Suitable schedules are provided in the Code of Maintenance Standards. These could be six monthly, annually or even biannually.

Long term planning for these activities becomes very much experienced guesswork as forecasting 20 or 30 years in advance of dry or wet seasons, crew availability, various constraining holidays what event maintenance proposals may clash. It is usual to issue schedules when these should be undertaken. Such guidelines would be annually updated to form a guide for future planning. To cost these for 20 or 40 years is completely unrealistic

A3 Periodic (Event) Maintenance

Event maintenance activities are planned major actions for the repair and rehabilitation of the pavement. The quantity and scope estimates of requirements are based on issued RTA Maintenance Diaries. The following listing illustrates such activities for PCP for the first 10 years.

Year	Asset Item	Initiating Event	Planned Event Maintenance	Duration (days)
1	PCP	Cracking, deforming	2,500m^2 slab replacement	39
1	PCP	Crack separation	1,100m cross-stitching	10
3	LM	Faded lines	Waterborne Line marking	5
5	PCP	Cracking, deforming	2,500m^2 slab replacement	39
5	LM	Faded lines	Thermoplastic Line marking	5
6	PCP	Crack separation	1,100m cross-stitching	10
7	LM	Faded lines	Waterborne Line marking	5
9	PCP	Cracking, deforming	2,500m^2 slab replacement	39
9	PCP	Failing Silicone Sealant	Resealing transverse joints	50
10	LM	Faded lines	Thermoplastic Line marking	5

It should be noted that the actual quantities of work can be more or less than the estimate, end hence cost estimates also become academic

A4 Specific Maintenance

This would cover major or large maintenance rehabilitation or repair activities which have not been foreseen. The requirements are generally driven by structural or functional deficiency, e.g. results from deterioration modelling, Incident damage etc. Any estimate will be a purely academic exercise.

SECTION B

Factual Total Cost Study

To my knowledge, there has been only one detailed study of 10 year period of maintenance costs done in Australia. This was by the Roads and Traffic Authority of New South Wales State. The results were formally presented by their Pavements Manager at the PIARC Conference in Brussels some time ago, but have not been widely distributed in Australia.

The attached graphs illustrate the findings. The study length covered about 100 km of Hume Highway which is the main transport link between Sydney and Melbourne. The study covered 10 years of both concrete and flexible pavements and was then extrapolated to 20 years to cover the design life of flexible pavements compared to only half of the design life of concrete pavements.

Even though the unit costs would have escalated since, it may be assumed that the relationships remain the same.

In summary, the total pavement maintenance costs for the first 20 year period were:

- Good quality concrete pavement cost \$3/m^2 (Mittagong City By-pass)
- Poor quality concrete pavement cost \$30/m^2 (Goulburn City By-pass)
- Flexible pavements costs varied between \$55 and \$75/m^2

As an example, if one assumes 10 km of dual carriageway (2 x 11 = 22m), then for the 20 year period the maintenance costs could be:

- Good quality concrete pavement - \$660,000 (~€580,000)
- Poor quality concrete pavement - \$6,600,000 (~€5,800,000) i.e. 10 X
- Good quality flexible pavement- \$12,100,000 (~€9,680,000), i.e. 19 X more than good quality concrete pavement.
- Poor quality flexible pavement - \$16,500,000 (~€13,200,000) i.e. 25 X more than good quality concrete pavement.

Conclusion

Without attempting to escalate the costs to the likely current values, the fact remains that the total maintenance cost of concrete pavements is at least 19 times less than for flexible pavements with the same traffic loading over a 20 year period.

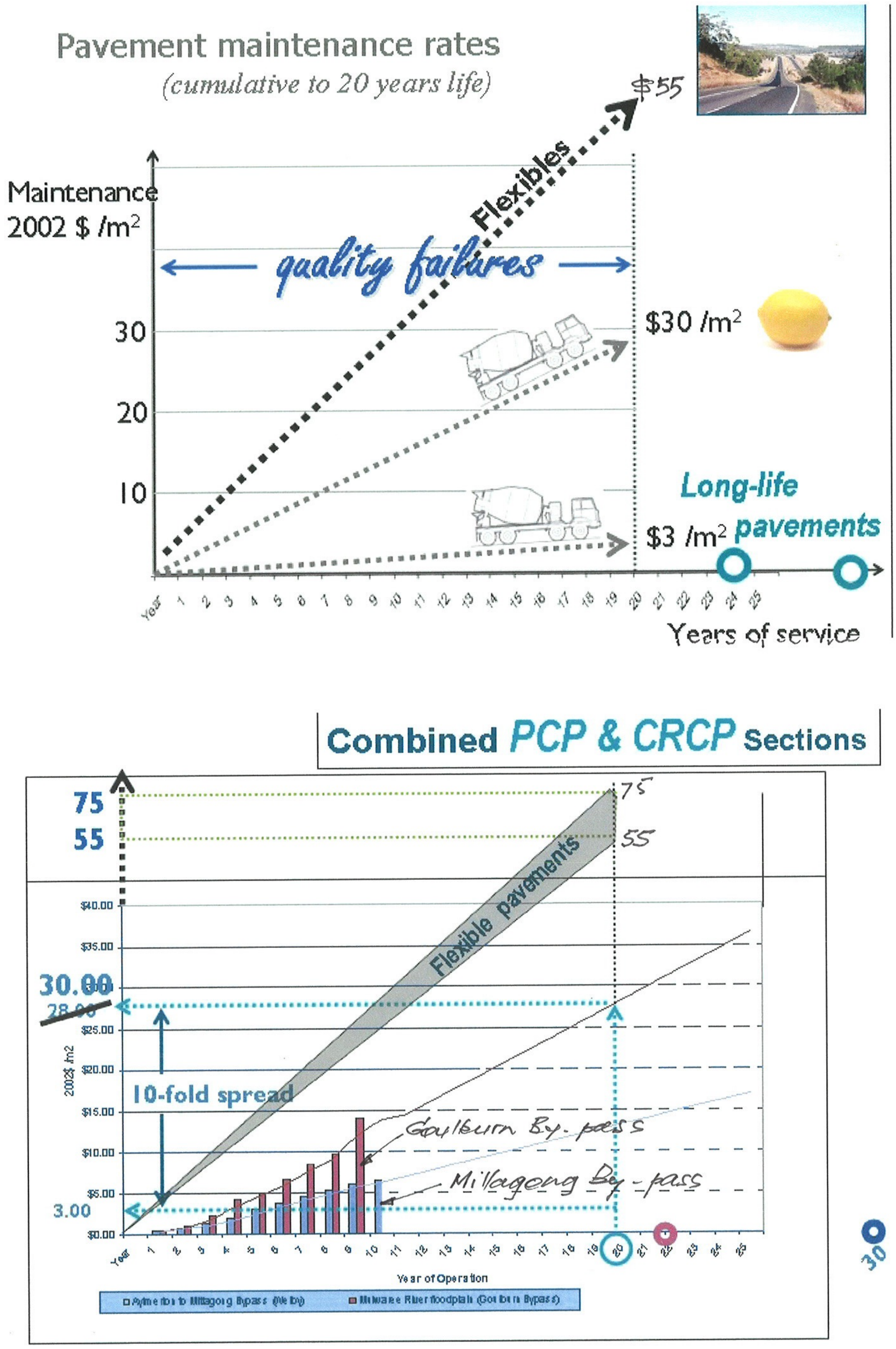

Figure 1 – Actual pavement maintenance costs

COMPARISON OF ESTIMATED CONSTRUCTION COSTS OF HEAVY DUTY PAVEMENTS

Assumptions

1 The cost of SMZ is not included as it is regardes as same for all pavements

2 The pavement designs are for identical traffic loading

Note: The concrete pavement costs include all activities like curing, jointing, texturing, anchors etc.

Ser	Pavement layer	Unit Costs $	Unit Rate $	250 PCP $	250 PCP + 40 OGA $	230 CRCP $	230 CRCP + 40 OGA $	175 DSA on 220 LMC $	175 DSA + 30 OGA on 220 LMC	280 DSA + 30 OGA on 200 CTCR	350 DLA $	350 DLA+ 30 OGA $
1	30 OGA	165/t	330/m3						9.90	9.90		9.90
2	40 OGA	165/t	330/m3		13.20		13.2					
3	Seal		4/m2						4.00	4.00	4.00	4.00
4	230 CRCP		380/m3			74.0	74.0					
5	250 PCP		258/m3	65.0	65.00							
6	175 DSA	125/t	300/m3					52.5	52.50			
7	280 DSA	120/t	288/m3							80.60		
8	Primer seal		2/m2		2.00		2.00	2.00	2.00	2.00		
9	150 LMC		161/m3	25.0	25.00	25.0	25.0					
10	220 LMC		161/m3					35.4	35.40			
11	200 CTCR	33/t	72/m3							14.40		
12	350 DLA	120/t	288/m3								100.80	100.80
	TOTAL/m2			**91.0**	**105.2**	**99.0**	**112.2**	**89.9**	**103.8**	**110.90**	**104.80**	**114.70**
	Ranking			**2**	**6**	**3**	**8**	**1**	**4**	**7**	**5**	**9**

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