Missouri's Full Depth Pavement with Modified Binders

Dave Ahlvers

### Alternate Pavement Bidding Responsibility

5,000 miles of Major Roads 27,000 miles of Minor Roads 10,000 Bridges

# Annual Pavement Quantities

Year	Asphalt					
	Tons	\$\$				
1995	2,110,902	50,445,371				
2000	5,115,218	200,192,172				
2005	8,035,462	397,618,849				
2009	4,719,775	258,484,735				

# Where We Were and Where We Are

2000 ≥ 2800 tons of polymer modified asphalt mix

Placed on 2 centerline miles of major roads  2006
 > 3,000,000 tons of polymer modified asphalt mix
 > Placed on 1500 centerline miles

of major roads

## **Smooth Roads Initiative**



## Better Roads Brighter Future



## **NCAT Results**

Polymer modified asphalt reduced rutting

- Modified (PG 76-22) asphalt 60% less rutting over unmodified sections (PG 67-22)
- Polymer allowed higher asphalt content without rutting.
  - > 0.5% increase in non-polymer asphalt (PG 67) increased rutting about 50%
  - > 0.5% increase in polymer asphalt (PG 76) had no significant effect.

# Life Cycle Cost Savings Analysis\*

- Cost of polymer in Project: \$31,574
   (5% AC; 3% polymer in the AC @ \$1.00 lb.)
   (9.20% of Total Mix Cost)
- Life Increase Required for Payback of polymer: 0.38 Years (4.10\*0.0920)
- > Average Life of polymer/HMAC from PMIS:

6.50 Years2.02 Years

Additional Life of polymer/HMAC

(6.5-(4.10+0.38)

\* Colorado Data



## Why Did We Change?

Unhappy with quality of mixtures.
 Progressed from rutting mixtures to dry raveling fatigued mixtures.
 Mixtures were prone to stripping.
 Internal culture of MoDOT was resistant to changing asphalt binders.





# Raveling

# Rutting

# Why Did We Change?

### Alternate Bidding Requires Longer Lasting Asphalt Pavements





Asphalt and Concrete go Head to Head

## **Alternate Pavement** Designs $\succ$ New construction (based on M-E Design Guide) > JPCP Conventional HMA $\geq$ Rehabilitation (default thickness derived partly from M-E and empirical data) > 8" Unbonded PCC overlay (UBOL) > Rubblization w/ 12" HMA overlay

## **Method of Measurement**

New JPCP and HMA measured in square yards

Unbonded overlays measured in <u>cubic</u> <u>yards</u> for furnishing and <u>square yards</u> for placing

HMA overlay (on rubblized PCC) measured in wet tons

# Alternate Design Life Cycle Costs

LCCA used solely to determine adjustment factor for 45-year design life Life cycle costs considered Initial construction Maintenance > Rehabilitation Salvage value > User costs

## **Rehabilitation Assumptions**

### ≻HMA

- Mill and fill wearing course <u>at 20 years</u> in driving lanes
- Mill and fill wearing course <u>at 33 years</u> across whole surface

>PCC

Diamond grind whole surface and perform full-depth repairs on 1 ½ % of surface area <u>at</u> <u>25 years</u>

## **Adjustment Factor**

## <u>Adjustment factor</u> = PW (future HMA rehab) – PW (future PCC rehab)

Adjustment factor calculated by Estimating Section using current market unit prices

Present worth (PW) values of future rehabilitation determined using OMB discount rates.

#### Life-Cycle Cost Adjustment Worksheet

Job Number	
County	
Route	
Call	
Letting Date	

Total Area of Paving Area of Traveled Way

Le

20

Mo Co

33 Dis Mil AC Mit Mo Co

Ye

SP125 Weight Factor

Estimated Unit Price for SP125 Estimated Unit Price for Cold Milling Estimated Unit Price for Diamond Grinding Estimated Unit Price for Pavement Repair\*\*





1.97 Tons/CY



\$1,469,204

This Documentation should be filed with all other Final Engineer's Estimate Documentation. Also include a copy along with the pavement estimation worksheet in the Alternate Pavements Notebook

Spreadsheets use OMB Real Interest Rates March 2004 5-Year 10-Year 20-Year\* 25-Year\* 2.100% 2.800% 3.150% 3.325% \*Straight Line Interpolation From Published Rates

"Includes all related Pavement Repair Items

USE # 1,469,200

Total LCCA Adjustment Factor For Job Special Provision

oDOT AC Projection							2003
	% or				Unit		Present
	Thick. (in.)	Year	Quantity	Unit	Price	Cost	Worth
Year Maintenance							
scount Rate: 3.150%	1						
Surface Lift Traveled Way	1	20	256,781	SY	\$1.47	\$377 468	\$203.000
Resurfacing Traveled Way	1.75	20	24,590	TON	\$38,78	\$953,614	\$512,847
scellaneous	20%	20	1	Price	\$266.216.35	\$266,216	\$143,169
bilization	5%	20	1	Price	\$79.864.90	\$79,865	\$42,951
nstruction added costs	12.9%	20	1	Price	\$216,354.02	\$216,351	\$116,354
Year Maintenance							
scount Rate: 3.500%							
Surface Lift - all	1	33	415.518	SY	\$1.47	\$610,811	\$198.280
Resurfacing (100%) - all	1.75	33	39,792	TON	\$38.78	\$1,543,119	\$495,870
scellaneous	20%	33	1	Price	\$430,786.09	\$430,786	\$138,430
bilization	5%	33	1	Price	\$129,235.83	\$129.236	\$41,529
nstruction added costs	12.9%	33	1	Price	\$350,099.86	\$350,100	\$112,502
ars in analysis:	Total Cost:					\$4,957,569	\$2,002,932
count Rate: 3.500%	1						
	Equivalent Uniform	Annual Co	ost:				\$89.037
							200,001

MoDOT PCC Projection							2003
-	% or				Unit		Present
	Thick. (in.)	Year	Quantity	Unit	Price	Cost	Worth
25 Year Maintenance							
Discount Rate: 3.325%							
Traveled Way Slab Replacements	1.5%	25	3,852	SY	\$100.00	\$385.172	\$170.027
Diamond Grinding of Traveled Way		25	256,781	SY	\$1.81	\$464,774	\$205,166
Miscellaneous	20%	25	1	Price	\$169,989.02	\$169,989	\$75.039
Mobilization	5%	25	1	Price	\$50,996.71	\$50,997	\$22,512
Construction added costs	12.9%	25	1	Price	\$138,150.08	\$138,150	\$60,984
ars in analysis: Total Cost: \$1,200 pe					\$1 209 081	\$533 729	
45						\$1,205,001	0000,720
Discount Rate: 3.500%							
	Equivalent Uniform Annual Cost:					\$23,726	

## **Alternate Bid Selection**

Low bidder = lower of (PCC bid price) vs. (HMA bid price + adjustment factor)

### Alternate Pavement Update Jobs Thru Dec 2010 with LCCA Factor

>187 Alternate Projects to Date (\$2.234 bil) > 174 Full Depth (\$2.052 bil) > 13 Rehabilitation (\$182.1 mil) Full Depth > 59 Asphalt Awards (\$539.4 mil) > 115 Concrete Awards (\$1.513 bil) Rehabilitation > 1 Asphalt Award (\$2.6 mil) > 12 Concrete Awards (\$179.5 mil)

## Results – Difference in Low Bids

Low PC Bids vs. Low AC Bids LCCA Factor not Applied
 PC Total – \$854,428,378
 AC Total - \$871,075,824
 Difference - \$16,647,446 (1.9%)
 Low PC Bids vs. Low AC Bids LCCA Factor Applied
 PC Total – \$854,428,378
 AC Total - \$901,988,624
 Difference - \$47,560,246 (5.6%)

LCCA Factor has Determined Low Bid 4 Times since October 2003.

## **Number of Bidders**



■ All Projects ■ Alternate Paving Projects

# US 71\_McDonald County Alternate Bid Example

- J7P0601F 5.4 mi.
   South of Rte EE to South of Rte H near Pineville, MO.; 04/2005.
- 3 Asphalt Bidders; No PCCP Bidders
- 12" SuperPave vs 10" PCCP on Rock Base



## US 71\_McDonald Typical Sections 12.0" SuperPave VS 10.0" PCCP





AC Low Bid = \$45,720,525.53

## MO 249\_Jasper County Alternate Bid Example

### Two Consecutive Projects

(J7U0436) – 2.4 mi. Rt. 66 to Zora St.; 03/2007
9 Bids – 3 AC and 6 PC
(J7U0436H) – 2.1 mi. Zora St. to Rte171; 08/2007
4 Bids – 3 AC and 1 PC
14" SuperPave vs 10" PCCP on 4" Agg. Base



## Rte 249 – Typical Sections



J7U0436 = AC BID -\$4,346,937.93 J7U0436H= AC BID-\$6,667,006.49 J7U0436 = PC BID -\$4,939,202.68 J7U0436H= PC BID-\$7,962,048.16

## MO 5\_Camden County Alternate Bid Example

► J5P0591 – South of Lake Rd. to South of Old Rte 5; 3.6 miles; Let Date 12/2007  $\geq$  6 Bids – 3 AC and 3 PC ➤ 8" SuperPave vs. 8" PCCP on Rock Base



# Rte 5 – Typical Sections

VS

### 8.0" SuperPave

8.0" PCCP



AC Low Bid = \$9,206,186.96

# PC Low Bid = \$10,718,451.15

## 2009 Alternate Bidding Results

≥26 Full Depth Construction Projects in 2009 with Alternate Bidding >13 Full Depth Asphalt Projects Awarded bidding against PCCP with LCCA. Total Asphalt Bid Amount w/ No LCCA -\$64,294,362 >LCCA Total Amount - \$1,677,000

## 2010 Alternate Bidding Results

17 Full Depth Construction Projects in 2010 with Alternate Bidding

- 6 Full Depth Asphalt Projects Awarded bidding against PCCP with LCCA.
- Total Asphalt Bid Amount w/ No LCCA-\$23,392,371

LCCA Total Amount - \$631,300

## **Future of Polymer**

"MoDOT is willing to pay more for polymer modified asphalt to provide a longer lasting pavement"