 Alternate Pavement Bidding in Missouri

2008 SES Pavement Management and Design Conference
North Little Rock, AR

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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

\[ \text{Adjustment factor} = \text{PW (future HMA rehab)} - \text{PW (future PCC rehab)} \]
Adjustment factor spreadsheet used by Central Office Estimating Section

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**Life-Cycle Cost Adjustment Worksheet**

| Job Number | 2029487 |
| County | Rancho Cucamonga |
| Route | 63 |
| Call | 040316-203 |
| Letting Date | 07/11/14 |

| Total Area of Paving | 24,132 SF |
| Area of Traveled Way | 25,000 SF |

**SP125 Weight Factor**

- 1.97 Tons/CY

**Estimated Unit Price for SP125**

| Unit | $1.23 /CY |

**Estimated Unit Price for Cost Milling**

| 5% | 20,000 TON | $1.23 /CY |

**Estimated Unit Price for Diamond Grinding**

| 10% | 20,000 TON | $1.48 /CY |

**Estimated Unit Price for Pavement Repair**

| 100.00 | SY |

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

<p>| <strong>MoDOT AC Projection</strong> |
| % or Thickness (in.) |</p>
<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Cost</th>
</tr>
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<tbody>
<tr>
<td><strong>20 Year Maintenance</strong></td>
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<tr>
<td>Discount Rate:</td>
<td>3.1604%</td>
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<tr>
<td>Mill Surface Lift Traveled Way</td>
<td>1</td>
<td>20</td>
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<tr>
<td>AC Resurfacing Traveled Way</td>
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<td>20</td>
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<tr>
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<td>20%</td>
<td>20</td>
<td>1 CY</td>
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<tr>
<td>Mobilization</td>
<td>5%</td>
<td>20</td>
<td>1 CY</td>
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<tr>
<td>Construction added costs</td>
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<td>20</td>
<td>1 CY</td>
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<tr>
<td><strong>33 Year Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount Rate:</td>
<td>3.1604%</td>
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<tr>
<td>Mill Surface Lift - all</td>
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<td>33</td>
<td>418,820 SY</td>
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<tr>
<td>AC Resurfacing (100%) - all</td>
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<td>39,752 TON</td>
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<tr>
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<td>20%</td>
<td>33</td>
<td>1 CY</td>
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<tr>
<td>Mobilization</td>
<td>5%</td>
<td>33</td>
<td>1 CY</td>
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<td>33</td>
<td>1 CY</td>
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</table>

| **Years in analysis:** | 45 |
| **Total Cost:** | $4,967,569 | $2,032,932 |
| **Equivalent Uniform Annual Cost:** | $89,037 |

**MoDOT PCC Projection**

<p>| % or Thickness (in.) |</p>
<table>
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<th>Year</th>
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<td>Discount Rate:</td>
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<td>Traveled Way Slab Replacements</td>
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<td>Diamond Grinding of Traveled Way</td>
<td>25%</td>
<td>25</td>
<td>256,781 SY</td>
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<tr>
<td>Miscellaneous</td>
<td>20%</td>
<td>25</td>
<td>1 CY</td>
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<td>Mobilization</td>
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<td>Construction added costs</td>
<td>12.9%</td>
<td>25</td>
<td>1 CY</td>
</tr>
</tbody>
</table>

| **Years in analysis:** | 45 |
| **Total Cost:** | $1,209,081 | $633,725 |
| **Equivalent Uniform Annual Cost:** | $23,725 |
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

Asphalt $/Ton

3-year Average: $49.86
3-year Non-Alt Average: $50.04
3-year Alt Average: $47.49
Concrete Results – Over 2 Lane Miles

Concrete $/CY

$140.00
$135.00
$130.00
$125.00
$120.00
$115.00

3-year Average

3-year Non-Alt Average

3-year Alt Average

$134.96
$126.85
$123.32
Number of Bidders

- 2005: All Projects - 3.7
- 2006: All Projects - 4.2
- 2007: All Projects - 4.2
- Oct 03 to Present: Alternate Paving Projects - 5.5
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 ¼” 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?

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