Special Experimental Project No. 14 (SEP-14)
Alternative Contracting Program Report

Highway Construction Contract with both Alternate Pavement Sections and
Life Cycle Cost Analysis Bid Factor

IM 15-4(125)234 I-15: Craig – Stickney Creek

Prepared February 2012

Introduction
The Montana Department of Transportation (MDT) submits this report as
required under the provisions of Special Experimental Project No. 14 (SEP-14),
for the use of alternative contracting methods. The report summarizes an
alternative contracting method developed in coordination with the Federal
Highway Administration (FHWA) - Montana Division.

This report summarizes results for a highway construction contract including
alternate rigid and flexible pavement sections. What makes this project unique is
that it was awarded to the bidder providing the lowest bid for pavement life cycle
cost, instead of lowest initial bid.

Process Overview
The steps taken to develop this alternative contract were as follows:

1. Identify a project for which rigid pavement, when compared to flexible
   pavement, is both reasonably cost competitive and has decreased future
   maintenance costs.
2. After identifying a candidate project, prepare plans and bid documents
   including both rigid and flexible pavement sections.
3. Perform a Life Cycle cost Analysis (LCCA) for both pavement options over
   a 40-year life. The purpose of the LCCA is to calculate the net present
   value (NPV) of initial construction, maintenance, and remaining service life
   (salvage costs) over the LCCA period.
4. Calculate the C-Factor. The C-Factor is the long-term cost savings
   associated with the rigid pavement option. The C-Factor is the calculated
   as follows:

   \[ C \text{-Factor} = (\text{Flexible Pavement NPV}) – (\text{Rigid Pavement NPV}) \]

5. Instruct potential flexible pavement bidders to add the C-Factor to bids
   prepared with the flexible pavement option (See Appendix A).
6. Open bids and award project to the lowest bidder. Lowest bid is the
   lowest of either the rigid pavement bid (without C-Factor) or flexible
   pavement bid (with C-Factor).
Project Description
The subject project is IM 15-4(125)234. I-15: Craig – Stickney Creek. The major work item within this project is major rehabilitation of both northbound and southbound lanes of I-15, from RP 233.5 northbound to RP 236.8. Alternate pavement sections included the following two sections:

- Flexible Section (20-year design life):

 Travel Lanes:
  
  - Mill and remove 0.50’ existing plant mix surfacing (PMS)
  - Pulverize milled surface through 0.50’ deep
  - Place 0.50’ PMS within milling trench to match existing grade. PMS includes 0.20’ Grade S and underlain with 0.30’ Hot Recycled PMS (30% recycled asphalt pavement (RAP))
  - Place chip seal

  Shoulders:
  
  - 0.20’ mill
  - 0.20’ Grade S PMS
  - Chip seal

- PCCP Section (40-year design life):

  Travel Lanes extending 1 foot into outside shoulder:
  
  - Remove 1.25’ existing PMS and base gravel
  - Place 0.50’ Crushed Aggregate Course (CAC)
  - Place 0.75’ PCCP with doweled joints to match existing grade

  Shoulders:
  
  - 0.20’ mill
  - 0.20’ Grade S PMS
  - Chip Seal
Life Cycle Cost Procedure and Project Calculations

Both flexible and rigid alternatives were evaluated using LCCA, using a 40-year service life and 2.8% discount rate. Discount rate was determined from White House Office of Budget and Management (OMB) Circular No. A-94. NPV was calculated for both options, which accounted for initial construction cost, maintenance costs, and remaining service life (salvage value) at 40 years.

The Great Falls District prepared the LCCAs and calculated the C-Factor, with general guidance and review from the Surfacing Design Unit.

The flexible pavement LCCA was estimated as follows:

<table>
<thead>
<tr>
<th>PMS Section</th>
<th>Cost ($)</th>
<th>Maintenance Type</th>
<th>Maintenance Year</th>
<th>(1+I)^n</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Construction</td>
<td>$4,992,685</td>
<td></td>
<td>0</td>
<td>1</td>
<td>$4,992,685</td>
</tr>
<tr>
<td>Maintenance #1</td>
<td>$242,155</td>
<td>Chip Seal</td>
<td>7</td>
<td>1.213254198</td>
<td>$199,591</td>
</tr>
<tr>
<td>Maintenance #2</td>
<td>$1,587,746</td>
<td>0.2&quot; O-Lay Chip Seal</td>
<td>12</td>
<td>1.392891781</td>
<td>$1,139,892</td>
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<tr>
<td>Maintenance #3</td>
<td>$1,771,698</td>
<td>0.2&quot; Mill-fill; chip seal</td>
<td>21</td>
<td>1.785892888</td>
<td>$992,052</td>
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<tr>
<td>Maintenance #4</td>
<td>$242,155</td>
<td>Chip seal</td>
<td>26</td>
<td>2.050316851</td>
<td>$118,106</td>
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<tr>
<td>Maintenance #5</td>
<td>$7,482,946</td>
<td>PMS major rehab</td>
<td>30</td>
<td>2.289778324</td>
<td>$3,267,978</td>
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<tr>
<td>Maintenance #6</td>
<td>$242,155</td>
<td>Chip seal</td>
<td>37</td>
<td>2.77808316</td>
<td>$87,166</td>
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<tr>
<td>Continued use value (10 years remaining on 20 year Design Life of Major Rehab)</td>
<td>-$3,741,473</td>
<td></td>
<td>40</td>
<td>3.01803718</td>
<td>-$1,239,704</td>
</tr>
</tbody>
</table>

Total Cost $12,820,067
Total PV $9,557,766

The rigid pavement LCCA was estimated as follows:

The initial cost of PCCP is assumed to be $45/yd². The Year 20 concrete rehabilitation consists or 2% slab replacement, diamond grind within driving lanes, and 0.20' mill/fill and chip seal upon the shoulders.

<table>
<thead>
<tr>
<th>PCCP Section (PCCP $45/SY)</th>
<th>Cost ($)</th>
<th>Type of Maintenance</th>
<th>Year of Maintenance</th>
<th>(1+I)^n</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Construction</td>
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<td>1</td>
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<tr>
<td>Maintenance #1</td>
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<td>Concrete Rehab</td>
<td>20</td>
<td>1.737249891</td>
<td>$853,520</td>
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<td>Salvage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$9,723,581</td>
<td></td>
<td></td>
<td></td>
<td>$9,094,323</td>
</tr>
</tbody>
</table>
Based upon the NPV’s shown in the above tables, the cost difference between flexible and rigid pavement alternates is $463,443 ($9,557,766 - $9,094,323 = $463,443). This is known as the “C-factor”. The C-factor is the additional cost of maintaining the flexible pavement over the 40-year LCCA period.

A short special provision including instructions for bidding the alternate pavement sections was included within the bid contract. It is attached to this report within Appendix A.

**Bidding Response**

Bids were opened October 21, 2010. Schellinger Construction and United Materials Inc. bid the project. Both Montana contractors bid the flexible surfacing option. Two bidders are not unusual for an interstate project of this size and scope. No bids for the rigid option were received. The contract was awarded to Schellinger Construction, with bids as follows:

- Schellinger Construction $6,246,724
- United Materials, Inc. $ 8,569,858

One possible benefit of bidding alternate pavement sections is lower bids for both options due to increased competition. In this case, it was hypothesized that flexible pavement bids may have been lower as a result of potential perceived competition from the rigid pavement industry. To examine this possibility, major project bid items were compared (PMS, PG binder and milling) to bid tabulations from other comparable interstate projects. This analysis showed that flexible pavement bids were similar to other interstate projects, with no clear trend showing that bidding alternate typical sections produced lower construction bids.

**Discussion and Conclusions**

This section presents lessons learned from the alternate bidding process.

*Proper Project Selection*

The most important observation is that proper project selection is crucial to alternate bidding success. More emphasis should be put on selecting candidate projects for which flexible and rigid pavement options have relatively equal initial construction costs. To identify such projects, the following items should be considered:

- New pavement construction or reconstruction. The subject project is a major rehabilitation project. Ideally, alternate sections should be considered for new pavement or reconstruction projects. These project
types require flexible pavements to have thicker base gravel sections, making rigid pavements are more cost effective.

- High ADT or heavy truck traffic loading. The subject project has only moderate truck traffic (546 daily flexible equivalent single axle loads (ESALs)). Heavier trafficked roadways require thicker asphalt surfacing, and make rigid pavements more cost effective.

- Soft subgrade soils. The subject project has moderate strength soils and a thick existing base course, resulting in a relatively thin flexible pavement design. In the future, projects with weak subgrade soils should be considered. Such projects require thicker base gravel sections for flexible pavements, and show rigid pavements to be more cost effective.

**Utilizing 30-year flexible Pavement Designs**

Rigid and flexible pavements aren’t usually cost competitive because they have markedly different service lives. MDT designs flexible pavement and rigid pavements to provide 20 and 40-year design lives, respectively. It would be more effective to design the flexible option with a 30-year design life. The additional cost of a 30-year flexible pavement would show rigid surfacing to be more cost competitive.

**Utilizing Alternate Pavement Sections during times of Liquid Asphalt Price Escalation**

The PG 70-28 liquid asphalt bid item for the subject project was $660/ton. This price is relatively low given recent past projects with PG 70-28 approaching $800/ton. Alternate pavement sections (PCCP) should receive increasing emphasis when liquid asphalt prices climb towards $800/ton. For example, current prices for PMS and PCCP are approximately $125 and $150 per cubic yard in-place, respectively. At these prices, liquid base asphalt prices must increase to $850 per ton to make PCCP cost competitive on a unit volume basis.

Unfortunately, planning for market price fluctuations can be difficult and unpredictable, especially for projects with lengthy design phases.
Appendix A: Alternate Pavement Sections Special Provision

PAVEMENT ALTERNATES [102]

A. Optional Mainline Pavements. The mainline pavement may be either portland cement concrete pavement (PCCP) or asphalt plant mix surfacing (PMS), constructed on a prepared subgrade in accordance with the contract.

B. Bid Preparation. Separate pay items, descriptions, and quantities are included in the itemized proposal for each of the two options. Items included in the PCCP option carry the designation OP1 in the Schedule of Items. Items included in the Bituminous Plant Mix carry the designation OP2 in the Schedule of Items. Only bid one of the two options. Leave the contract unit price column blank for any pay item listed for the other option.

C. Low Bid Determination. The Department will add $463,443 to the total bid when the PMS option is submitted to factor in the life cycle maintenance cost analysis of the roadway. The life cycle maintenance cost does not represent an additional payment to be made to the successful bidder and is used only for determining the low bid.

D. Bidders may submit bids using one of the two pavement options under consideration for this project. Each bidder must choose its preferred pavement option and submit only one bid. The submission of more than one bid proposal for the same work from an individual firm or corporation under the same name or from an affiliated company will result in the rejection of the bids from those bidders.

E. The basis for the added dollar value is the Department’s estimated cost difference for the future rehabilitation needs of the two pavement options over the 40-year anticipated performance for each pavement option (Life Cycle Cost Adjustment Factor).