Alternate Pavement Bidding in Missouri

2008 SES Pavement Management
and Design Conference

North Little Rock, AR

John P. Donahue, P.E.
Missouri DOT

January 23, 2008

Alternate Pavement Design Bidding

Alternate pavement designs in Missouri consist of ‘structurally equivalent’ PCC and HMA construction and rehabilitation solutions that are bid competitively by using life cycle cost analysis correction factors.

General Policy

All new paving projects shall have either alternate pavement designs with a life cycle cost (LCC) adjustment factor for construction > two lane-miles in length (recently changed to > 7500 sq yd in a continuous area) or optional pavement designs without an LCC adjustment factor for smaller paving quantities, unless waived at the Central Office level for documented reasons.

Possible Exceptions to the Rule

- Paving minor percentage of entire contract
- Widening existing pavement
- Urban construction
- Poor subsurface conditions under existing pavement
- Short design life required

First Alternate Bidding Experiment

- Missouri let five pilot projects in 1996 under the auspices of FHWA SEP-14
- Project conditions included
  - Design costs within 15% of each other
  - At least one mile of paving
  - Primary work was paving
  - Minimal grade change impact
  - Area unit prices
- An LCCA adjustment factor was used

First Alternate Bidding Experiment

- Bidding results ➔ 3 – HMA / 2 – PCC
- Low paving prices, but not lower than expected
- Higher number of bidders per project
- Overall - no verdict, process went dormant

Alternate Bidding Restart

- Pavement Team; composed of MoDOT, PCC and HMA paving industry, and FHWA representatives; recommended in 2003 to restart alternate pavement design bidding
- First year impacted mostly projects originally designed as JPCP, therefore PCC paving industry initially resistant

Alternate Bidding Restart

- LCCA assumptions difficult to reach consensus on.
- Initial alternate designs determined with 1986 AASHTO Guide for the Design of Pavement Structures, but the Pavement Team soon recommended adopting a mechanistic-empirical (M-E) design approach for pavements in Missouri and the NCHRP MEPDG was selected.

Reasons for Selecting NCHRP M-E Pavement Design Guide

- Common traffic and climatic module platforms are provided for both PCC and HMA analysis
- Distress models were calibrated and validated with largest pavement database ever
- New materials in designs could be evaluated
- Probably will become most defensible method because of AASHTO adoption

M-E Design Implementation

Average JPCP thicknesses reduced by

- ~ 2“ for high truck volume routes
- ~ 1“ for low to medium truck volume routes

Average HMA thicknesses reduced by

- ~ 3-4“ for high truck volume routes
- ~ 1-2“ for low to medium truck volume routes

Alternate Pavement Designs

- New construction (based on MEPDG)
  - JPCP
  - Conventional HMA
- Rehabilitation (default thickness derived partly from 1986 AASHTO Guide and empirical data)
  - 8“ Unbonded PCC overlay (UBOL)
  - Rubblization w/ 12“ HMA overlay

Design Transition

- Not as bad as you think
- After several iterations the procedures were simplified to one set of designs
- Alternate (or optional) bid designs have become second nature to MoDOT and consultant designers

Alternate Roadway Design Guidelines

Grading project separate from paving project with 18” rock base

- Subgrade profile and pavement cross-sections designed for thicker (HMA) alternate
- If thinner (JPCP) alternate selected, contractor increases rock base thickness

Alternate Roadway Design Guidelines

Grading project separate from paving project with 4” crushed stone base or 4” OGTB on 4” crushed stone subbase

- Subgrade profile and pavement cross-sections designed for thinner (JPCP) alternate
- If thicker (HMA) alternate selected, contractor removes difference from subgrade
- Crossroad structures designed to accommodate minimum cover based on thicker pavement

Alternate Roadway Design Guidelines

Grading and paving combined in one project

- Subgrade profile and pavement cross-sections designed for thinner (JPCP) alternate
- Crossroad structures designed to accommodate minimum cover based on thicker pavement
- Contractor maintains profile grade of either design with no direct pay

Method of Measurement

- New JPCP and HMA measured in square yards
- Unbonded overlays measured in cubic yards for furnishing and square yards 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 at 20 years in driving lanes
  - Mill and fill wearing course at 33 years across whole surface
- PCC
  - Diamond grind whole surface and perform full-depth repairs on 1 ½ % of surface area at 25 years

Rehabilitation Discount Rate

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

Adjustment Factor

Adjustment factor = PW (future HMA rehab) – PW (future PCC rehab)

Adjustment factor spreadsheet used by Central Office Estimating Section

Life-Cycle Cost Adjustment Worksheet

Job Number	J2P0487
County	Randolph
Route	63
Call	040716-201
Letting Date	07/16/04
Total Area of Paving	415518 SY
Area of Traveled Way	256781 SY
SP125 Weight Factor	1.97 Tons/CY
Estimated Unit Price for SP125	$38.78 /Ton
Estimated Unit Price for Cold Milling	$1.47 /SY
Estimated Unit Price for Diamond Grinding	$1.81 /SY
Estimated Unit Price for Pavement Repair**	$100.00 /SY

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

Total LCCA Adjustment Factor For Job Special Provision **$1,469,204** Use $1,469,200

MoDOT AC Projection

	% or Thick. (in.)	Year	Quantity	Unit	Unit Price	Cost	2003 Present Worth
20 Year Maintenance							
Discount Rate: 3.150%							
Mill Surface Lift Traveled Way	1	20	256,781	SY	$1.47	$377,468	$203,000
AC Resurfacing Traveled Way	1.75	20	24,590	TON	$38.78	$953,614	$512,847
Miscellaneous	20%	20	1	Price	$266,216.35	$266,216	$143,169
Mobilization	5%	20	1	Price	$79,864.90	$79,865	$42,951
Construction added costs	12.9%	20	1	Price	$216,354.02	$216,354	$116,364
33 Year Maintenance							
Discount Rate: 3.500%							
Mill Surface Lift - all	1	33	415,518	SY	$1.47	$610,811	$196,280
AC Resurfacing (100%) - all	1.75	33	39,792	TON	$38.78	$1,543,119	$495,870
Miscellaneous	20%	33	1	Price	$430,786.09	$430,786	$138,430
Mobilization	5%	33	1	Price	$129,235.83	$129,236	$41,529
Construction added costs	12.9%	33	1	Price	$350,099.86	$350,100	$112,502
Years in analysis: 45	**Total Cost:**					$4,957,569	$2,002,932
Discount Rate: 3.500%							
	Equivalent Uniform Annual Cost:						$89,037

MoDOT PCC Projection

	% or Thick. (in.)	Year	Quantity	Unit	Unit Price	Cost	2003 Present 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
Years in analysis: 45		**Total Cost:**				$1,209,081	$533,728
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 Bid Example #1

- 21 miles of grading and paving new dual lane on US 63 in Macon/Adair Counties
- Adjustment factor = $1,541,000
- Low HMA construction bid = $22,220,790
- Low HMA bid for comparison = $23,761,790
- Low JPCP construction bid = $24,320,546
- Winner ➔ low HMA bid
- Adjustment factor has no impact

Alternate Bid Example #2

- 8 miles of grading, paving, and bridges for new dual lane on US 36 in Macon County
- Adjustment factor = $964,800
- Low HMA construction bid = $40,499,627
- Low HMA bid for comparison = $41,464,427
- Low JPCP construction bid = $35,322,473
- Winner ➔ low JPCP bid
- Adjustment factor has no impact

Alternate Bid Example #3

- 11 miles of grading and paving new dual lane on US 63 in Randolph County
- Adjustment factor = $1,469,200
- Low HMA construction bid = $25,262,509
- Low HMA bid for comparison = $26,731,709
- Low JPCP construction bid = $26,452,184
- Winner ➔ low JPCP bid
- Adjustment factor HAS impact

Alternate Pavement Bidding Update Thru Dec 2007

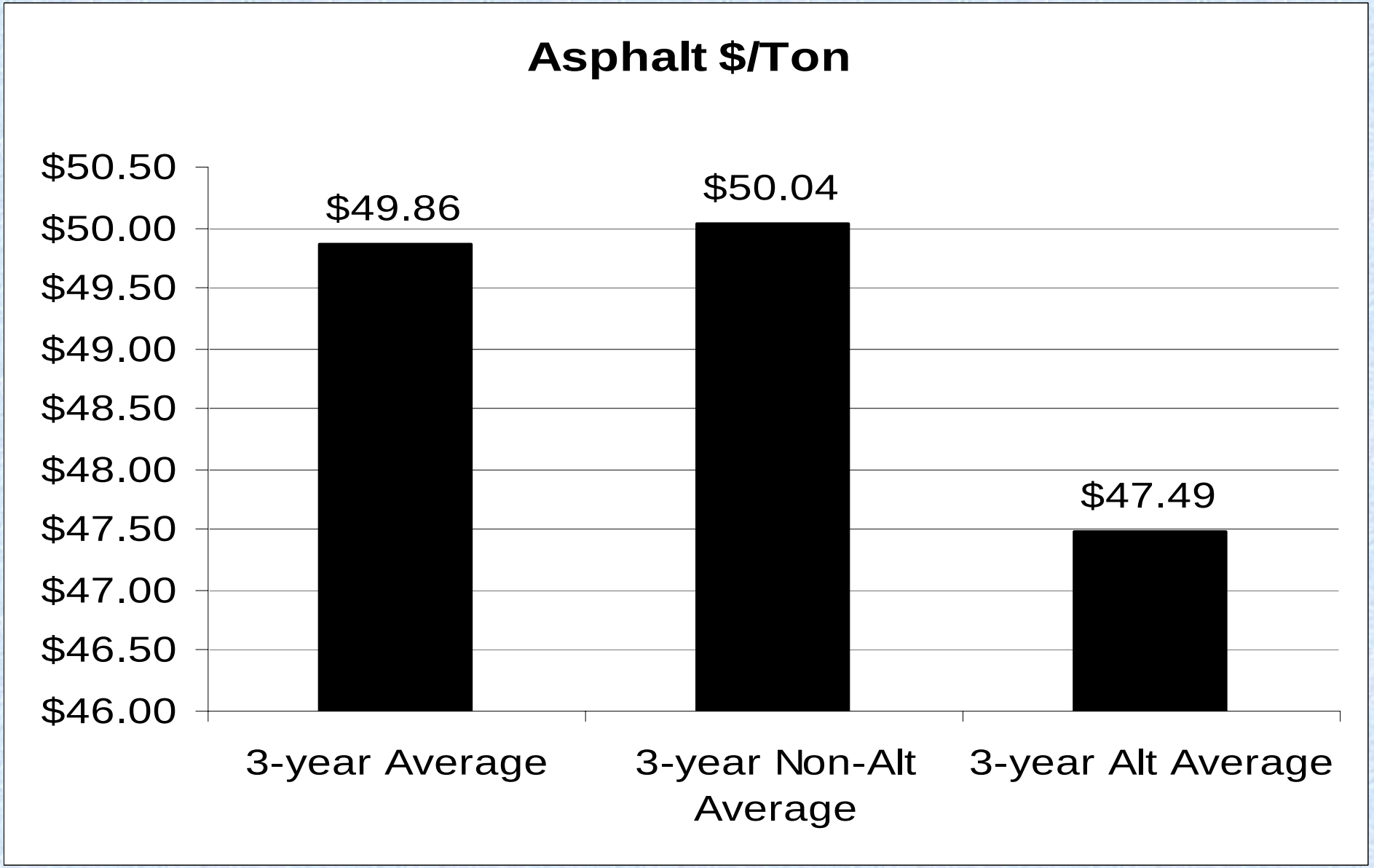
- 95 Alternate Projects to Date ($1.253 bil)
  - 89 Full Depth ($1.171 bil)
  - 6 Rehabilitation ($82.6 mil)
- Full Depth
  - 37 Asphalt Awards ($434.3 mil)
  - 52 Concrete Awards ($736.4 mil)
- Rehabilitation
  - 1 Asphalt Award ($2.6 mil)
  - 5 Concrete Awards ($80 mil)

Results – Difference in Low Bids

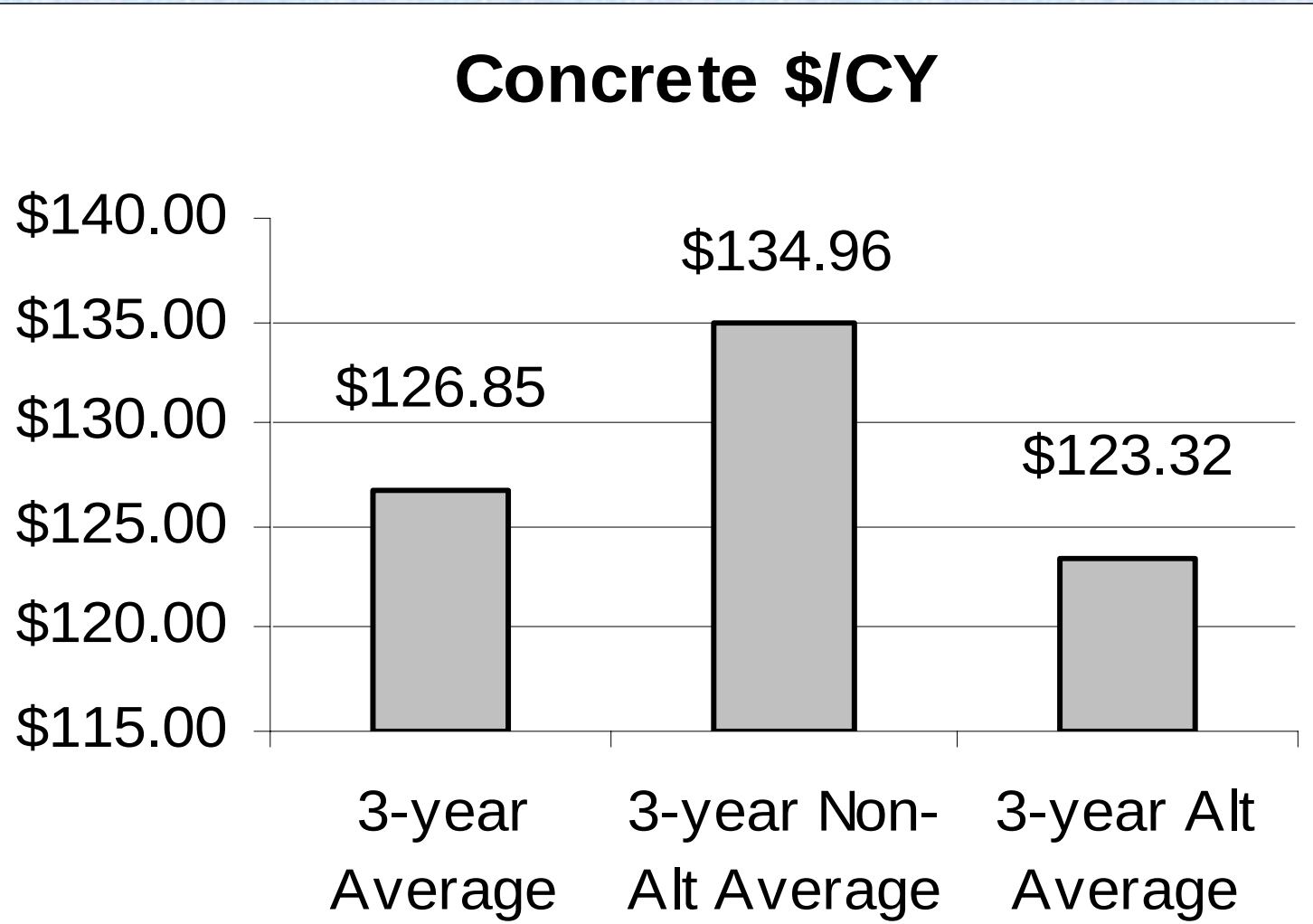
- Low PCC Bids vs. Low HMA Bids w/o LCCA Factor
  - PC Total – $588,615,291
  - AC Total - $605,920,007
  - Difference - $17,304,716 (2.9%)
- Low PCC Bids vs. Low AC Bids w/ LCCA Factor
  - PC Total – $588,615,291
  - AC Total - $628,254,407
  - Difference - $39,639,116 (6.7%)

LCCA Factor has Determined Low Bid 3 Times since October 2003.

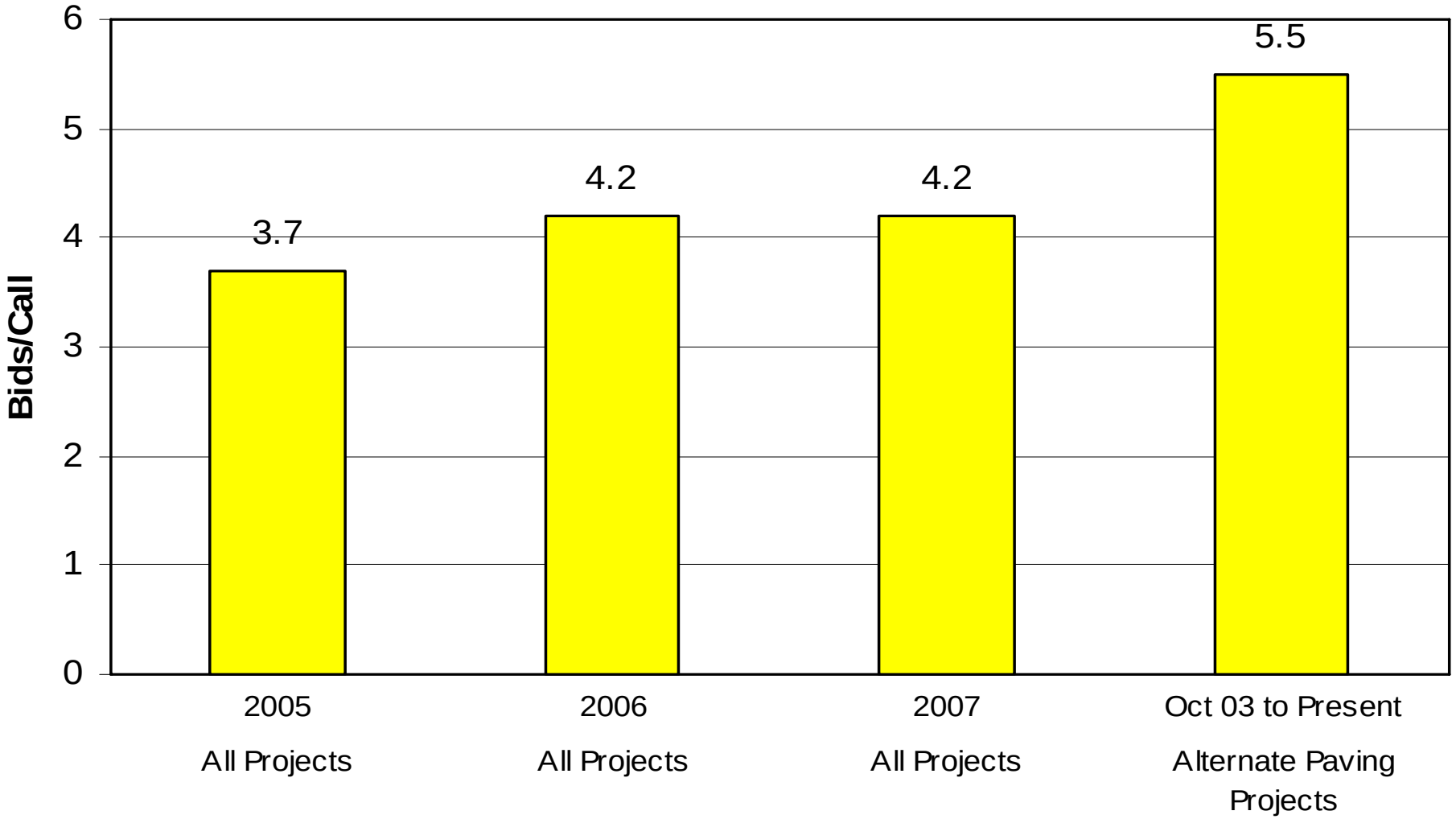
Asphalt Results – Over 2 Lane Miles



Concrete Results – Over 2 Lane Miles



Number of Bidders



Price Summaries

- 3-year average asphalt price/ton for alternate paving projects is 5.1% below that for non-alternate projects and 4.8% below the 3-year average for all projects
- 3-year average concrete price/CY for alternate paving projects is 8.6% below that for non-alternate projects and 2.8% below the 3-year average for all projects
- Optional pavement (no LCCA) for projects with less than 2-lane miles is standard where applicable

Other Alternate Bidding

- Intermediate overlays
  - 5 ¾” HMA vs.
  - 5” ‘big block’ PCC
- Thinner overlays
  - 3 ¾” HMA vs.
  - 4” ultrathin PCC

Other Alternate Bidding

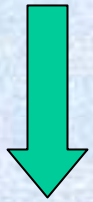
- Thin overlays
  - 1 ¾” HMA vs.
  - 1” HIR plus surface treatment

  and
  - 3 ¾” HMA vs.
  - 4” CIR plus surface treatment

Optional Shoulder Designs

- A2 design
  - 5 ¾” HMA
  - 5 ¾” PCC
- A3 design
  - 3 ¾” HMA
  - 4” PCC (also roller compacted option)

An independent third party peer review was performed in late 2005 by a respected national consultant on MoDOT's alternate pavement bidding process.



"It appears that MoDOT has developed a balanced, innovative program that could serve as a national model for other highway agencies throughout the nation and beyond."

Thank You!

Questions?

john.donahue@modot.mo.gov
(573) 526-4334