

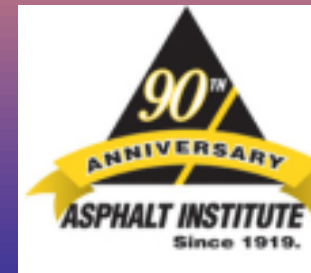
Assoc. of Modified Asphalt Producers



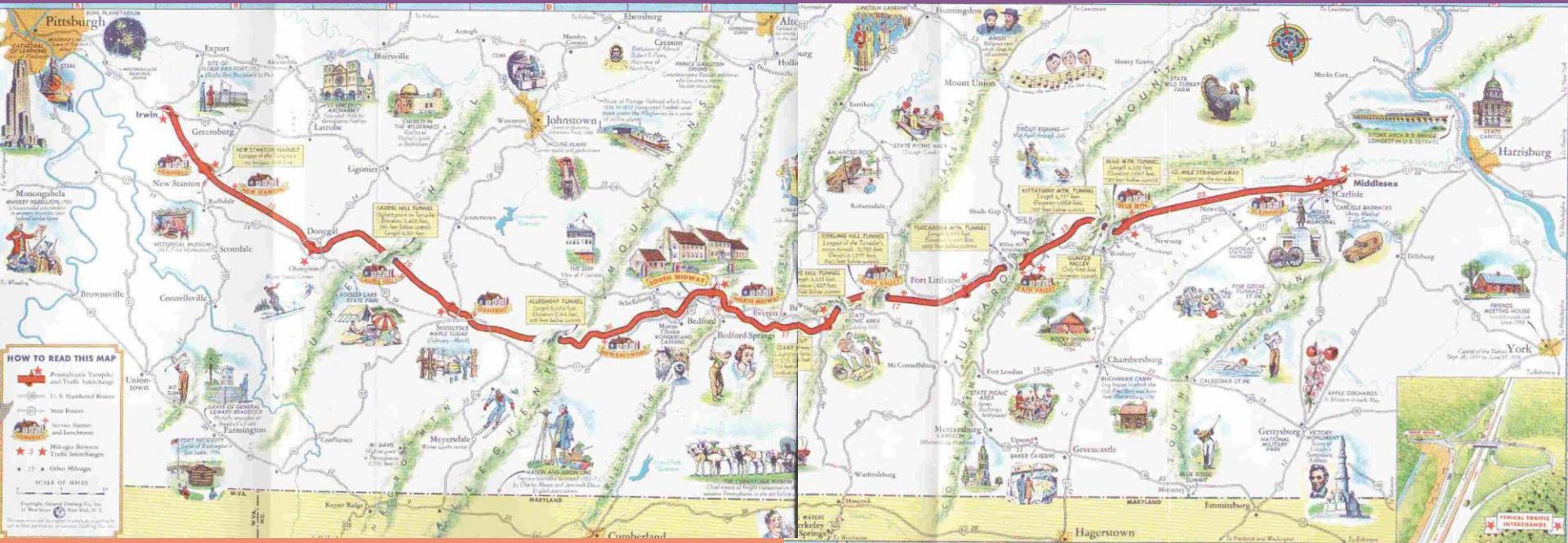
**Reconstruction of
Pa Turnpike**



Carlos Rosenberger



This Map was Published in 1941 to Illustrate the Original Pennsylvania Turnpike

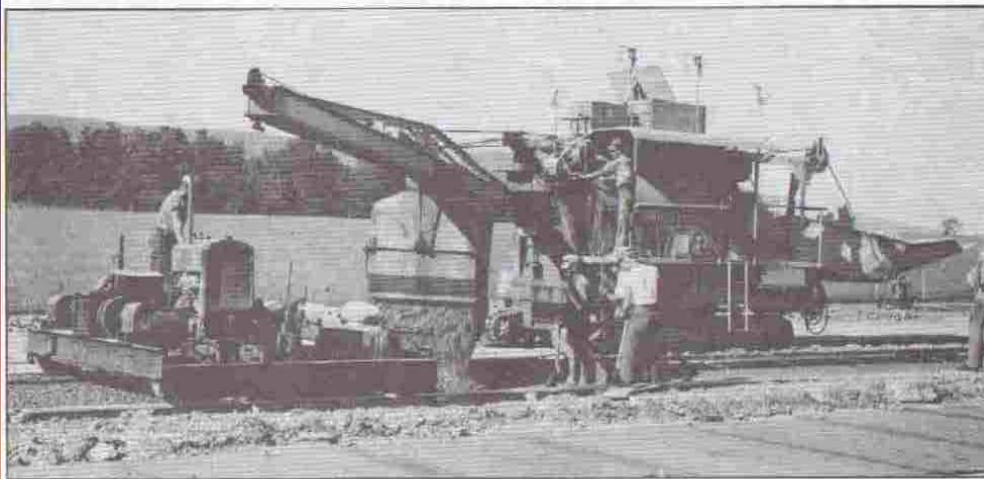


160 miles, Irwin to Carlisle

Groundbreaking Oct. 27, 1938

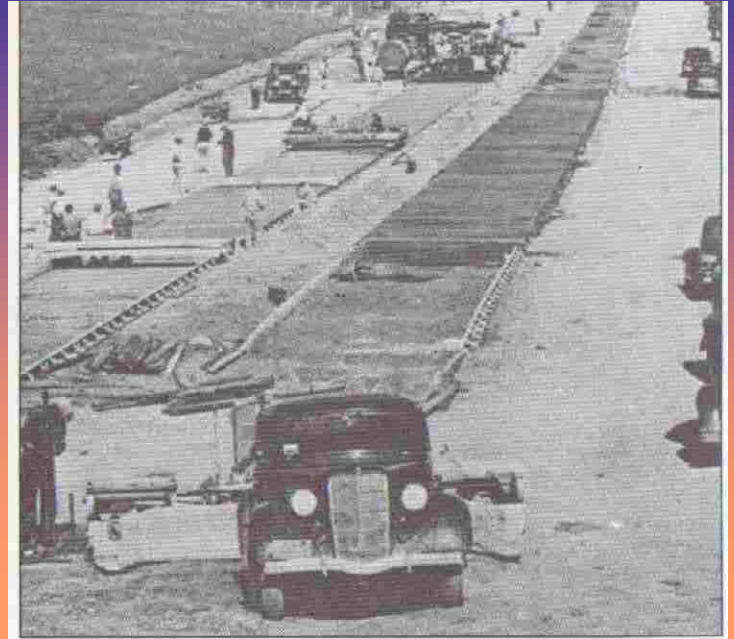
Opened to Traffic Oct. 1, 1940

Toll - \$1.50 travel 160 miles; January 2009 \$11.90



Concrete mixed on site is placed into roadway forms by these machines.

PTC



Roadway construction along the 12-mile straight stretch west of Carlisle.

PTC

Westbound

10' shoulder, 12' travel, 12' passing, 10' median (pcc) - Eastbound
(proposed used of HMA for 2 lanes was dropped)

Unskilled labor \$ 0.525 / hr

Heavy equipment operator \$ 1.40 / hr

Total Reconstruction Project Began in 1998, to date:

50 miles completed

20 miles currently under construction (Dec 2008)

Typical Section is 2 Contracts:

- **Bridge replacement contract**
- **Pavement contract**

2008 850,000 tons of Hot-Mix on the Pa Turnpike

Next 10 years look very similar

Pa T-pike MP 94 - 99



2" 19 mm →

2" 25 mm →

10" BCBC ↗
↘

4" ATPB ↘



10 Year Capital Plan


Fiscal Year 2007-2008 (in \$000)
Roadway


[illegible]

10 Year Capital Plan - Roadway - Windows Internet Explorer

http://www.patrianpike.com/improve/caplan/Roadway_08.htm

10 Year Capital Plan - Roadway

 Roadway

 10 Year Capital Plan

Fiscal Year 2007-2008 (in \$000)
Roadway

	1st Year 2007 - 2008	Priority A (years 2-4)				Priority B (years 5-7)			Priority C (years 8-10)			Total Funding Needed
Project Number - Title	2008 - 2009	2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017			
Z000.00RR004 - Design/Construction Audit Services	\$50	\$50	\$250	\$0	\$0	\$0	\$0	\$0	\$0	\$350		
Study	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0			
Design	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0			
Right of Way	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0			
Utility	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0			
Const	\$50	\$50	\$250	\$0	\$0	\$0	\$0	\$0	\$0			
Inspect	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0			
Total Number of Roadway Projects: 71	Totals:	\$273,450	\$260,950	\$241,750	\$254,950	\$252,880	\$254,500	\$252,200	\$255,100	\$274,100	\$280,150	\$2,600,030

Page: << 1 2 3 4 5 6 7 8

Page 8

\$ 2,600,030,000

26 Total Reconstructions Projects out of the total of 71 projects

Major Construction Projects



Monthly
Construction
Schedule



Capital
Plan



Milepost 0-10
Reconstruction
Project



Six-Lane
Widening - Valley
Forge to
Norristown



Mon/Fayette
Southern Beltway



Route 903 Slip
Ramp Project



Route 29 Slip
Ramp Project



Gettysburg Pike
Interchange



I-95 Interchange



Milepost 320-326
Widening



Milepost A20-A30
Widening



Allegheny River
Bridge Project



Milepost 67-75
Reconstruction



Milepost 210-215
Reconstruction

Alternate Bid Remaining Projects

The Pennsylvania Turnpike

CONSTRUCTION AND EXPANSION

Reconstruction MP 210 to MP 215

[Travel Advisory](#)

[Project Overview](#)

[Project Map](#)

[Current Construction](#)

[Detour Status](#)

[Traffic Cameras](#)

[Project Photo Album](#)

[Project Team](#)

[PA Turnpike Home](#)



PROJECT SUMMARY:

Total roadway and bridge reconstruction between MP 210.9 and 215.3

CONSTRUCTION START:

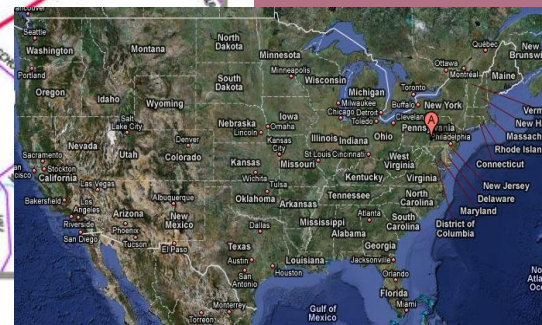
March 2008.

CONSTRUCTION COMPLETION:

November 2009.

PROJECT TOTAL:

\$61.7 million.





SR 233 Bridge Demolition



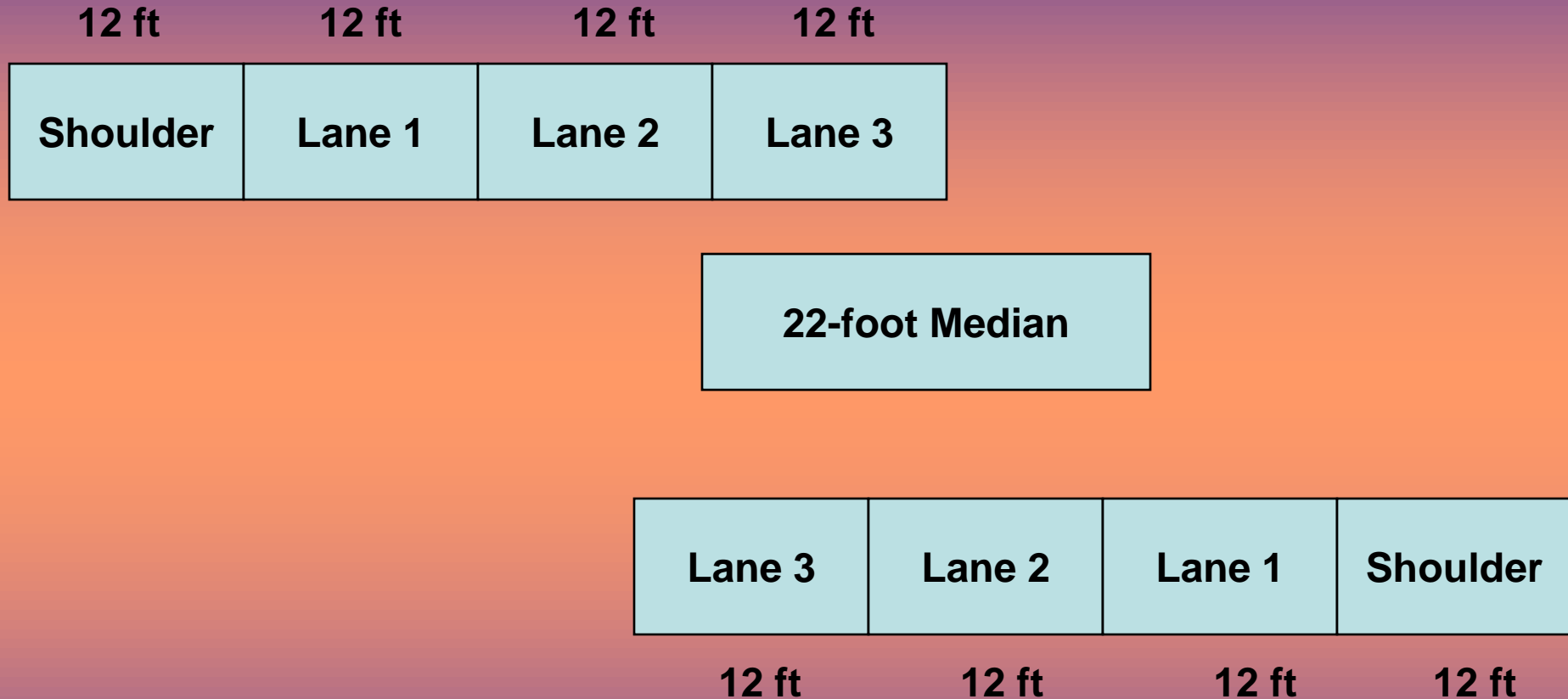
Prestressed Concrete Bridge Beams
SR 233



Feb. 4, 2009



Typical Reconstructed Section



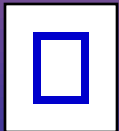
AII HMA



Paving WB Shoulder



Feb. 4, 2009



A photograph of a road surface showing significant damage. A long, irregular crack runs diagonally across the frame. Along this crack, there are several large, dark, irregular potholes. The road is paved with a light-colored material, likely asphalt. White dashed lines are visible on the road surface. Overlaid on the image is the text "Superpave is not all it is cracked up to be" in a bold, black, sans-serif font, rotated diagonally to follow the path of the crack.

"Superpave is not all it is cracked up to be"

Less than 3 years old

Mp 111 to MP 115 Perpetual Pavement “Proposed” Design

	2-inch	12.5mm (PG 76-22)
	3-inch	25mm (PG 76-22)
	4-inches	BCBC (PG 64-22)
	3-inches	BCBC (PG 64-22 rich bottom)
	4-inches	Asphalt Treated Permeable Base
	6-inches	2A subbase

16-inches frost free select borrow / 6-inches prepared subgrade

Mp 111 to MP 115 Perpetual Pavement “Proposed” Design

	<u>HMA</u>		<u>PG</u>
	20,648 tons	12.5mm (PG 76-22)	1,200 tons @ 5 ⁸
	30,972 tons	25mm (PG 76-22)	1,550 tons @ 5 ⁰
	41,296 tons	BCBC (PG 64-22)	1,569 tons @ 3 ⁸
	30,972 tons	BCBC (PG 64-22 rich bottom)	1,270 tons @ 4 ¹
	<hr/> 41,296 tons	ATPB	1,032 tons @ 2 ⁵
	165, 184 tons	TOTAL	6,621 tons

850,000 tons / year x .04% = 34,000 tons PG x 10 years = 340,000 tons PG
Modified estimate = 14,122 = 141,220

Pa Turnpike MP 110 to MP 115

(as constructed)

	<u>\$ / TON</u> ^(Note)
2-inch 12.5mm (PG 76-22)	84⁵⁵
3-inch 19mm (PG 64-22)	50⁶¹
8-inch HMA Base (PG 64-22)	45²³
4-inch Rich Bottom (PG 64-22)	59⁵⁵
4-inch ATPB (PG 64-22)	38⁹⁰

Note: estimated from sy bid

Pa Turnpike MP 110 to MP 115

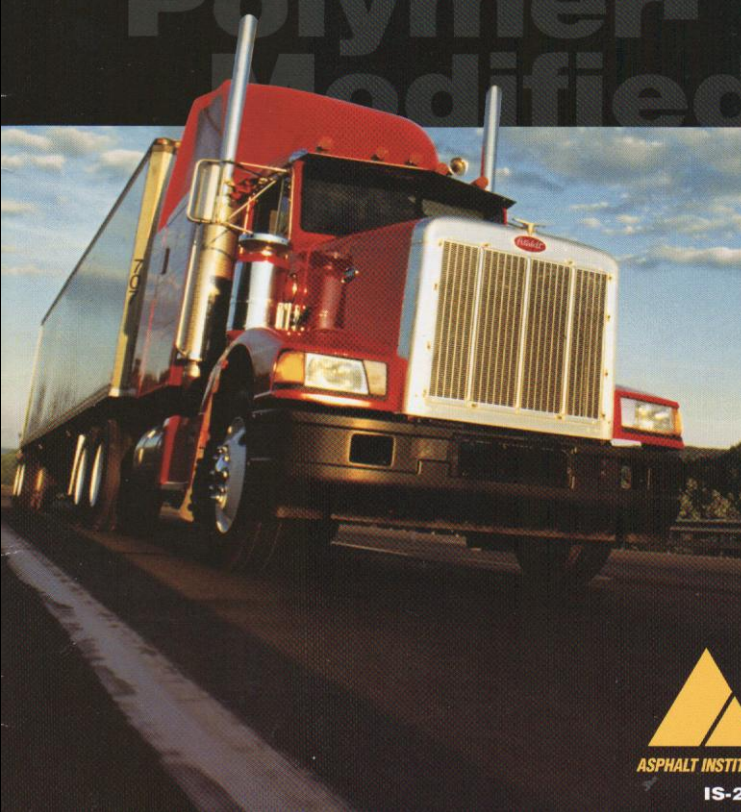
(what if)

	<u>\$ / sy</u>	
2-inch 12.5mm (PG 76-22)	9^{30}	
3-inch 19mm (PG 64-22)	8^{35}	x 120% = 10^{02}
8-inch HMA Base (PG 64-22)	19^{90}	
4-inch Rich Bottom (PG 64-22)	13^{10}	
4-inch ATPB (PG 64-22)	6^{85}	
Total HMA \$\$\$ on Project	<u>\$15,689,243</u>	<u>\$16,128,541</u> + 2 ⁸ % pav't section
Total \$\$\$\$ on Project	\$61,714,654	\$62,153,952 + 0 ⁷ % project

10/26/1938 MP 204 to MP 215 was \$458,058

Quantifying the Effects of PMA

FOR REDUCING PAVEMENT DISTRESS



Quantifying the Effects of PMA
for Reducing Pavement Distress

EXPECTED INCREASE IN SERVICE LIFE FOR PAVEMENTS WITH PMA MIXTURES

The M-E damage-based analyses completed for fatigue cracking and distortion were used to estimate the increase in expected service life for flexible pavements and HMA overlays. The computations were completed assuming that the pavement was adequately designed for 20 years using unmodified HMA mixtures and that PMA mixtures are used in the wearing surface and base layers. Table 2 summarizes the expected increase in service life for various conditions and site features.

Table 2. Expected Increase in Service Life for Flexible Pavements and HMA Overlays, Assuming a Design Period of 20 years

Site Feature	Condition Description		Increase in Service Life, Years ⁽¹⁾
Foundation Soils	Non-expansive, coarse-grained soils		5 – 10
	Expansive soils; moderately to highly plastic soils (Plasticity Index > 35)		2 – 5
	Frost Susceptible Soils in cold climates; moderately to highly frost susceptible (Class 3 and 4) ⁽²⁾		2 – 5
Water Table Depth	Deep		5 – 10
	Shallow; adequate drainage		5 – 8
	Shallow; inadequate drainage		0 – 2
Traffic	Low	Stop & Go/Intersections	5 – 10
		Thoroughfares	3 – 6
		Heavy loads/Special containers	5 – 10
	Moderate volumes		5 – 10
Climate	High volumes		5 – 10
	Hot		5 – 10
	Mild		2 – 5
	Cold		3 – 6
Existing Pavement Condition	HMA	Good condition	5 – 10
		Poor condition; extensive cracking ⁽³⁾	1 – 3
		Good condition ⁽³⁾	3 – 6
	PCC/JPCP	Poor condition; faulting & mid-panel cracking ⁽³⁾	0 – 2

Notes:

1. The range of the increase in service life is based on the M-E damage-based analyses, comments from the experts, and engineering judgment.
2. Without sufficient thickness of non-frost susceptible materials to prevent frost from penetrating frost susceptible soils.
3. Without the use of any reflection cracking mitigation techniques.

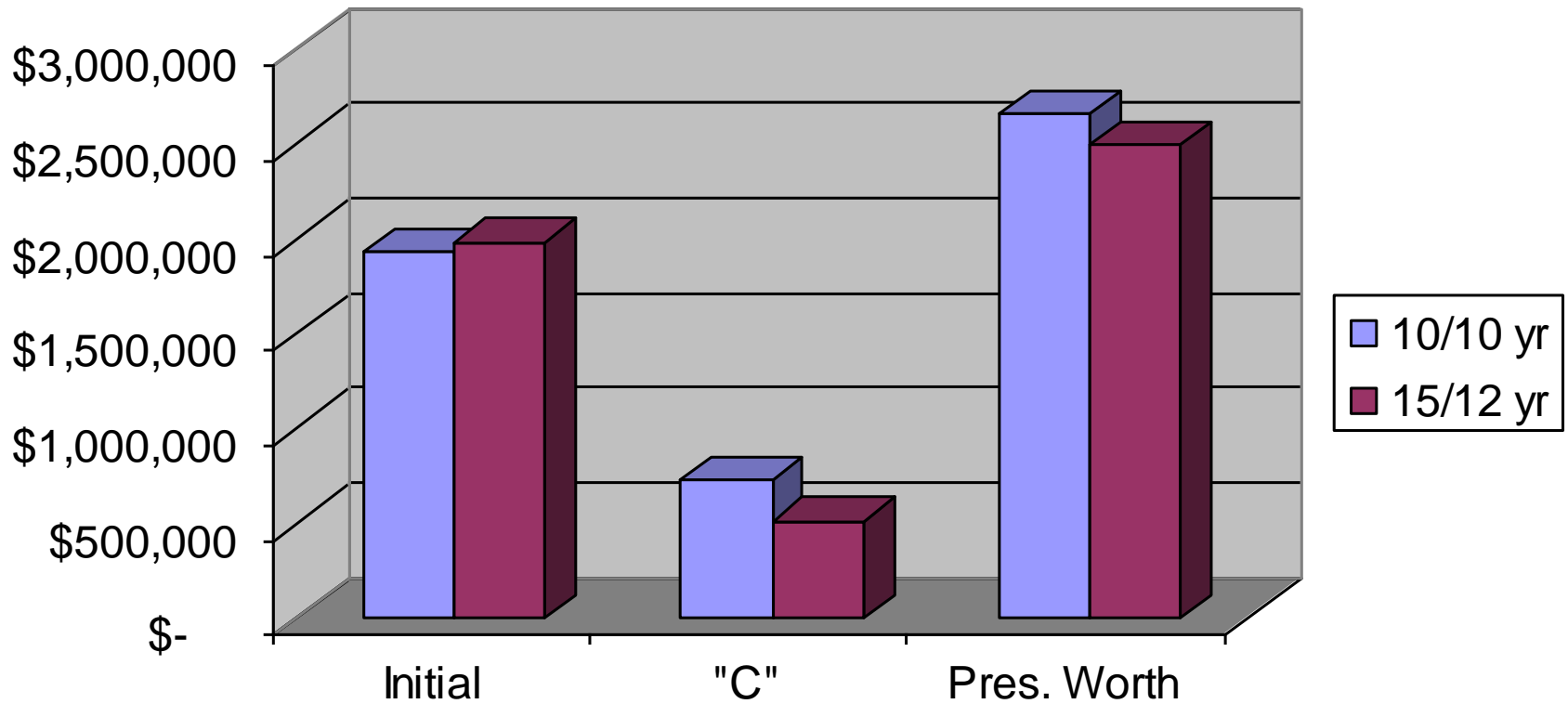
The expected increase in service life is based on structural requirements and not routine maintenance that will still be required for both conventional and PMA mixtures. Many state highway agencies have maintenance and rehabilitation schedules that are used or assumed in life

Present Worth Analysis		10year performance period				
		48' Mainline + 28' Shoulders @ 13.5-inches				
Interest						
3						
Year	Construction Item and/or	Quantities	Unit	Cost/Unit	Current Price	PW
0	12.5mm @ 2-inches (M)	3098	ton	\$ 68.66	\$212,709	\$212,709
0	19mm @ 2.5-inches (M)	3872	ton	\$ 68.66	\$265,852	\$265,852
0	37.5mm @ 5-inches (M)	7744	ton	\$ 53.14	\$411,516	\$411,516
0	37.5mm @ 4-inches (M)	6195	ton	\$ 53.14	\$329,202	\$329,202
0	12.5mm @ 2-inches (S)	1807	ton	\$ 68.66	\$124,069	\$124,069
0	19mm @ 2.5-inches (S)	2259	ton	\$ 68.66	\$155,103	\$155,103
0	37.5mm @ 9-inches (S)	8131	ton	\$ 53.14	\$432,081	\$432,081
						\$1,930,532
10	Mill 2-inches (M)	28160	sy	\$ 2.00	\$56,320	\$41,907
10	12.5mm @ 2-inches (M)	3098	ton	\$ 68.66	\$212,709	\$158,275
10	Mill 2-inches (S)	16427	sy	\$ 2.00	\$32,854	\$24,446
10	12.5mm @ 2-inches (S)	1,807	ton	\$ 68.66	\$124,069	\$92,319
						\$ 316,948
20	Mill 2-inches (M)	28160	sy	\$ 2.00	\$56,320	\$31,183
20	12.5mm @ 2-inches (M)	3098	ton	\$ 68.66	\$212,709	\$117,772
20	Mill 2-inches (S)	16,427	sy	\$ 2.00	\$32,854	\$18,190
20	12.5mm @ 2-inches (S)	1,807	ton	\$ 68.66	\$124,069	\$68,694
						\$ 235,839
30	Mill 2-inches (M)	28160	sy	\$2.00	\$56,320	\$23,203
30	12.5mm @ 2-inches (M)	3098	ton	\$ 68.66	\$212,709	\$87,633
30	Mill 2-inches (S)	16427	sy	\$ 2.00	\$32,854	\$13,535
30	12.5mm @ 2-inches (S)	1807	ton	\$ 68.66	\$124,069	\$51,115
						\$ 175,486
				Total	Present Worth	\$2,658,805
					PW - Initial	\$728,273

\$2,658,805

Present Worth Analysis		15 / 12 year performance period					
		48' Mainline + 28' Shoulders @ 13.5-inches					
Interest							
3							
Year	Construction Item and/	Quantities	Unit	Cost/Unit	Current Price	PW	
0	12.5mm @ 2-inches (M)	3098	ton	\$ 81.00	\$250,938	\$250,938	
0	19mm @ 2.5-inches (M)	3872	ton	\$ 68.66	\$265,852	\$265,852	
0	37.5mm @ 5-inches (M)	7744	ton	\$ 53.14	\$411,516	\$411,516	
0	37.5mm @ 4-inches +1/2%	6195	ton	\$ 55.64	\$344,690	\$344,690	at \$500 ton AC
0	12.5mm @ 2-inches (S)	1807	ton	\$ 68.66	\$124,069	\$124,069	
0	19mm @ 2.5-inches (S)	2259	ton	\$ 68.66	\$155,103	\$155,103	
0	37.5mm @ 9-inches (S)	8131	ton	\$ 53.14	\$432,081	\$432,081	\$1,984,248
15	Mill 2-inches (M)	28160	sy	\$ 2.00	\$56,320	\$36,150	
15	12.5mm @ 2-inches (M)	3098	ton	\$ 81.00	\$250,938	\$161,068	
15	Mill 2-inches (S)	16427	sy	\$ 2.00	\$32,854	\$21,088	
15	12.5mm @ 2-inches (S)	1,807	ton	\$ 68.66	\$124,069	\$79,635	\$ 297,940
27	Mill 2-inches (M)	28160	sy	\$ 2.00	\$56,320	\$25,355	
27	12.5mm @ 2-inches (M)	3098	ton	\$ 81.00	\$250,938	\$112,970	
27	Mill 2-inches (S)	16,427	sy	\$ 2.00	\$32,854	\$14,791	
27	12.5mm @ 2-inches (S)	1,807	ton	\$ 68.66	\$124,069	\$55,854	\$ 208,969
39	Mill 2-inches (M)	28160	sy	\$ 2.00	\$56,320	\$17,783	
39	12.5mm @ 2-inches (M)	3098	ton	\$ 81.00	\$250,938	\$79,235	
39	Mill 2-inches (S)	16427	sy	\$ 2.00	\$32,854	\$10,374	
39	12.5mm @ 2-inches (S)	1807	ton	\$ 68.66	\$124,069	\$39,175	\$ 146,567
						\$0	
40	Salvage value 90% yr 39	1	LS	-\$464,181	-\$464,181	-\$142,298	-\$142,298
				Total	Present Worth	\$2,495,426	\$2,495,426
					PW - Initial	\$511,178	

Agency Costs Economic Analysis



15 / 12	Initial Cost	+ 3%
15 / 12	"C" factor	- 30%
15 / 12	Pres. Worth	- 6%

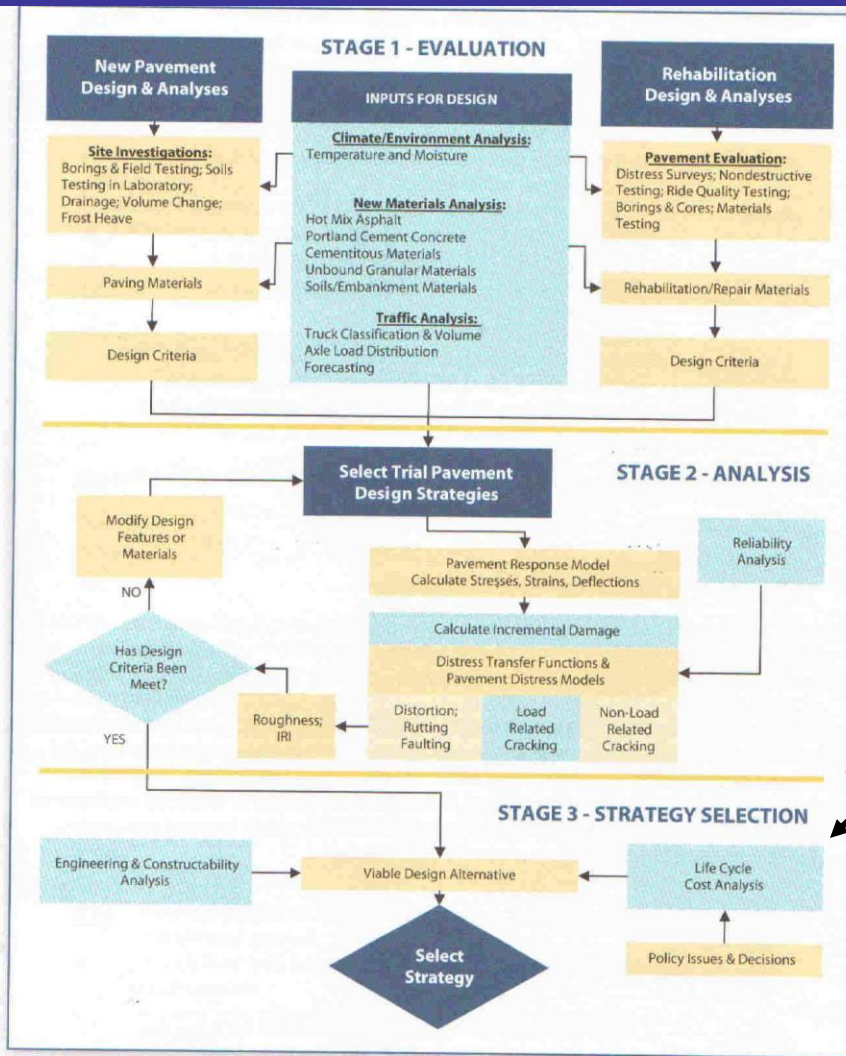


Figure 1: Conceptual Flow Chart of the Three-Stage Design/Analysis Process for the MEPDG (after NCHRP Project 1-40B, 2007b)

Life Cycle Cost Analysis



Calibration Factors for
Polymer-Modified Asphalts
USING M-E BASED DESIGN METHODS

ER-235

Present Worth Analysis 15 / 12 year performance period

72' Mainline + 46' Shoulders @ 17-inches

Interest

4

17-inch pav't section

2-inch 12.5mm 76-22

Year	Construction Item	Quantities	Unit	Cost/Unit	Current Price	PW
0	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$392,904
0	19mm @ 3-inches (M)	6969	ton	\$ 50.61	\$352,701	\$352,701
0	37.5mm @ 8-inches (M)	18586	ton	\$ 45.23	\$840,645	\$840,645
0	37.5mm @ 4-inches +1/2%	9293	ton	\$ 59.55	\$553,398	\$553,398
0	12.5mm @ 2-inches (S)	2969	ton	\$ 84.55	\$251,029	\$251,029
0	19mm @ 3-inches (S)	4454	ton	\$ 50.61	\$225,417	\$225,417
0	37.5mm @ 8-inches (S)	11876	ton	\$ 45.23	\$537,151	\$537,151
0	37.5mm @ 4-inches +1/2%	5937	ton	\$ 59.55	\$353,548	\$353,548
						\$3,506,794
15	Mill 2-inches (M)	42240	sy	\$ 2.00	\$84,480	\$46,909
15	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$218,166
15	Mill 2-inches (S)	26987	sy	\$ 2.00	\$53,974	\$29,970
15	12.5mm @ 2-inches (S)	2,969	ton	\$ 84.55	\$251,029	\$139,387
						\$ 434,432
27	Mill 2-inches (M)	42240	sy	\$ 2.00	\$84,480	\$29,299
27	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$136,266
27	Mill 2-inches (S)	26,987	sy	\$ 2.00	\$53,974	\$18,719
27	12.5mm @ 2-inches (S)	2,969	ton	\$ 84.55	\$251,029	\$87,061
						\$ 271,345
39	Mill 2-inches (M)	42240	sy	\$2.00	\$84,480	\$18,300
39	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$85,111
39	Mill 2-inches (S)	26987	sy	\$ 2.00	\$53,974	\$11,692
39	12.5mm @ 2-inches (S)	2969	ton	\$ 84.55	\$251,029	\$54,378
						\$0
40	Salvage value 90% yr 39	1	LS	-\$782,387	-\$782,387	-\$162,963
				Total	Present Worth	\$4,219,088

PW - Initial

\$712,295

\$ 3,506,794

\$ 4,219,088

Present Worth Analysis 15 / 12 year performance period

72' Mainline + 46' Shoulders @ 12-inches

VonQuintus Per

12-inch pav't section

2-inch 12.5mm 76-22

3-inch 19mm 76-22

Interest						
4						
Year	Construction Item	Quantities	Unit	Cost/Unit	Current Price	PW
0	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$392,904
0	19mm @ 3-inches (M)	6969	ton	\$ 60.73	\$423,227	\$423,227
0	37.5mm @ 4-inches (M)	9293	ton	\$ 45.23	\$420,322	\$420,322
0	37.5mm @ 3-inches +1/2%	6970	ton	\$ 59.55	\$415,064	\$415,064
0	12.5mm @ 2-inches (S)	2969	ton	\$ 84.55	\$251,029	\$251,029
0	19mm @ 3-inches (S)	4454	ton	\$ 60.73	\$270,491	\$270,491
0	37.5mm @ 4-inches (S)	5938	ton	\$ 45.23	\$268,576	\$268,576
0	37.5mm @ 3-inches +1/2%	4453	ton	\$ 59.55	\$265,176	\$265,176
						\$2,706,789
15	Mill 2-inches (M)	42240	sy	\$ 2.00	\$84,480	\$46,909
15	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$218,166
15	Mill 2-inches (S)	26987	sy	\$ 2.00	\$53,974	\$29,970
15	12.5mm @ 2-inches (S)	2,969	ton	\$ 84.55	\$251,029	\$139,387
						\$ 434,432
27	Mill 2-inches (M)	42240	sy	\$ 2.00	\$84,480	\$29,299
27	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$136,266
27	Mill 2-inches (S)	26,987	sy	\$ 2.00	\$53,974	\$18,719
27	12.5mm @ 2-inches (S)	2,969	ton	\$ 84.55	\$251,029	\$87,061
						\$ 271,345
39	Mill 2-inches (M)	42240	sy	\$2.00	\$84,480	\$18,300
39	12.5mm @ 2-inches (M)	4647	ton	\$ 84.55	\$392,904	\$85,111
39	Mill 2-inches (S)	26987	sy	\$ 2.00	\$53,974	\$11,692
39	12.5mm @ 2-inches (S)	2969	ton	\$ 84.55	\$251,029	\$54,378
						\$0
40	Salvage value 90% yr 39	1	LS	-\$782,387	-\$782,387	-\$162,963
				Total	Present Worth	\$3,419,084
						3,419,084
					PW - Initial	\$712,295

\$ 2,706,789

\$ 3,419,084

<u>Pavement Section</u>	<u>Initial</u>	<u>Present Worth</u>
17-inch (2-inch PG 76-22)	\$ 3,506,794	\$ 4,219,089
12-inch (5-inch PG 76-22)	<u>\$ 2,706,789</u>	<u>\$ 3,419,084</u>
Savings	\$ 800,005	800,005
	23%	19%

MON/FAYETTE EXPRESSWAY AND SOUTHERN BELTWAY PROJECTS



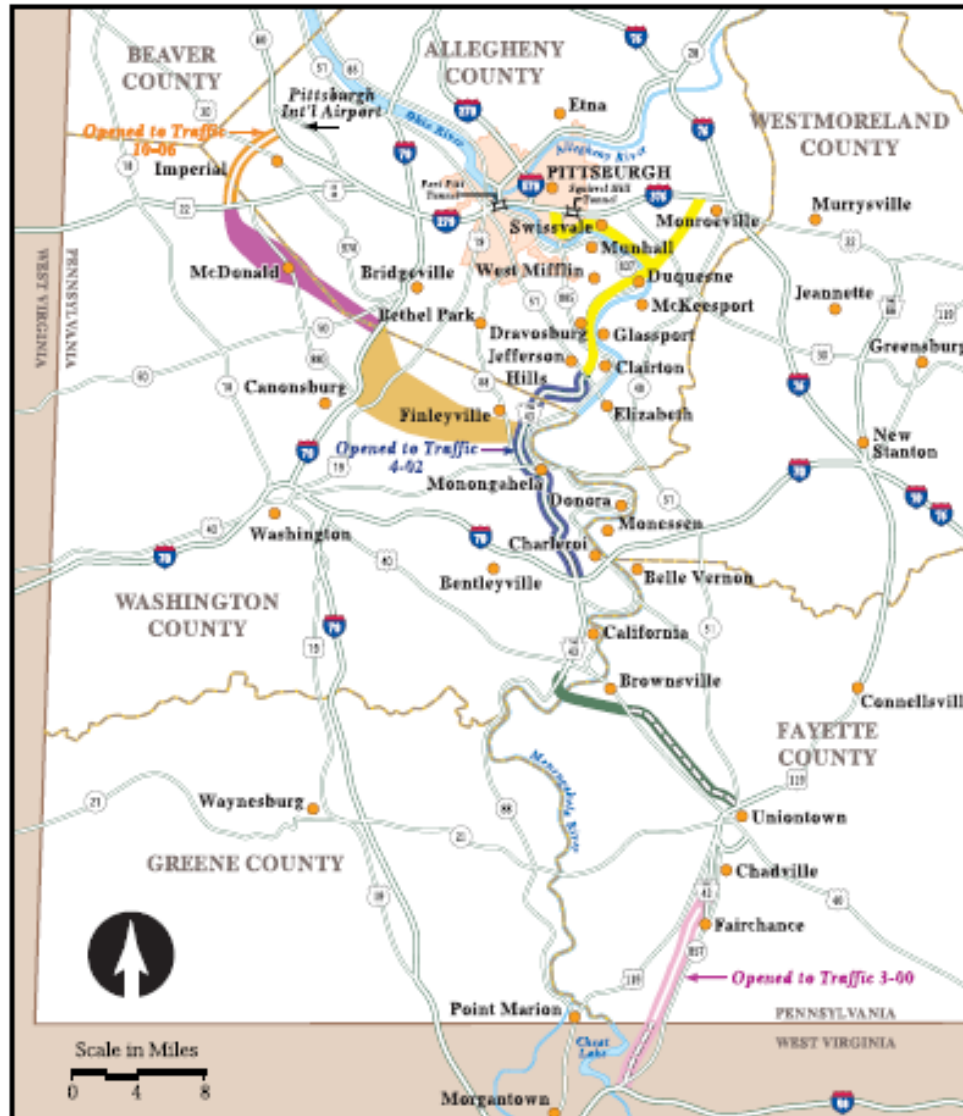
Pennsylvania Turnpike Commission
Western Regional Office
2200 North Center Avenue
New Stanton, PA 15672-9602

Pavement

17-inch (2-in

12-inch (5-in

Savings



MON/FAYETTE EXPRESSWAY

- I-68 to Route 43 (#R00-994)
- Uniontown to Brownsville (#R00-1000)
- I-70 to PA-51 (#R00-1004)
- PA-51 to Pittsburgh (#R00-1294)

Project Status

- Open to Traffic/Construction
- Final Design/Construction
- Open to Traffic
- Final Design

SOUTHERN BELTWAY

- PA-60 to US 22 (#R00-1000)
- US 22 to I-79
- I-79 to Mon/Fayette

Project Status

- Open to Traffic
- Environmental Study
- Environmental Study

REVISED: 10/01/04
#R00: Record of Decision
Prepared by: M&C CONSULTING, INC.

nt Worth

19,089

19,084

00,005

19%





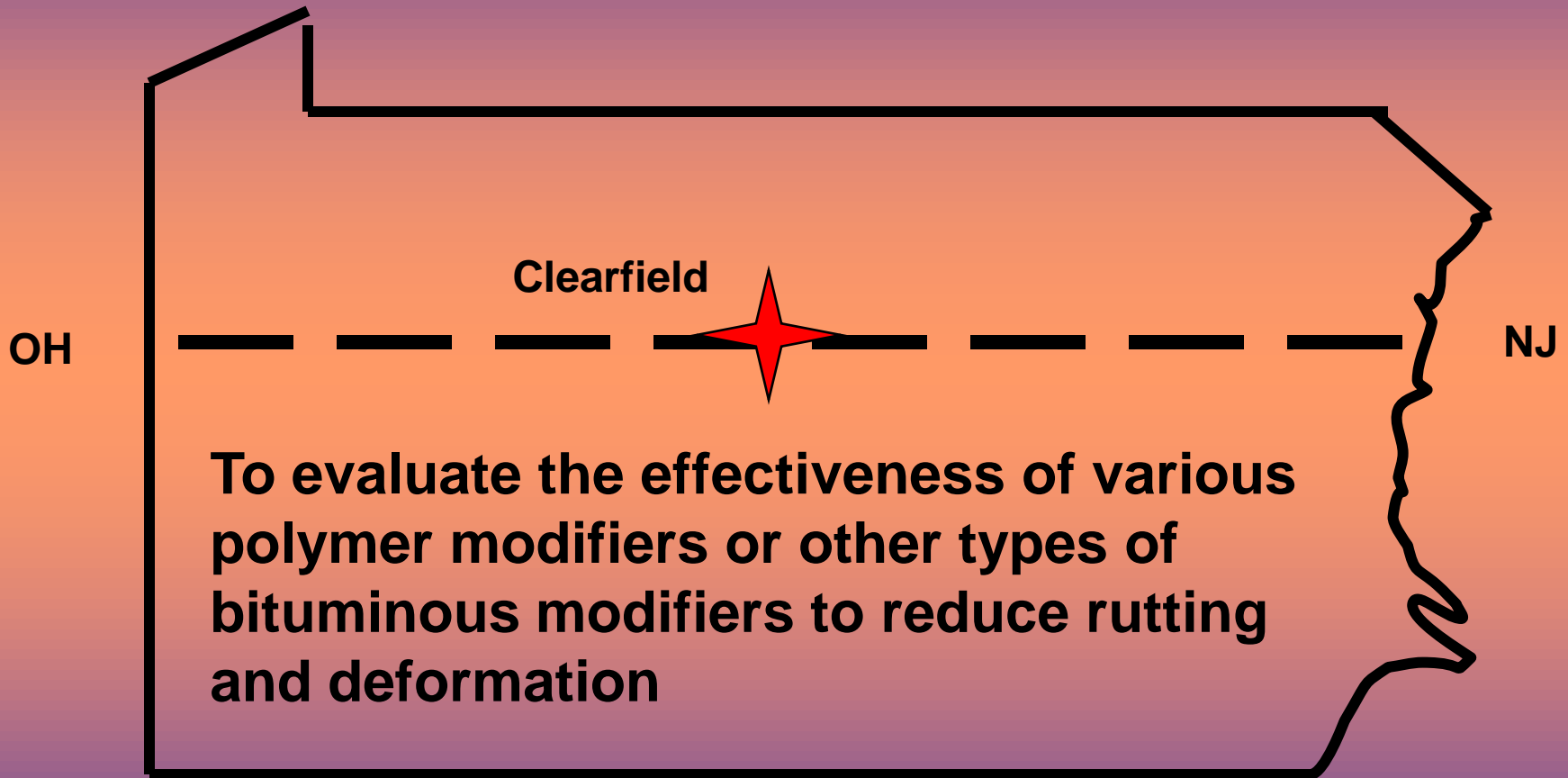
QUESTIONS / DISCUSSION



Thanks, I enjoyed it

Carlos Rosenberger
Asphalt Institute

Research Project 87 – 50C



I-80



**Test Sections: 3% grade, ½-mile long, travel lane
AADT 8,284 36% trucks**

PLACEMENT DATES

April - September 1989

TEST SECTIONS

Polybilt

Styrelf

Kraton

Gilsonite

Novaphalt

AC – 40

(binder & base courses)

ID-3 wearing

(equivalent to 19mm)

Special Binder

Pavement Evaluations

Average Rut Depth after 4 years

STYRELF	0.02
ALL OTHER MODIFIED ASPHALTS	0.04 – 0.06
ALL AC-20 MATERIALS	0.07 – 0.12

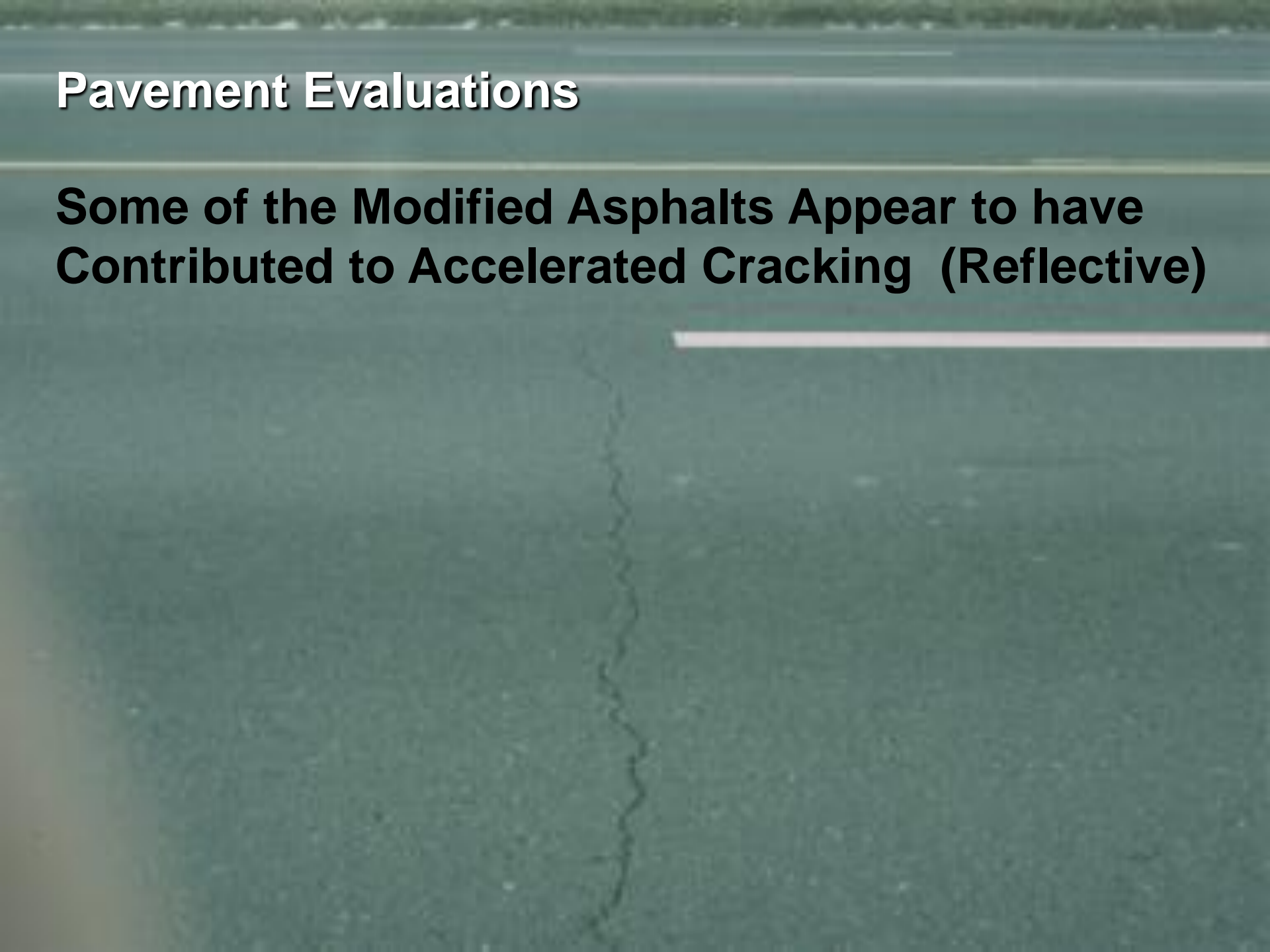
MAXIMUM RUT DEPTH AFTER 4-YEARS

I-80 CLEARFIELD COUNTY

	inches
SBS, SB	≤ 0.05
PE, Fiber, PRA, AC-40	≤ 0.10
EVA, ID-3 w/Sp B, 3 AC-20	≤ 0.15
1 AC-20	≤ 0.20
1 AC-20	≤ 0.25

Pavement Evaluations

**Some of the Modified Asphalts Appear to have
Contributed to Accelerated Cracking (Reflective)**





EVA



SBS



EVA
ID-3



AC-40



AC-20



SBS
ID-3

I-80



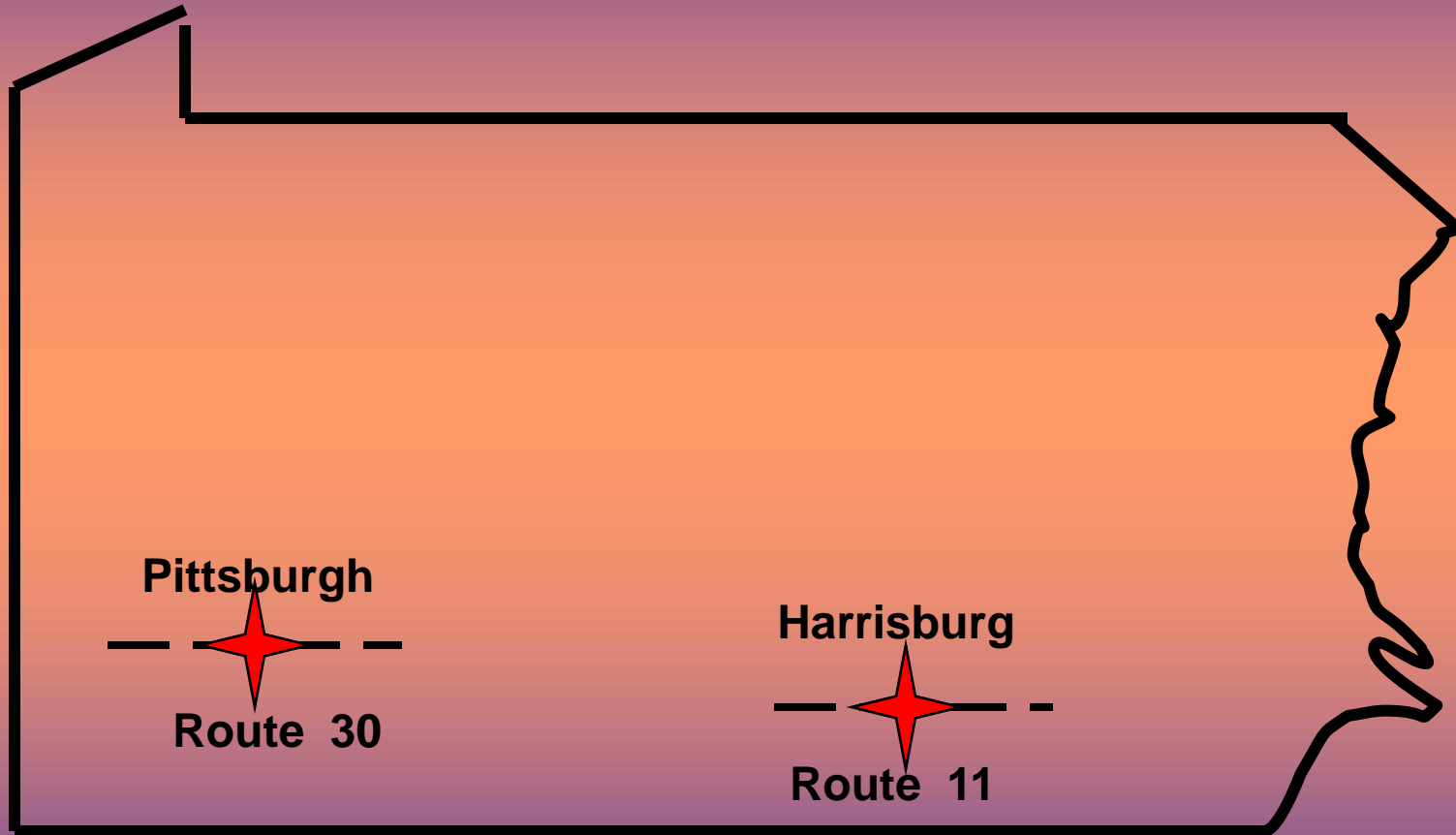
Overall Best Performance

Styrelf

Kraton

Poly – E - fibers

Research Project 91 - 58



Speed up the results

Route 11 Mechanicsburg, PA



Route 30 Pittsburgh, PA





Lab & field results suggest –

Modified asphalts can contribute to improved rut resistance

Remove all shear susceptible material to a depth of 4-inches