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(129)229 I-15: Augusta Intch – Craig

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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 following report summarizes an alternative contracting method developed in coordination with the Federal Highway Administration (FHWA) - Montana Division.

This report will summarize the results of a highway construction contract that included alternate rigid and flexible pavement sections. What makes this project unique is that it was not awarded solely on the lowest initial bid, but instead was awarded to the bidder who provided the bid with the lowest pavement life cycle cost.

Process Overview

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

1. Identify a project where a rigid pavement, when compared to flexible pavement, will be both reasonably cost competitive and have 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 time period. 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-Factor = (Flexible Pavement NPV) – (Rigid Pavement NPV)

5. Instruct potential flexible pavement bidders to add the C-Factor to the bids prepared with the flexible pavement option (See Appendix A).
6. Open bids and award project to the lowest bidder. The 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(129)229 I-15: Augusta Intch – Craig. The major work item within this project is major rehabilitation of both the northbound and southbound lanes of I-15, extending from MP 229.1 northbound to MP 233.5. 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. The 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 the end of the 40-year period.

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:

PMS Section

	Cost ($)	Maintenance Type	Maintenance Year	(1+I)^n	Present Value
Initial Construction	$5,013,680		0	1	$5,013,680
Maintenance #1	$320,158	Chip Seal	7	1.2132542	$263,884
Maintenance #2	$2,366,891	0.2" O-Lay, Chip Seal	12	1.39289178	$1,699,264
Maintenance #3	$2,583,494	0.2" Mill-fill; chip seal	21	1.78589289	$1,446,612
Maintenance #4	$320,158	Chip seal	26	2.05031685	$156,150
Maintenance #5	$9,492,773	PMS major rehab	30	2.28977832	$4,145,717
Maintenance #6	$320,158	Chip seal	37	2.77808316	$115,244
Continued use value (10 years remaining on 20 year Design Life of Major Rehab)	-$4,746,387		40	3.01803718	-$1,572,673
Total Cost	$15,670,926			Total PV	$11,267,878

The rigid pavement LCCA was estimated as follows:

PCCP Section (PCCP $45/SY)

	Cost ($)	Type of Maintenance	Year of Maintenance	(1+I)^n	Present Value
Initial Construction	$9,287,699		0	1	$9,287,699
Maintenance #1	$1,851,013	Concrete Rehab	20	1.737249891	$1,065,485
Salvage					$0
Total Cost	$11,138,712			Total PV	$10,353,184

The initial cost of PCCP is assumed to be $45/yd^2. 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.

Based upon the NPV's shown in the above tables, the cost difference between flexible and rigid pavement alternates is $914,694 ($11,276,878 - $10,353,184 = $914,694). 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 also attached to this report within Appendix A.

Bidding Response

Bids were opened on July 28th, 2011. All bidders were based in Montana, and included Riverside Contracting, Schellinger Construction and Nelcon. All three contractors bid the flexible surfacing option. Three bidders is a typical number for an interstate project of this size and scope. No bids for the rigid option were received. The contract was awarded to Riverside Contracting, Inc., with bids as follows:

Riverside Contracting	$6,119,569
Schellinger Construction	$6,674,920
Nelcon Inc.	$7,449,517

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

Discussion and Conclusions

This section presents lessons learned from this process.

Proper Project Selection

Generally, the most important lesson learned is proper project selection. In the future, more emphasis should be put into selecting candidate projects where flexible and rigid pavement options have relatively equal initial construction costs. To identify these projects, the following items should be considered:

- New pavement construction or reconstruction. The subject project is a major rehabilitation project. In the future, alternate sections should be evaluated on new pavement or reconstruction projects. On these types of projects, flexible pavements require thicker base gravel sections, resulting in rigid pavements becoming more cost effective.

- High ADT or heavy truck traffic loading. The candidate project has moderate truck traffic (546 daily flexible equivalent single axle loads (ESALs)). In the future, heavier trafficked roadways should be considered. On heavy traffic roadways, a thick layer of asphalt surfacing is required, resulting in rigid pavements becoming more cost effective.

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

Utilizing 30-year flexible Pavement Designs

Rigid and flexible pavements aren't commonly cost competitive because they have markedly different service lives. Within MDT, flexible pavement and rigid pavements are designed to provide a 20 and 40-year design life, respectively. In the future, it may be more effective to design the flexible option with a 30-year design life. The additional cost of a 30-year flexible pavement may result in the rigid option being more cost competitive.

Utilizing Alternate Pavement Sections during times of Liquid Asphalt Price Escalation

The PG 70-28 liquid asphalt bid item on the subject project was $660/ton. This is relatively low considering there have been projects in the recent past where PG 70-28 approached $800/ton. In the future, more emphasis should be placed on alternate pavement sections when liquid asphalt prices climb towards $800/ton.

For example, at current prices, PMS and PCCP cost approximately $125 and $150 per cubic yard in-place, respectively. At these prices, liquid base asphalt prices would have to 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 preliminary design phases.

Appendix A: Alternate Pavement Sections Special Provision

PAVEMENT OPTIONS

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 Option OP 1 in the Schedule of Items. Items included in the Bituminous Plant Mix option carry the designation Option OP 2 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 option not being bid upon.

C. Low Bid Determination. The Department will add $914,694 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).