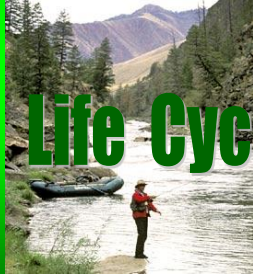


Our Mission. Your Mobility.
ABOUT US | TRAVELER SERVICES | DMV | PROJECTS | NEWS & INFO

Idaho Transportation Department





Life Cycle Analysis

Life Cycle Analysis - "Economics"


Life Cycle Costs was legislative defined in Section 303, *Quality Improvement*, of the National Highway System NHS Designation Act of 1995. The definition was modified by TEA-21 to the definition below -

Life Cycle Cost is "... A process for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future cost, such as maintenance, user, reconstruction, rehabilitation, restoring and resurfacing costs, over the life of the project segment."


Carlos Rosenberger
Asphalt Institute



IDAHO TRANSPORTATION DEPT. CENTRAL MATERIALS
Life Cycle Cost Analysis

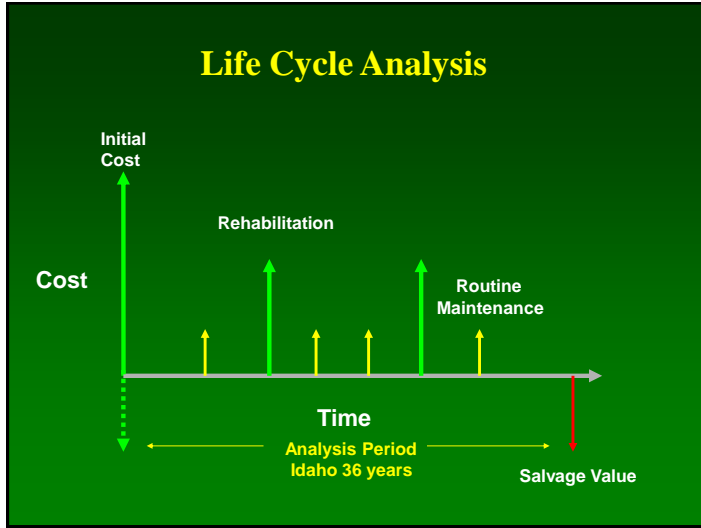


Year	Work	Cost	PW	CRF	EUAC
0	Initial Cost	\$375,600	1.0000	0.0529	\$19,909
5					
10	Seal Coat Driving Lanes	\$30,100	0.7307	0.0529	\$1,200
15	Rehab and Seal - Year 12	\$42,400	0.6246	0.0529	\$1,400
15	Seal Cracks	\$12,300	0.5553	0.0529	\$400
15	Seal Cracks	\$12,300	0.4938	0.0529	\$300
15	Seal Coat Driving Lanes	\$30,100	0.4748	0.0529	\$800
20	Seal Cracks	\$12,300	0.4388	0.0529	\$300
25	Rehab and Seal - Year 24	\$42,400	0.3901	0.0529	\$900
25	Seal Cracks	\$12,300	0.3468	0.0529	\$200
30	Seal Cracks	\$12,300	0.3083	0.0529	\$200
30	Seal Coat Driving Lanes	\$30,100	0.2965	0.0529	\$500
30	Seal Cracks	\$12,300	0.2741	0.0529	\$200
35	End Life - Salvage Value	\$0	0.2444	0.0529	\$0
TOTAL		\$624,500		EUAC →	\$26,300
				Total Net Present Worth @ 4%	\$487,200

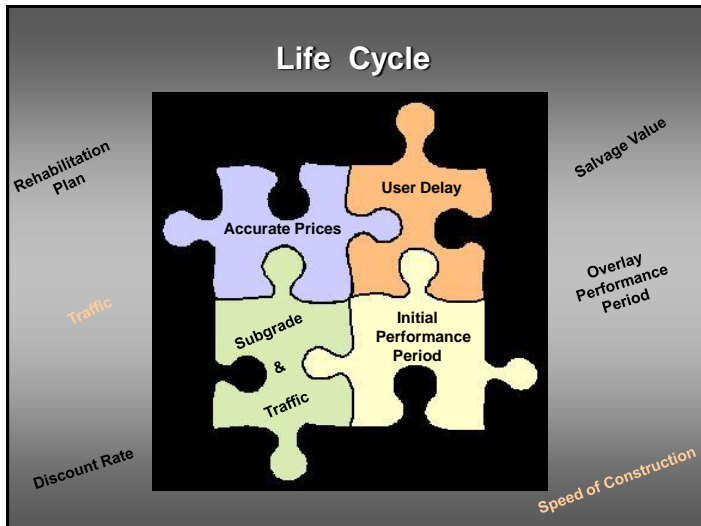


36 year analysis period
4% discount rate
\$0 Salvage @ year 36

Navigation: Title Page / Introduction / Flex Worksheet / Flex Analysis / Flex Timeline / Flex



- Initial Performance Period
- Accurate Prices
- Subgrade / Traffic
- User Delay / Traffic / Speed of Construction
- Rehabilitation Plan
- Overlay Performance Period
- Analysis Period
- Discount Rate
- Salvage Value



Year	Work	Cost	PW	CRF	EUAC	
0	Initial Cost	\$375,600	1.0000	0.0529	\$19,900	76%
10	Seal Coat Driving Lanes	\$30,100	0.7307	0.0529	\$1,200	6%
12	Rehab and Seal - Year 12	\$42,400	0.6246	0.0529	\$1,400	5%
15	Seal Cracks	\$12,300	0.5553	0.0529	\$400	
16	Seal Cracks	\$12,300	0.4938	0.0529	\$300	
17	Seal Coat Driving Lanes	\$30,100	0.4748	0.0529	\$800	3%
18	Seal Cracks	\$12,300	0.4388	0.0529	\$300	
24	Rehab and Seal - Year 24	\$42,400	0.3901	0.0529	\$900	3%
25	Seal Cracks	\$12,300	0.3468	0.0529	\$200	
30	Seal Cracks	\$12,300	0.3083	0.0529	\$200	
31	Seal Coat Driving Lanes	\$30,100	0.2965	0.0529	\$500	2%
32	Seal Cracks	\$12,300	0.2741	0.0529	\$200	
35	End Life - Salvage Value	\$0	0.2444	0.0529	\$0	
TOTAL		\$624,500			\$26,300	
					\$487,200	
					Total Net Present Worth @ 4%	

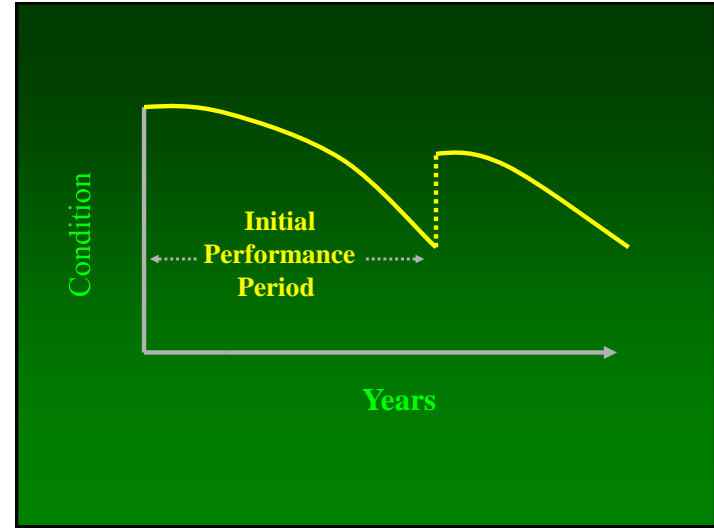
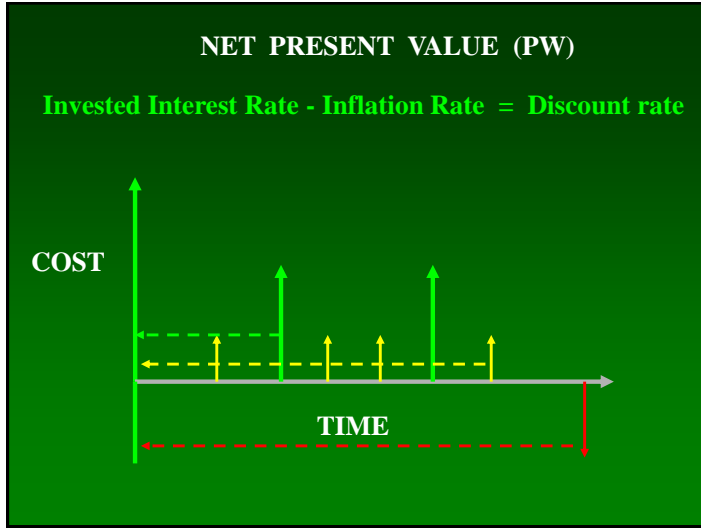


Table 2.16. Present value discount factors: single future payment.

Year	Discount Factor			Year	Discount Factor		
	3%	4%	5%		3%	4%	5%
1	0.9709	0.9615	0.9524	21	0.5375	0.4388	0.3589
2	0.9426	0.9246	0.9070	22	0.5219	0.4220	0.3418
3	0.9151	0.8890	0.8638	23	0.5067	0.4057	0.3256
4	0.8885	0.8548	0.8227	24	0.4919	0.3901	0.3101
5	0.8626	0.8219	0.7835	25	0.4776	0.3751	0.2953
6	0.8375	0.7903	0.7462	26	0.4637	0.3607	0.2812
7	0.8131	0.7599	0.7107	27	0.4502	0.3468	0.2678
8	0.7894	0.7307	0.6768	28	0.4371	0.3335	0.2551
9	0.7664	0.7026	0.6446	29	0.4243	0.3207	0.2429
10	0.7441	0.6756	0.6139	30	0.4120	0.3083	0.2314
11	0.7224	0.6496	0.5847	31	0.4000	0.2965	0.2204
12	0.7014	0.6246	0.5568	32	0.3883	0.2851	0.2099
13	0.6810	0.6006	0.5303	33	0.3770	0.2741	0.1999
14	0.6611	0.5774	0.5051	34	0.3660	0.2636	0.1904
15	0.6419	0.5553	0.4810	35	0.3554	0.2534	0.1813
16	0.6232	0.5339	0.4581	36	0.3450	0.2437	0.1727
17	0.6050	0.5134	0.4363	37	0.3350	0.2343	0.1644
18	0.5874	0.4936	0.4155	38	0.3252	0.2253	0.1566
19	0.5703	0.4746	0.3957	39	0.3158	0.2166	0.1491
20	0.5537	0.4564	0.3769	40	0.3066	0.2083	0.1420

 ? %

Performance Period

The discount rates... trends over long periods of time. Although long-term... and 4 percent, 3 to 5 percent is an acceptable range and is consistent with values historically reported in Appendix A of OMB Circular A-94.

Performance periods for individual pavement designs and rehabilitation strategies have a **significant impact on analysis results**, individual pavement... and work zones user costs.

While most analyses include traditional agency costs, some do not fully account for the SHA engineering and construction management overhead, especially on future rehabilitations. This can be a serious oversight on short-lived rehabilitations as SHAs design processes lengthen in an era of downsizing.

Routine, reactive type annual maintenance costs have only a marginal effect on NPV. They are hard to obtain, generally very small in comparison to initial construction and rehabilitation costs, and differentials between competing pavement strategies are usually very small, particularly when discounted over 30- to 40-year analysis periods.

Salvage value should be based on the remaining life of an alternative at the end of the analysis period as a prorated share of the last rehabilitation cost.

especially initial performance period

User costs are the delay, vehicle operating, and crash costs incurred by the users of a facility and should be included in the LCCA. Vehicle delay and crash costs are unlikely to vary among alternative pavement designs between periods of construction, maintenance, and rehabilitation operations. Although vehicle operating costs are likely to vary during periods of normal operations for different pavement design strategies, there is little research on quantifying such Vehicle Operating Cost (VOC) differentials under the pavement condition levels prevailing in the U.S.A. The *Technical Bulletin* therefore focuses strictly on work zone user cost differences

from: FHWA-SA-98-079 Life Cycle Cost Analysis in Pavement Design

DETERMINE PERFORMANCE PERIODS AND ACTIVITY TIMING

Performance life for the initial pavement design and subsequent rehabilitation activities has a major impact on LCCA results. It directly affects the frequency of agency intervention on the highway facility, which in turn affects agency cost as well as user costs during periods of construction and maintenance activities. SHAs can determine specific performance information for various pavement strategies through analysis of pavement management data and historical experience. Operational pavement management systems can provide the data and analysis techniques to evaluate pavement condition and performance and traffic volumes to identify cost-effective strategies for short- and long-term capital projects and maintenance programs. Some SHAs develop performance lives based on the collective experience of their senior engineers.

Lane-mile Population Used in Service Life Statistics for LCCA

Cycle	Flexible Pavement
Initial	4,527
1 st Rehabilitation	3,000
2 nd Rehabilitation	1,227
3 rd Rehabilitation	355

Note: Pavements since 1950



Average Service Lives for LCCA

Cycle	Flexible Pavement
Initial	14.8
1 st Rehabilitation	11.9
2 nd Rehabilitation	11.1
3 rd Rehabilitation	12.0

Service Lives Standard Deviation for LCCA

Cycle	Flexible Pavement
Initial	5.8
1 st Rehabilitation	4.7
2 nd Rehabilitation	4.4
3 rd Rehabilitation	4.5

Maryland



Clean and seal all joints with fiber asphalt membrane.
60-#/sy leveling course.
3.5-in ID-2 or 4-in ID-3/ID-2 overlay.
Saw and seal joints.
Type 7 paved shoulders.
Adjust all guide rail and drainage structures.
Maintenance and protection of traffic.
User delay.

35 Seal coat shoulders.


Note: The CPR strategy slated for year 20 can be moved to year 15 at the District's discretion. However, when doing this, the overlay at year 30 must be moved to year 25, and another overlay added at year 33.

Current FHWA efforts to analyze pavement performance data collected as part of the Strategic Highway Research Program (SHRP) Long-Term Pavement Performance Program (LTPP) should provide an additional valuable resource to SHAs. To support that effort, the FHWA is also coordinating the development and wide distribution of the DataPave software program to make LTPP performance data directly available to the SHAs. Specific pavement performance information is also available in various pavement performance reports developed by SHAs such as Minnesota and Illinois, just to mention a few.

Work zone requirements for initial construction, maintenance, and rehabilitation directly affect highway user costs and should be estimated along with pavement strategy development. The

Expected Service Life and Performance Characteristics of HMA Pavements in LTPP

Applied Research Associates
Harold L. Von Quintus, P.E.
Jag Mallela
Jane Jiang



6. SUMMARY OF FINDINGS AND FUTURE RECOMMENDATIONS

6.1 Findings

“The average expected service life of flexible pavements is greater than 20 years”

and show that well-maintained and deep strength sections in the LTPP program have 20-year and more life potentials, with a range of performance between the conventional and deep strength sections. It is expected that the general base or surface wear of the conventional and deep strength pavements will receive performance characteristics similar to a newly placed or newly placed HMA before any distress and cracking.

2. One of 172 LTPP flexible pavement sections, there are at least 100 sections which are older than 20 years and have moderate to high levels of distress, while there are over 50 in the LTPP section with low performance characteristics are classified as conventional wearing pavements. In addition, most of the deep strength HMA pavements have low to moderate levels of distress. This finding indicates the importance for good, not just acceptable, maintenance for pavement placed in old states.

3. Current practice will show that acceptable and non-acceptable roads in the LTPP program are expected to be similar to the high quality of LTPP sections that have been performed 20 years with no or low levels of distress. A large portion of the LTPP program may not be representative of the distribution of all types across North America.

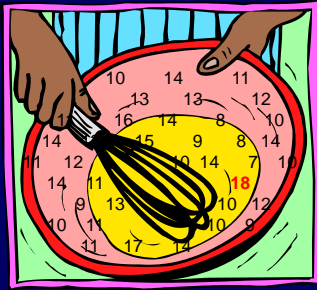
4. There are a few test sections that have an expected level or magnitude of distress for all flexible pavements using simple regression techniques. Mechanistic empirical procedures will need to be used to estimate a detailed nature of these sections in comparison to those sections that have minimal or acceptable levels of distress.

5. Results from regression analysis show that the overall planned and estimated values using the LTPP data indicate the CBR is not accurate to the expected distribution.

Asphalt Pavement Alliance 2008 Survey

Time to:

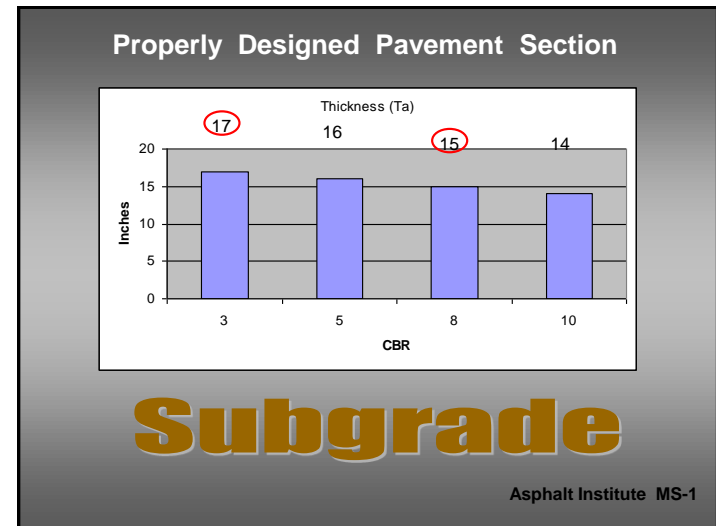
	First Overlay	Second Overlay	Third Overlay	Discount Rate
Avg.	15 ⁴	12	11 ⁴	3 ⁷
Min.	10	20	30	2 ³
Max.	30	45	50	6



Total 420 years / 36 projects = 11.7

420 + 18 / 37 projects = 11.8

pcc bowl has no overlays in it




Life Cycle Analysis_IAC09

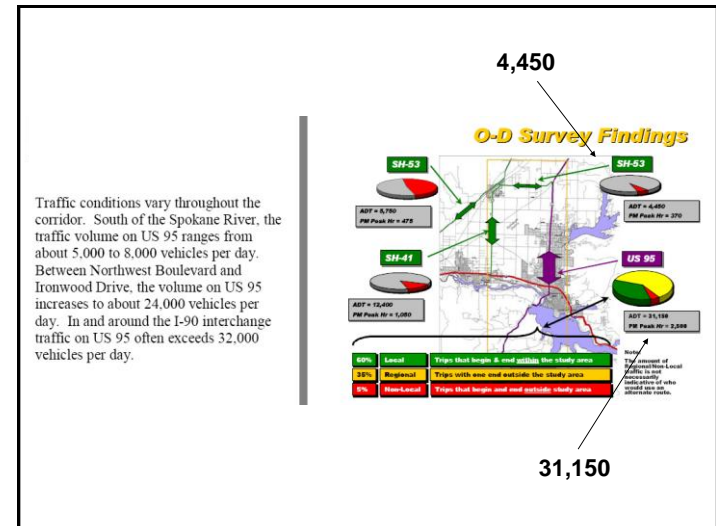
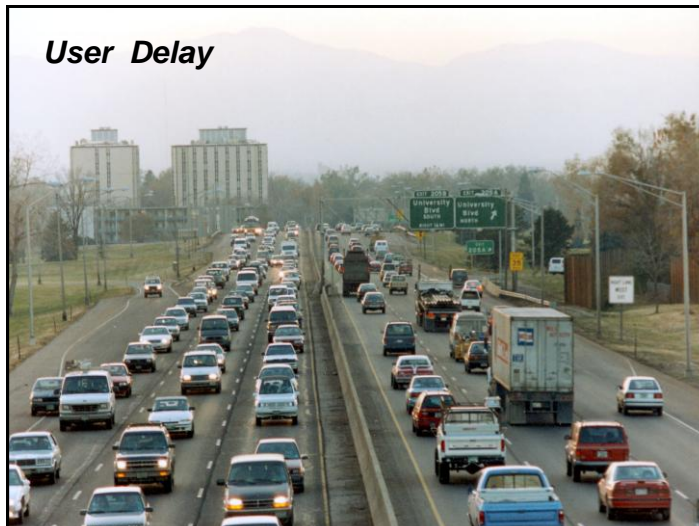
Present Worth Analysis (Initial) for -- LCCPu400yr 10/13.xls						Present Worth Analysis (Initial) for -- LCCPu400yr 10/13.xls					
13 inch section + ATPB						15 inch section + ATPB					
8-inches of HMA base						10-inches of HMA base					
Year	Construction Item and/or Material	Quantity	Unit	Current Price	PW	Year	Construction Item and/or Material	Quantity	Unit	Current Price	PW
01	HMA Base (3 - 10 EAL)	7040	sq	\$ 57.55	\$178,577	01	HMA Base (3 - 10 EAL)	7040	sq	\$ 57.55	\$223,221
02	HMA Binder (3 - 10 EAL)	7040	sq	\$ 63.00	\$73,181	02	HMA Binder (3 - 10 EAL)	7040	sq	\$ 63.00	\$73,181
03	HMA Wearing (3 - 10 EAL)	7040	sq	\$ 76.00	\$58,854	03	HMA Wearing (3 - 10 EAL)	7040	sq	\$ 76.00	\$58,854
04	ATPB	11146	sq	\$ 9.70	\$108,116	04	ATPB	11146	sq	\$ 9.70	\$108,116
05	Maint. & Protection of Traffic @10%	1	hr	\$67,057	\$67,057	05	Maint. & Protection of Traffic @10%	1	hr	\$67,057	\$67,057
06	Mobilization @5%	1	hr	\$33,529	\$33,529	06	Mobilization @5%	1	hr	\$33,529	\$33,529
07	Deep Patch 2% (mainline)	141	sq	\$ 81.00	\$11,406	07	Deep Patch 2% (mainline)	141	sq	\$ 81.00	\$11,406
08	M1 1.5" (mainline)	7040	sq	\$ 4.00	\$28,160	08	M1 1.5" (mainline)	7040	sq	\$ 4.00	\$28,160
09	1.5" hma overlay (mainline)	7040	sq	\$ 76.00	\$44,141	09	1.5" hma overlay (mainline)	7040	sq	\$ 76.00	\$44,141
10	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	10	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927
11	Maint. & Protection of Traffic @10%	1	hr	\$8,863.28	\$8,863	11	Maint. & Protection of Traffic @10%	1	hr	\$8,863.28	\$8,863
12	Mobilization @5%	1	hr	\$ 4,431.64	\$4,432	12	Mobilization @5%	1	hr	\$ 4,431.64	\$4,432
13	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	13	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927
14	Deep Patch 2% (mainline)	141	sq	\$ 81.00	\$11,421	14	Deep Patch 2% (mainline)	141	sq	\$ 81.00	\$11,421
15	M1 1.5" (mainline)	7040	sq	\$ 4.00	\$28,160	15	M1 1.5" (mainline)	7040	sq	\$ 4.00	\$28,160
16	1.5" hma overlay (mainline)	7040	sq	\$ 76.00	\$44,141	16	1.5" hma overlay (mainline)	7040	sq	\$ 76.00	\$44,141
17	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	17	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927
18	Maint. & Protection of Traffic @10%	1	hr	\$12,451	\$12,451	18	Maint. & Protection of Traffic @10%	1	hr	\$12,451	\$12,451
19	Mobilization @5%	1	hr	\$5,245	\$5,245	19	Mobilization @5%	1	hr	\$5,245	\$5,245
20	Same Scenario as Year 10	1	hr	\$101,928	\$101,928	20	Same Scenario as Year 10	1	hr	\$101,928	\$101,928
21	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	21	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927
22	Total Annual Maintenance (\$1825/yr)	40	yr	\$ 1,825.00	\$73,000	22	Total Annual Maintenance (\$1825/yr)	40	yr	\$ 1,825.00	\$73,000
Total Present Worth \$592,311						Total Present Worth \$963,813					

\$ 882,518 / \$ 963,803 = 84% LCC

Agency Cost Scale



Representative Costs
Accurate Pavement Section
Initial Performance Period



Life Cycle Analysis_IAC09

STEP 4: USER DELAY COSTS, PART III (continued)

4.2. (a)

Year	Hours of M&PT		Total ADT	Direction 1		Stopped ADT	User Delay Cost / Day
	Begin	End		Delayed			
				%	ADT		
0	0	24	30,357	100.0	30,357	0	2,019
30,357							
10	0	24	44,078	100.0	44,078	0	2,932
44,078							
20	0	24	64,003	100.0	64,003	3,400	6,609
64,003							
30	0	24	92,934	100.0	92,934	52,989	42,833
92,934							
40	0	24	134,942	100.0	134,942	73,105	59,541
134,942							

4% growth

STEP 4: USER DELAY COSTS, PART III (continued)

4.2. (a)

Year	Hours of M&PT		Total ADT	Direction 1		Stopped ADT	User Delay Cost / Day
	Begin	End		Delayed			
				%	ADT		
0	0	24	30,357	100.0	30,357	0	2,019
5	8	16	36,580	46.2	16,900	0	1,124
10	0	24	44,078	100.0	44,078	0	2,932
15	0	24	53,114	100.0	53,114	0	3,533
18	0	24	59,402	100.0	59,402	1,012	4,651

Begin	End	Total ADT	Stopped ADT	User Delay Cost / Day
0	24	59,402	1,012	\$4,651

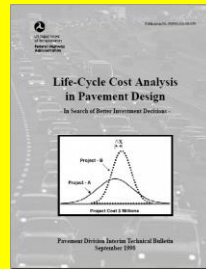
Year	Begin	End	Total ADT	%	ADT	Stopped ADT	User Delay Cost / Day
35	0	24	111,985	100.0	111,985	64,239	51,882
40	8	16	134,942	46.2	62,343	15,840	15,103
45	0	24	162,605	100.0	162,605	74,743	62,514

Hour (24-Hr Clock)	Rural				Urban			
	% ADT	Direction %		% ADT	Direction %			
		In	Out		In	Out		
0-1	1.8	48	52	1.2	47	53		
1-2	1.5	48	52	0.8	43	57		
2-3	1.3	45	55	0.7	46	54		
3-4	1.3	53	47	0.5	48	52		
4-5	1.5	53	47	0.7	57	43		
5-6	1.8	53	47	1.7	58	42		
6-7	2.5	57	43	5.1	63	37		
7-8	3.5	56	44	7.8	60	40		
8-9	4.2	56	44	6.3	59	41		
9-10	5.0	54	46	5.2	55	45		
10-11	5.4	51	49	4.7	46	54		
11-12	5.6	51	49	5.3	49	51		
12-13	5.7	50	50	5.6	50	50		
13-14	6.4	52	48	5.7	50	50		
14-15	6.8	51	49	5.9	49	51		
15-16	7.3	53	47	6.5	46	54		
16-17	9.3	49	51	7.9	45	55		
17-18	7.0	43	57	8.5	40	60		
18-19	5.5	47	53	5.9	46	54		
19-20	4.7	47	53	3.9	48	52		
20-21	3.8	46	54	3.3	47	53		
21-22	3.2	48	52	2.8	47	53		
22-23	2.6	48	52	2.3	48	52		
23-24	2.3	47	53	1.7	45	55		

Off peak hours

8:00 pm to 6:00 am

15%



STEP 4: USER DELAY COSTS, PART III (continued)

4.2. (a)

Year	Hours of M&PT		Total ADT	Direction 1		Stopped ADT	User Delay Cost / Day
	Begin	End		Delayed			
				%	ADT		
0	0	24	30,357	100.0	30,357	0	2,019
5	8	16	36,580	46.2	16,900	0	1,124
10	0	24	44,078	100.0	44,078	0	2,932
15	0	24	53,114	100.0	53,114	0	3,533
18	0	24	59,402	100.0	59,402	1,012	4,651
20	0	24	64,003	100.0	64,003	3,400	6,609
25	0	24	77,123	100.0	77,123	24,049	21,764
25	8	16	77,123	46.2	35,631	8,626	8,337

Begin	End	Total ADT	Stopped ADT	User Delay Cost / Day
0	24	77,123	24,049	\$21,764
8	16	77,123	8,626	\$ 8,337

But, if **20 6 15% of 77,123 = 12,108 \$805**

Life Cycle Analysis_IAC09

Life-Cycle Cost Analysis RealCost USER MANUAL

Alternative 1: HMA Corridor "H"

Initial Construction: Rehabilitation 1 | Rehabilitation 2 | Rehabilitation 3 | Rehabilitation 4 | Rehabilitation 5 | Rehabilitation 6

Activity Description: Mill & Overlay 2-inches Mainline + Shldr

Activity Cost and Service Life Inputs

Agency Construction Cost (\$1000): 517 Activity Service Life (years): 12

User Work Zone Costs (\$1000): 5 (Inactive if User Costs are to be Calculated by Software)

Maintenance Frequency (years): 24 Agency Maintenance Cost (\$1000): 1

Activity Work Zone Inputs

Work Zone Length (miles): 1 Work Zone Duration (days): 8

Work Zone Capacity (vphpl): 1300 Work Zone Speed Limit (mph): 50

No. of Lanes Open in Each Direction During Work Zone: 1

Work Zone Hours

	Inbound		Outbound	
	Start	End	Start	End
First Period of Lane Closure:	20	24	20	24
Second Period of Lane Closure:	0	6	0	6
Third Period of Lane Closure:				

Buttons: Open..., Save..., Ok, Cancel

Construction Duration Estimates

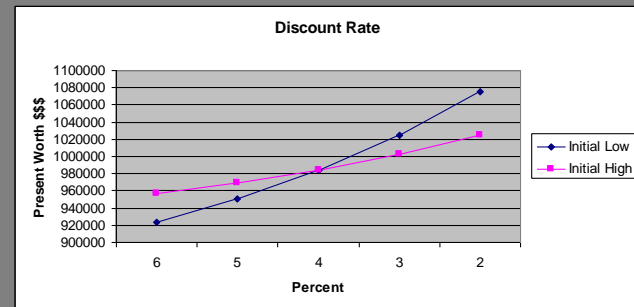
Construction Operation	Average Duration	Conservative Duration
HMA Placement	1,400 – 1,500 tons/day	800 – 1,000 tons/day
HMA Grinding	8,000 – 10,000 SY/day	
HMA Base and Base Widening/Patching	Increase Conservative Duration if you have large/wide pulls	200 SY/day or 100 tons/day
PCC Placement	3,200 SY/day	
PCC Patching	250 – 300 SY/day	
PCC Grinding	5,600 – 7,000 SY/day	
Clean and Seal Joints	5,000 – 6,000 LF/day	
Graded Aggregate Base Placement	7,000 SY/day	3,000 – 4,000 SY/day
Class 1-A Excavation	2,000 SY/day	
Remove and Replace Concrete Curb and Gutter	300 LF/day for forming or slipforming	

User Delay Scale



Initial Cost \$ 771,157

Initial Cost \$ 888,278



Discount Rate

Discount Rate

OFFICE OF MANAGEMENT AND BUDGET
 About OMB | President's Budget | Management | Information & Regulatory Affairs | Legislative Information | Agency Information

AGENCY INFORMATION OMB HOME - AGENCY INFORMATION - CIRCULARS OMB Circular No. A-94

APPENDIX C
 Revised December 2008

Click icon for PDF assistance

DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
0.9	1.6	1.9	2.4	2.9	2.7

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

http://www.whitehouse.gov/omb/circulars_a094_a94_appx-c

Present Worth Analysis (n/m) for - LCCPub408yr 15/10.xls 15-inch section + ATPB

Year	Construction Item and/or Material	Quantity	Unit	Cost/Unit	Current Price	PW
0	10" HMA Base (3 - 10 EAL)	7040	sy	\$ 57.65	\$223,221	\$223,221
0	3" HMA Binder (3 - 10 EAL)	7040	sy	\$ 63.00	\$73,181	\$73,181
0	2" HMA Wearing (3 - 10 EAL)	7040	sy	\$ 76.00	\$58,854	\$58,854
0	10" HMA Base (0.3 - 3 EAL)	4106	sy	\$ 57.65	\$130,191	\$130,191
0	3" HMA Binder (0.3 - 3 EAL)	4106	sy	\$ 63.00	\$42,682	\$42,682
0	2" HMA Wearing (0.3 - 3 EAL)	4106	sy	\$ 76.00	\$34,326	\$34,326
0	4" ATPB	11146	sy	\$ 9.70	\$108,116	\$108,116
0	Maint. & Protection of Traffic @ 10%	1	ls	\$67,057	\$67,057	\$67,057
0	Mobilization @ 5%	1	ls	\$33,529	\$33,529	\$33,529
15	Deep Patch 2% (mainline)	141	sy	\$ 81.00	\$11,405	\$6,333
15	Mill 2" (mainline)	7040	sy	\$ 4.00	\$28,160	\$15,636
15	2" hma overlay (mainline)	7040	sy	\$ 76.00	\$58,854	\$32,680
15	Seal Coat Shoulders	4106	sy	\$ 1.20	\$4,927	\$2,736
15	Maint. & Protection of Traffic @ 10%	1	ls	\$10,334.64	\$10,335	\$5,738
15	Mobilization @ 5%	1	ls	\$ 5,167.32	\$5,167	\$2,669
20	Seal Coat Shoulders	4106	sy	\$ 1.20	\$4,927	\$2,249
20	Seal 10% of L-joints	528	lf	\$1,500	\$792	\$361
20	Maint. & Protection of Traffic @ 10%	1	ls	\$571.92	\$572	\$261
20	Mobilization @ 5%	1	ls	\$285.96	\$286	\$131
25	Same as Year 15	1	ls	\$118,848	\$118,848	\$44,582
30	Same as Year 20	1	lf	ls	\$6,577	\$2,028
35	Same Scenario as Year 15	1	ls	\$118,848	\$118,848	\$30,118
35	Same as Year 20	1	ls	\$6,577	\$6,577	\$1,667
40	Salvage (1/2 of Year 35)	-1	ls	\$59,424.00	-\$59,424	-\$12,377
20	Total Annual Maintenance (\$1825/yr)	40	yr	\$ 1,825.00	\$73,000	\$33,316
				Total	Present Worth	\$939,484

Salvage Value

\$ 12,377 = 1%
\$ 951,862

Economic Pavement Evaluation (Agency Cost)

- Accurate Pricing
- Initial Construction Performance Period
- Subgrade Strength / Traffic
- Future Overlay Performance Period
- Everything Else

(User Cost)

+ Off-Peak Paving Hours + Construction Duration



Life Cycle Analysis_IAC09

Asphalt Pavements Are



BEAUTIFUL !

Present Worth Analysis (In/mi) for -LCCPub408yr 10/10.xls
15-inch section - ATPB

Year	Construction Item and/or Material	Quantity	Unit	Cost/Unit	Current Price	PW
	0 10" HMA Base (3 - 10 EAL)	7040	sq	\$ 57.65	\$223,221	\$223,221
	0 3" HMA Binder (3 - 10 EAL)	7040	sq	\$ 63.00	\$73,181	\$73,181
	0 2" HMA Wearing (3 - 10 EAL)	7040	sq	\$ 76.00	\$58,854	\$58,854
	0 10" HMA Base (0.3 - 3 EAL)	4106	sq	\$ 57.65	\$130,191	\$130,191
	0 3" HMA Binder (0.3 - 3 EAL)	4106	sq	\$ 63.00	\$42,682	\$42,682
	0 2" HMA Wearing (0.3 - 3 EAL)	4106	sq	\$ 76.00	\$34,326	\$34,326
	0 4" ATPB	11146	sq	\$ 9.70	\$109,116	\$109,116
	0 Maint. & Protection of Traffic @10%	1	lb	\$67,057	\$67,057	\$67,057
	0 Mobilization @5%	1	lb	\$33,529	\$33,529	\$33,529
10	Deep Patch 2% (mainline)	141	sq	\$ 81.00	\$11,405	\$7,705
10	Mill 1.5" (mainline)	7040	sq	\$ 4.00	\$28,160	\$19,024
10	1.5" hma overlay (mainline)	7040	sq	\$ 76.00	\$44,141	\$29,820
10	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	\$3,329
10	Maint. & Protection of Traffic @10%	1	lb	\$ 8,863.28	\$8,863	\$6,988
10	Mobilization @5%	1	lb	\$ 4,431.64	\$4,432	\$2,994
15	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	\$2,736
20	Deep Patch 2% (mainline)	141	sq	\$ 81.00	\$11,421	\$5,212
20	#90 scratch course	11146	sq	\$ 70.00	\$23,602	\$10,771
20	1.5" hma overlay (mainline)	7040	sq	\$ 76.00	\$44,141	\$29,145
20	1.5" hma overlay (shoulder)	4106	sq	\$ 76.00	\$25,745	\$11,750
20	Maint. & Protection of Traffic @10	1	lb	\$10,491	\$10,491	\$4,788
20	Mobilization @5%	1	lb	\$5,245	\$5,245	\$2,394
30	Same Scenario as Year 10	1	lb	\$101,928	\$101,928	\$31,426
35	Seal Coat Shoulders	4106	sq	\$ 1.20	\$4,927	\$1,249
20	Total Annual Maintenance (\$1825/yr)	40	yr	\$ 1,825.00	\$73,000	\$33,316
					Total Present Worth	\$963,803

**Agency Costs
% of Total**

80

7

6

3

3