INDIANA DEPARTMENT OF TRANSPORTATION
Driving Indiana's Economic Growth

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Mitchell E. Daniels, Jr., Governor
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August 2, 2012

TO: Mr. Rick Marquis
Acting Division Administrator
Federal Highway Administration
575 N. Pennsylvania St., Room 254
Indianapolis, IN 46204

Mr. Jay Wasson
Deputy Commissioner
Engineering Services & Design
INDOT

FROM: Mr. David Holtz DBH 11-27-2012
Director, Pavement Engineering

SUBJECT: Special Experimental Project No. 14 (SEP-14)
2011 Annual Report for Alternate Bids on Pavement Type

Attached is a 2011 annual report of alternate bids on pavement type for fourteen (14) Experimental Projects across the State.

This report indicates that the use of alternate bids on pavement type for this experimental project attracted more bidders. This process was very successful and ultimately led to significant cost savings for the State.

If additional information is required, please contact this office.

PGP
Cc: Thomas Duncan,

Encl,

Prepared By: Mr. Pankaj Patel PGP

Concurred By: for Mr. Kumar Dave PGP

Indiana Department of Transportation
2011 Annual Report
For
Alternate Bid Process on Pavement Type Selection
July 22, 2012

A. Introduction

On November 18, 2009 the Federal Highway Administration approved the innovative contracting process of the Indiana Department of Transportation (INDOT) for alternate bids on pavement type for multiple projects. This process involved one bid with both Portland Cement Concrete Pavement (PCCP) and Hot Mix Asphalt (HMA) pavement in an "alternate pay items option" format that requires only one set of plans with both PCCP and HMA typical pavement sections. A Present Worth (PW) cost was calculated for future maintenance costs of both pavement types using an established Life Cycle Cost Analysis (LCCA) Strategy. This PW cost was added to the respective pay items option after the bid was opened, but the PW cost was only used to determine the low bidder. See attached Work Plan for SEP 14 with alternate bids on pavement type strategy and process dated November 2, 2009.

The primary reasons INDOT implemented this innovative contracting practice for alternate pavement type bidding are:

1. Attract more bidders and competition.
2. Obtain true cost savings over similar conventional bid projects.
3. Provide a more competitive market, i.e. lower bid costs on paving items using this procedure versus the standard procedure where the pavement type is pre-determined.

INDOT let fourteen (14) contracts from January 1, 2011 to December 31, 2011 with this process. Out of these fourteen (14), two (2) of them were design build and twelve (12) were design bid build. These fourteen contracts included one (1) Local Public Agency project contract. In 2011, INDOT let three (3) contracts out of fourteen (14), using an A (cost of items) + B (closure user cost) bidding component along with alternate pavement type options.

The Descriptions of the contracts are as follow:

Description of Contracts						
Route	Contract No.	Des. No.	Location	County	Letting Date	Length
PR 69	IR-33045	0500442	White River to CR 375 S (Section 2, Seg. 6)	Daviess	1/12/2011	4.35 miles
		0902205	CR 375 S to CSX RR (Section 2, Seg. 7)			5.15 miles
PR 69	IR-33633	0902202	9.8 mile N of SR 64 to 9.8 mile S of US 50 (Section 2, Seg. 5)	Pike	2/11/2011	2.85 miles
US 31	IR-28974	0600424	203rd St to 216th St	Hamilton	2/23/2011	1.26 miles
I-65	IR-30692(1,3)	0600304	0.5 mile S of CR 100E to 0.6 mile N of SR 32 (Phase-II)	Boone	4/13/2011	5.0 miles
SR 11	IR-30672	0401145	SR 11 @ I-65	Jackson	4/13/2011	0.63 mile
US 31	IR-30128	0710755	0.3 mile N of Intersection w/existing US 31	St. Joseph	4/13/2011	1.0 miles
PR 69	IR-33042	0902202	SR 61 to CR 650 (Section 2, Segment 4)	Pike	5/11/2011	3.37 miles
SR 25	IR-30845	0300694	0.42 mile E of Tipp/Carroll CL to 0.15 mile E of US 421 (Seg. 2, Ph-A)	Carroll	5/11/2011	2.84 miles
Dowling Street	R-30254(2)	0500897	200 feet W of Park Ave to US 6	Noble	5/13/2011	1.36 miles
US 31	IR-31218	0800583	0.65 mile N of CR 200 N to 0.5 mile N of CR 400 N	Howard	8/10/2011	2.10 miles
US 31	IR-30201(3)	0600438	Monon Trail to Greyhound Pass	Hamilton	9/23/2011	2.78 miles
PR 69	IR-33734(1)	0500446	US 231 to 4.1 mi N of US 231 (Section 4, Segment 1)	Greene	10/26/2011	4.5 miles
US 31	IR-30107	0600340	From 0.27 mi S of CR 500 S to 0.5 mi S of SR 26	Howard/ Tipton	11/16/2011	2.5 miles
PR 69	IR-33737(3)	0500448	SR 45 to SR 54 (Section 4, Segment 4)	Greene	12/21/2010	2.2 miles
		1006073	SR 54 to Carmichael Rd (Segment 4, Seg. 5)			2.5 miles
		1173067	SR 445 connector at SR 45 (Section 4, Seg. 6A)			1.0 mile
					Total	45.39 miles

Notes:
(1) Design Build Contracts
(2) Local Public Agency (LPA) Project
(3) A (cost of items) + B (closure user cost) Contract

B. Analysis

INDOT analyzed the design build contract bids using only the total bid amounts because these type of projects do not let using an itemized pay items format; therefore, the pavement item unit prices were not available. The estimated quantities were used to calculate PW costs for the design build contract. And the PW costs were applied to the total bid amounts.

This report analyzed the twelve (12) itemized pay items contract bids by:

1. Comparing the total bids before and after adding the PW costs.
2. Comparing some unit bid prices of unique pavement items against estimated costs, and
3. Comparing HMA items found in common section of both PCCP and HMA options to check for unbalanced bids.

Out of twelve (12) contracts, six (6) contract bids were below the engineer's estimate (both PCCP and HMA pay items) while on the other six (6) contracts one or more bids were above the estimate but low bids were below the estimate. On these twelve (12) contracts actual bid quantities were used to calculate PW costs. Bidding these contracts using one bid package (Plans, Specifications and Contract Documents with both PCCP and HMA pavement pay items options) allowed contractors who work with both types of pavements to bid on these contracts as either/or both.

Using the Mechanistic Empirical Pavement Design Guide (MEPDG) INDOT provided both PCCP and HMA pavement design thicknesses for the mainline on these projects. INDOT then utilized the FHWA "Real Cost" LCCA Software to perform LCCA with an established strategy to calculate a PW cost for both pavement types over a service life of fifty (50) years. See attached Appendix A-N for individual project Alternate Bid PW Cost Calculations. Estimated costs used to calculate the PW cost are from the data base maintained by the INDOT Office of Pavement Engineering. This data base is populated with actual historic bid costs on pavement items. In the LCCA the data from the previous five (5) years was used, this is standard procedure for INDOT. INDOT does not use a User Cost in their LCCA. Future maintenance of traffic costs was included in the calculations. See Appendix A, B, C, E, F, G, H, I, J, K, M, and N for individual project bid analysis summary for itemized pay items format contracts and Appendix D and L for Design Build project bid analysis.

INDOT is confident that enough data has been collected to compare how successful this alternate bidding for pavement type selection process is. INDOT compared the number of bidders on this process with the conventional bidding practices where the pavement type was selected ahead of the bidding and also compared it with 2010 alternate bidding process. The comparison is for work type of "New Road Construction", "Added Travel lanes", "Pavement Replacement", "Road Reconstruction", and some major "Interchange Modification" projects. The results are as follow:

1. Traditionally INDOT would receive four or five bids for conventional bidding. INDOT received on average 4.93 bidders per contract for twenty eight (28) contracts let between January 1, 2011 and December 31, 2011. By performing the alternate bid process on pavement type selection, in 2011 INDOT still received more bids than expected for both itemized pay items format (an average of 6.16 bidders per contract) and design build contracts format (an average of 5.00 bidders per contract). Overall INDOT received an average of 6.0 bidders per contract on all fourteen (14) alternate contracts.

2. To compare with 2010, INDOT received on average a little fewer bidders per contract in 2011. This reduction may be due to one or a combination of all of the following reasons:

a) In 2011 INDOT let alternate bid contracts not only on new alignment routes but also on existing alignments and/or urban areas. This was not done in 2010.
b) In 2011 INDOT let three (3) alternate bid contracts on an A+B format, cost of items (Part A) + closure user cost (Part B). Traditionally, A+B format attracts fewer bidders. A+B bidding was not done in 2010 on alternate bid contracts.
c) In 2011, INDOT let two (2) contracts as design build contracts and generally these types of contracts attract fewer bidders due to high bid amounts.

The above factors may have reduced the average compared to 2010, but still in 2011 the alternate bidding for pavement type attracted more bidders.

3. The winning bid amounts on all fourteen (14) alternate projects were below the engineer's estimate and some were substantially below the engineer's estimate. The average percentage was 21.1 below the engineer's estimate. The winning bid amounts on conventional bidding projects where the pavement type was selected ahead of the bidding were also below engineer's estimate but the average percentage was 15.4 below the engineer's estimate.

Number of and Type of Bids	Winning Bid Amounts $	Engineer's Estimate $	% Below Engineer's Estimate
28 Conventional	$346,312,239.71	$409,119,925.00	15.4
14 Alternate	$396,652,688.29	$502,582,279.72	21.1

The above comparison shows that INDOT attracted more bidders per contract for the alternate bidding process than the conventional bidding process. INDOT also received winning bid amounts that average (5.7) percent more below the engineer's estimate for the alternate bidding process than the conventional bidding process. The difference between the two bidding processes was 3.3 percent less in 2011 compare to 2010 and this may be due to one or more of the above reasons, but still INDOT considered this alternate bid process to be very successful in 2011.

INDOT met with both of the Asphalt and Concrete industry representatives and their members in 2011 for ongoing improvement to the alternate pavement type projects process in the future. Some of comments at the meetings were repeated from 2010 and INDOT included them in the 2010 report. INDOT responded to both industries 2010 comments after they were investigated and new comments were as follow:

1. INDOT specifications do not provide equivalent acceptance, structural, and surface provisions for concrete and asphalt.

   INDOT response – Structurally the HMA and PCCP pavements are designed for a fifty year life cycle so they are considered equivalent sections. As per INDOT current Standard Specification, HMA and PCCP "alternate bid" pavements accepted in the same manner as on non-alternate bid contracts. For smoothness, acceptance is based on profilograph but INDOT is currently investigating for future accepting pavement smoothness utilizing IRI.

2. The current pavement designs are not equivalent for shoulders for both pavement types.

   INDOT response - INDOT explained the design to both industries and they agreed that shoulder designs are equivalent for both pavement types. HMA industries submitted the shoulder cost and they found out that cost is the same for both pavement types.

3. Contractors desire an option to reduce the approved pavement thickness such as by proposing a stronger subgrade. This was the same comment industries made last year.

   INDOT response - INDOT investigated and found that pavement thickness will be reduced with a stronger soil foundation (higher Resilient Modulus) than the representative value given by INDOT Office of Geotechnical for weaker foundation soil. INDOT may add more options to bid in the future for different Resilient Modulus of soil associated with their pavement thickness.

4. Contractors want pay items for pavement type to be paid in SYS for both HMA and PCCP.

   INDOT response – Any change in the current pay item measurement needs to be studied for the pros and cons. This change will involve revising current QC/QA specifications that have served INDOT well for many years. This is a long term study project; INDOT is concentrating on higher priority items at this time, but will look into it for possible future changes after the study is finished.

5. Contactors want the PW cost published before bid opening so they can factor in their bid amount.

   INDOT response - With the success of this alternate bidding process INDOT is not considering publishing the PW cost prior to the bid opening at this time. The PW costs continue to be published just minutes before the bid opening. The formula and data is available for the contractors to calculate what the PW cost may be.

C. Conclusion

The primary reasons INDOT participated in this innovative contracting practice since 2009 for alternate pavement type bidding was:

1. Attract more bidders and competition.
2. Obtain true cost savings over similar conventional bid projects.
3. Provide a more competitive market, i.e. lower bid costs on paving items using this procedure versus the standard procedure where the pavement type is pre-determined.

The process was successful:

1. INDOT data indicates that more bidders were attracted and the process promotes more competitive bid prices than traditional methods.
2. Lower costs were realized than the estimates used for evaluation.
3. INDOT also received winning bid amounts that averaged 5.7 percent more below engineer's estimate for the alternate bidding process than the conventional bidding process. This clearly indicates that INDOT saved a great deal more on the alternate pavement type bid process and it also indicates that this process is most economical.

The cost savings of the individual contracts are shown on the attached appendixes. INDOT saved the tax payers on the fourteen (14) contracts approximately **$3.8M** immediately, at the bid openings, (HMA Low Bid – PCCP Low Bid) or (PCCP Low Bid – HMA Low Bid). Using the Bid Analysis amounts (after PW costs applied); INDOT saved the tax payers approximately **$10.1M** over the 50 year service life of the pavements.

If INDOT compares the average difference in percentage below the engineer's estimate for all fourteen (14) alternate bid contracts versus the conventional bid contracts, then the savings would be a much greater amount. INDOT received winning bid amounts that averaged 5.7 percent more below the engineer's estimate for the alternate bidding process than the conventional bidding process. Reference the table in section B Analysis above. The winning bid amounts for all fourteen (14) alternate bids were $396,652,688.29 and the engineer's estimate amounts were $502,582,279.72; therefore a 5.7 % difference between alternate and conventional bid for all items, INDOT saved the tax payers approximately **$28,600,000.00**. This shows that INDOT not only saved on pavement pay items, but saved on all other pay items in the contracts also. INDOT believes that this greater percentage below the engineer's estimate phenomenon for Alternate Bidding versus Conventional Bidding was because INDOT does not publish the PW cost before the bids are opened. INDOT believes that this Alternate Bid process for Pavement Type Selection may affect all the bid items in the contract based on the percentage below the engineer's estimate phenomenon.

The PW cost factor for future maintenance did impact which contractor received the contract on three (3) itemized pay item contracts out of the twelve (12). The comments received from the contractors are mostly positive and both industries support the process. Since, this process is more competitive and realizes cost savings, INDOT will continue to partner with the industries as questions and concerns develop.

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Mitchell E. Daniels, Jr., Governor
Michael W. Reed, Commissioner

November 2, 2009

TO: Mr. Robert F. Tally
Division Administrator
Federal Highway Administration
575 N. Pennsylvania St., Room 254
Indianapolis, IN 46204

THRU: Mr. Dave H. Andrewski DHA
Manager, Office of Pavement Engineering

FROM: Mr. Pankaj G. Patel PGP
Pavement Research Engineer

SUBJECT: Work Plan for Special Experimental Project No. 14 (SEP-14)
For Alternate Bids on Pavement Type

Attached is a work plan for an Experimental Project which will use alternate bids to determine the pavement type on ten (10) projects.

It should be noted that these projects have been designed based on Mechanistic Empirical Pavement Design Guide (MEPDG) for both HMA and PCCP pavement types. The pavement design will be in accordance with Chapter 52 of the Indiana Design Manual (IDM). FHWA real cost software will be used to perform Life Cycle Cost Analysis (LCCA). One set of plans will be developed for each project. The project will be bid with both HMA and PCCP in an alternate pay items options along with all other pay items of the contract. These pay items options of HMA and PCCP will compare to each other using a present worth cost. The selected projects are on the National Highway System except one which is on interstate.

If additional information is required, please contact this office.

PGP
Cc: Thomas Duncan,

Encl,

Indiana Department of Transportation

WORK PLAN
for
Special Experimental Project, SEP-14
With Alternate Bids on Pavement Type

PURPOSE

The Indiana Department of Transportation (INDOT) has scheduled ten (10) Federal-aid projects that will incorporate a choice of alternate pavement type designs, Hot Mix Asphalt (HMA) pavement or Portland Cement Concrete Pavement (PCCP). INDOT has developed an innovative procedure for the implementation of alternate pavement bidding for these projects and are processing it as an experimental feature in the use of alternate bids to determine the pavement type on the project. INDOT has actively involved the Asphalt Pavement Association of Indiana (APAI), the Indiana Chapter of the American Concrete Pavement Association (ACPA) and a representative contingent of contractors that are members of these associations in the development of this procedure. These industry representatives generally approve of utilizing this experimental process to determine if there is merit in it as a sound procedure to promote competition and provide economic benefits to the tax payers and stakeholders.

SCOPE

INDOT has selected the ten (10) projects for utilizing alternate bids to determine the pavement type. Out of these ten projects five (5) of them are on US 31 Kokomo By-Pass, one (1) on SR 25 Hoosier Heartland, one (1) each on Proposed Interstate 69 and Interstate 469, one (1) on PR 641 Terra Haute By-Pass, and one (1) on US 24 Fort to Port. All projects are on new alignment except I-469 and involve constructing new pavement. The Descriptions of the projects are as follow:

Description of Projects

Route	Des. No.	Contract No.	Location	County	Letting Date	Length
US 31	0800268	R-30108	0.5 mi S of SR 26 to 0.5 mi N of SR 26	Howard	1/13/2010	1.0 mile
US 31	0600339	R-30108	0.5 mi N of SR 26 to 1.5 mi S of SR 22/US 35	Howard	1/13/2010	1.25 miles
PR 69	0800284	R-30983	0.03 mi N of SR 68 to 1.54 mi N of SR 68	Gibson	2/10/2010	1.5 miles
SR 25	9802920	R-30840	I-65 to 0.1 mi E of CR 750 E (Seg. 1, Ph-A)	Tippecanoe	4/14/2010	4.5 miles
US 31	0800234	R-30889	0.5 mi S to 0.5 mi N of SR 22/US 35	Howard	7/7/2010	1.0 mile
US 35	9706380	R-30889	Goyer Rd to CR 300 E	Howard	7/7/2010	1.95 miles
US 24	0300291	R-30162	0.5 mi E of I-469 to 0.5 mi E of Ryan/Bruick Rd Phase-1	Allen	8/4/2010	2.5 miles
US 31	0600340	R-30107	CR 550 N to 0.5 mi S of SR 26	Howard/ Tipton	7/20/2011	2.5 miles
PR 641	0200305	R-30091	1600 ft N of SR 46/Riley Rd to I-70 (Ph-IVA)	Vigo	4/11/2012	1.0 mile
I-469	0400603	R-30314	0.7 mi W of SR 1 to 0.5 mi E of US 27	Allen	10/7/2011	6.55 miles

INDOT will submit all documentation required for a complete evaluation under SEP14. The schedule of the projects bid letting varies.

The INDOT Alternate Pavement Bidding procedure is a non-traditional construction contracting technique which deviates from the competitive bidding provisions in 23 USC 112. INDOT expects to evaluate this procedure by measuring three (3) benefits from the process:

1. Attract more bidders and competition.
2. Obtaining true cost savings over similar conventional bid projects.
3. Provide a more competitive market, i.e. lower bid costs on paving items using this procedure versus the standard procedure where the pavement type is pre-determined.

SCHEDULE

The contract will be advertised approximately four weeks prior to the letting date of a respective project. The target for award date will be one week after the letting date. The date for work to proceed will be approximately two weeks after the award date. The target for completion of construction for each project will be determined at a later time closer to the letting date.

MEASURES

The project will be evaluated to determine if the low bid alternate was the same alternate determined to be most economical by INDOT's standard Pavement Type Selection (PTS) process. INDOT will also evaluate the process for its success in attracting more bidders than under the conventional bidding method.

INDOT will compare each bid to the appropriate estimated alternate design, and review all bids to determine whether there were irregularities associated with this bidding process. There will be no adjustments made to the method of payment for either asphalt or concrete. Concrete pavements are paid by the square yard with cores taken to determine the thickness. Asphalt pavements are paid by the ton and the contractor is required to place the material at the proper rate to achieve the specified thickness, density, air voids, and VMA.

The successful low bid will be evaluated to determine if alternate bidding provides true cost savings to the State. The bids received will be evaluated to determine if alternate bidding is providing a more competitive market, such that lower bid costs on all items are being received than on like projects on which the pavement type was specified. The evaluation will also include the industry's comments on the alternate bidding process.

PROPOSED BIDDING PROCEDURE

1) INDOT uses Mechanistic Empirical Pavement Design Guide (MEPDG) software to design HMA and PCCP pavements.
2) One set of plans will be developed for each project with both HMA and PCCP typical section. The project will be bid with both HMA and PCCP in an alternate pay items options. The separate pay items options for the HMA and PCCP alternates will include all pay items for the contract.

3) INDOT will use FHWA real cost software to perform Life Cycle Cost Analysis (LCCA) on the pavement designs for both HMA pavement and PCCP.
4) Both HMA pavement and PCCP will be analyzed for a 50 year service life. The strategy for LCCA is as follows:

HMA Pavement:

a) 20 Year Design
b) Joint Seal at year 3, 6, 9, 12, 15, & 18
c) At year 20 Functional Overlay and cost of items as follow:
    1) 1" mill on Travel Lanes and Inside and Outside shoulder
    2) Overlay on Travel lanes and inside shoulder (same pay items) with 1.5" Surface on 2.5" Intermediate.
    3) Overlay on Outside shoulder with 1.5" Surface on 2.5" Intermediate.
    4) Traffic Maintenance (5%).
d) Joint Seal at year 23, 26, 29, & 32
e) At year 35 mill and resurface and cost of items as follow:
    1) 1" mill on Travel Lanes and Inside and Outside shoulder.
    2) Overlay on Travel lanes and inside shoulder (same pay items) with1.5" Surface.
    3) Overlay on Outside shoulder with 1.5" Surface.
    4) Traffic Maintenance (5%).
f) Joint Seal at year 38, 41, 44, & 47
g) At year 50 salvage value $0.00.

PCCP:

a) 30 year Design
b) Joint Seal at year 8, 16, and 24
c) At year 30 Functional Overlay and cost of items as follow:
    1) Profile Scarify mill PCCP on Travel Lanes.
    2) Profile Scarify mill on Inside and Outside HMA shoulder.
    3) Full depth PCCP patch on Travel Lanes about 1.5% of the area.
    4) Overlay on Travel lanes and inside shoulder (same pay items) with 1.5" Surface on 2.5" Intermediate.
    5) Overlay on Outside shoulder with 1.5" Surface on 2.5" Intermediate.
    6) Traffic Maintenance (5%).
d) Joint Seal at year 33, 36, & 39
e) At year 42 mill and resurface and cost of item as follow:
    1) 1" mill on Travel Lanes and Inside and Outside shoulder.
    2) Full depth patch on Travel Lanes about 0.75% of the area.
    3) Overlay on Travel lanes and inside shoulder (same pay items) with 1.5" Surface.
    4) Overlay on Outside shoulder with 1.5" Surface.
    5) Traffic Maintenance (5%).
f) Joint Seal at year 45 & 48
g) At year 50 salvage value $0.00.

INDOT uses a 4.0% Discount Rate, No user cost, and No future miscellaneous cost associated with rehabilitation of pavement contracts such as sign, guardrail, etc. Both the Asphalt and Concrete Pavement industries participated in the development of the 50 year service life pavement strategies that INDOT uses; however, both believe that treatment life and year of application need to continue to be monitored

5) Cost of the items for both HMA pavement and PCCP will come from the data base maintained by the Office of Pavement Engineering as unit price averages.
6) Pavement design and LCCA will yield two Present Worth (PW) Costs, one for HMA pavement and one for PCCP.
7) Both pay item options will be compared to each other with pay item option amount plus present worth cost as follows:

HMA Pay Item Option =	**HMA Pavement pay item option Amount + PW of Future HMA Rehabilitation**
PCCP Pay Item Option =	**PCCP pay item option Amount + PW of Future PCCP Rehabilitation**

Winner Bid = Lower of HMA Pay Item Option versus Lower of PCCP Pay Item Option

The winner Bid with lower pay item option will be executed for that type pavement. This procedure will be published when the solicitation for bids is advertised. The PW of Future HMA Rehab and PW of Future PCCP Rehab will not be published until the bid is opened.

REPORTING

INDOT will prepare and submit to FHWA an initial and final report on the project. The initial report will include the paving industries' reaction to the alternate bid for pavement type selection process. It will also contain the letting procedures, individual pavement pay items, quantities, and cost for the work as well as the life cycle cost procedures and estimated costs. The initial report will be issued within six (6) month of the individual project letting.

INDOT will prepare and submit to FHWA a final report at the completion of the individual project construction and when the contract is finalized. The final report will contain an overall evaluation of the process along with any suggestions and recommendations for improving the process. Additional information will be obtained and included in the final report in regard to the feasibility of this type of procedure being utilized on future projects. The advantages and disadvantages of this type of bidding process from both the INDOT’s and Industries’ points of view will be evaluated further.

Appendix A

PR 69 (IR-33045)

Seven (7) contractors participated in the bidding and all bids were substantially below the engineer's estimate. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. All 7 contractors participated in the PCCP option and none of the contractors participated in the HMA option. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. PR 69 mainline
   a. 11 inches of PCCP or
   b. 13.5 inches of HMA

2. US 50 Ramps
   a. 9.5 inches of PCCP or
   b. 10 inches of HMA.

3. US 50 mainline
   a. 10 inches of PCCP or
   b. 12.5 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$23,591,617.04	+	$3,919,178.39	+	$75,215,629,02	=	$102,726,424.50
B	$24,188,987.57	+	$3,919,178.39	+	$77,432,973.21	=	$105,541,139.20
C	$23,304,297.95	+	$3,919,178.39	+	$79,928,401.64	=	$107,151,877.98
D	$26,297,594.68	+	$3,919,178.39	+	$79,424,349.63	=	$109,644,122.70
E	$26,360,989.65	+	$3,919,178.39	+	$82,186,809.93	=	$112,466,977.97
F	$23,304,297.95	+	$3,919,178.39	+	$91,462,079.67	=	$118,685,556.01
G	$24,542,054.40	+	$3,919,178.39	+	$99,045,370.61	=	$127,506,603.40

Since, none of the contractor bid HMA option, Bidder A's (PCCP option) PCCP pay items and common pay items was low bid amount after adding PCCP PW cost. PCCP pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA PCCP, 11 IN.	267,182 yd^2	$29.88	$24.00	$24.00 - $32.49	$26.55	PCCP
QC/QA PCCP, 10 IN.	33,940 yd^2	$28.50	$25.00	$24.00 - $32.00	$27.57	PCCP
QC/QA PCCP, 9.5 IN.	23,375 yd^2	$27.87	$24.41	$23.00 - $30.20	$26.26	PCCP
Subbase for PCCP	91,809 yd^3	$30.64	$34.00	$34.00 - $43.8	$37.40*	PCCP
D-1 Contraction Joint	180,671 ft	$8.71	$10.00	$8.00 - $10.00	$9.05	PCCP

* All Bidders were higher on this pay item.

The above table shows that pavement item bids on PCCP are lower than the estimates used in evaluation except "subbase for PCCP", on this item all bidder were higher than the estimate. "D-1 Contraction Joint" average bid pay item is higher than the estimate but still within bidder range of the estimate used. This indicates that a true cost savings was realized by INDOT in this process.

The table below compares some of the HMA items on the common section of the contract to check for unbalanced bids. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid[2]**
HMA Surface, Type A	5,729 TON	$50.00	$50.00 - $81.40[1]	$59.63	PCCP
HMA Surface, Type B	665 TON	$65.00	$61.00 - $84.00[1]	$69.00	PCCP
HMA Intermediate, Type A	10,738 TON	$40.00	$40.00 - $71.50[1]	$50.50	PCCP
HMA Intermediate, Type B	1,117 TON	$50.00	$50.00 - $77.00[1]	$57.57	PCCP

Note:

1) Bidder F was higher on all common HMA items.
2) These common items were for both HMA and PCCP options but no contractor participated in HMA option.

Conclusion

Since, none of the contractors participated in the HMA option, INDOT did not realize any savings by comparing the HMA and PCCP bids, immediately after the bid opening. However after using the PW cost factor (difference between HMA PW cost ($6,234,874.21) minus PCCP PW cost ($3,919,178.39)), INDOT saved the tax payers approximately $2,295,695.82 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $20,000.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bid and which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

I-69 (IR-33045)

PW of HMA Section = $6,234,874.21

PW of PCCP Section = $3,919,178.39

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	332,663.00	295,736.20
6	Joint Seal	332,663.00	262,908.40
9	Joint Seal	332,663.00	233,724.61
12	Joint Seal	332,663.00	207,780.33
15	Joint Seal	332,663.00	184,715.96
18	Joint Seal	332,663.00	164,211.81
20	Mill and Functional Overlay	7,226,373.00	3,298,022.31
23	Joint Seal	332,663.00	134,970.14
26	Joint Seal	332,663.00	119,987.96
29	Joint Seal	332,663.00	106,668.86
32	Joint Seal	332,663.00	94,828.23
35	Mill and Resurface	3,464,031.00	877,839.05
38	Joint Seal	332,663.00	74,944.13
41	Joint Seal	332,663.00	66,625.06
44	Joint Seal	332,663.00	59,229.43
47	Joint Seal	332,663.00	52,654.75
Total HMA PW Cost			$6,234,847.21

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	379,407.00	277,228.98
16	Reseal the Joint	379,407.00	202,568.50
24	Reseal the Joint	379,407.00	148,014.82
30	Mill and Functional Overlay	7,317,331.00	2,256,069.75
33	Joint Seal	332,663.00	91,180.99
36	Joint Seal	332,663.00	81,059.57
39	Joint Seal	332,663.00	72,061.66
42	Mill and Resurface	3,548,817.00	683,413.19
45	Joint Seal	332,663.00	56,951.38
48	Joint Seal	332,663.00	50,629.57
Total PCCP PW Cost			$3,919,178.39

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost	Alternative 1: 11 inches PCCP		Alternative 2: 13.5 inches HMA	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$13,667.68*	*$0.00*	*$15,347.69*	*$0.00*
Present Value	**$3,919.18**	**$0.00**	**$6,234.85**	**$0.00**
EUAC	$182.44	$0.00	$290.23	$0.00

Lowest Present Value Agency Cost	**Alternative 1: 11 inches PCCP**
Lowest Present Value User Cost	**Alternative 1: 11 inches PCCP**

Expenditure Stream

Year	Alternative 1: 11 inches PCCP		Alternative 2: 13.5 inches HMA	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$332.66	
4				
5				
6			$332.66	
7				
8	$379.41			
9			$332.66	
10				
11				
12			$332.66	
13				
14				
15			$332.66	
16	$379.41			
17				
18			$332.66	
19				
20			$7,226.37	
21				
22				
23			$332.66	
24	$379.41			
25				
26			$332.66	
27				
28				
29			$332.66	
30	$7,317.33			
31				
32			$332.66	
33	$332.66			
34				
35			$3,464.03	
36	$332.66			
37				
38			$332.66	
39	$332.66			
40				
41			$332.66	
42	$3,548.82			
43				
44			$332.66	
45	$332.66			
46				
47			$332.66	
48	$332.66			
49				
50				

Appendix B

PR 69 (IR-33633)

Six (6) contractors participated in the bidding and all bids were below the engineer's estimate. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. All 6 contractors participated in the PCCP option and none of the contractors participated in the HMA option. There was a third section in this bid that was comprised of the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. PR 69 mainline
    a. 11 inches of PCCP or
    b. 13.5 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$7,937,643.15	+	$961,275.73	+	$16,701,352.10	=	$25,600,270.98
B	$8,021,335.80	+	$961,275.73	+	$16,938,656.20	=	$25,921,267.73
C	$8,643,799.30	+	$961,275.73	+	$17,093,079.09	=	$26,698,154.12
D	$8,706,567.00	+	$961,275.73	+	$17,187,891.00	=	$26,855,733.73
E	$7,942,023.95	+	$961,275.73	+	$18,549,922.10	=	$27,453,221.78
F	$8,925,072.33	+	$961,275.73	+	$18,639,925.25	=	$28,526,273.31

Since, none of the contractor bid HMA option, Bidder A's (PCCP option) PCCP pay items and common pay items was low bid amount after adding PCCP PW cost. PCCP pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA PCCP, 11 IN.	81,220 yd^2	$28.06	$25.00	$22.75 - $27.04	$25.28	PCCP
Subbase for PCCP	24,991 yd^3	$30.78	$33.00	$31.20 - $39.00	$33.33*	PCCP
D-1 Contraction Joint	45,786 ft	$9.04	$10.00	$10.00 - $11.44	$10.65*	PCCP

* All Bidders were higher on this pay items.

The above table shows that pavement item bids on PCCP are not lower than the estimates used in evaluation except "QC/QA PCCP 11 IN.", on this item all bidder were lower than the estimate. "Subbase for PCCP" and "D-1 Contraction Joint" average bid pay item is higher than the estimate but still overall the total PCCP pay items cost is lower than the estimate. This indicates that a true cost savings was realized by INDOT in this process.

The table below compares some of the HMA items on the common section of the contract to check for unbalanced bids. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid[2]**
HMA Surface, Type A	1,239 TON	$55.00	$55.00 - $85.00[1]	$62.03	PCCP
HMA Intermediate, Type A	1,945 TON	$52.00	$52.00 - $81.00[1]	$57.68	PCCP

Note:

1) Bidder B was higher on all common HMA items.
2) These common items were for both HMA and PCCP options but no contractor participated in HMA option.

Conclusion

Since, none of the contractors participated in the HMA option; INDOT did not realize any savings immediately by comparing HMA and PCCP bids, at the bid opening. However after using the PW cost factor (difference between HMA PW cost ($1,552,043.59) minus PCCP PW cost ($961,275.73)), INDOT saved the tax payers approximately $584,767.86 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $6,000.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bid and which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

I-69 (IR-33633)

PW of HMA Section = $1,552,043.59

PW of PCCP Section = $961,275.73

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	88,483.50	78,661.51
6	Joint Seal	88,483.50	69,929.80
9	Joint Seal	88,483.50	62,167.33
12	Joint Seal	88,483.50	55,266.53
15	Joint Seal	88,483.50	49,131.75
18	Joint Seal	88,483.50	43,677.94
20	Mill and Functional Overlay	1,749,552.18	798,472.78
23	Joint Seal	88,483.50	35,900.09
26	Joint Seal	88,483.50	31,915.05
29	Joint Seal	88,483.50	28,372.36
32	Joint Seal	88,483.50	25,222.92
35	Mill and Resurface	812,541.70	205,910.64
38	Joint Seal	88,483.50	19,934.04
41	Joint Seal	88,483.50	17,721.29
44	Joint Seal	88,483.50	15,754.16
47	Joint Seal	88,483.50	14,005.39
Total HMA PW Cost			$1,552,043.59

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	96,150.60	70,256.30
16	Reseal the Joint	96,150.60	51,335.59
24	Reseal the Joint	96,150.60	37,510.41
30	Mill and Functional Overlay	1,776,520.81	547,734.53
33	Joint Seal	88,483.50	24,252.81
36	Joint Seal	88,483.50	21,560.66
39	Joint Seal	88,483.50	19,167.35
42	Mill and Resurface	835,223.53	160,843.11
45	Joint Seal	88,483.50	15,148.23
48	Joint Seal	88,483.50	13,466.73
Total PCCP PW Cost			$961,275.73

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Total Cost				
	Alternative 1: 11 inches PCCP		Alternative 2: 13.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$3,342.61*	*$0.00*	*$3,800.85*	*$0.00*
Present Value	**$961.27**	**$0.00**	**$1,552.04**	**$0.00**
EUAC	$44.75	$0.00	$72.25	$0.00
Lowest Present Value Agency Cost		Alternative 1: 11 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 11 inches PCCP		

Expenditure Stream				
	Alternative 1: 11 inches PCCP		Alternative 2: 13.5 inches HMA	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$88.48	
4				
5				
6			$88.48	
7				
8	$96.15			
9			$88.48	
10				
11				
12			$88.48	
13				
14				
15			$88.48	
16	$96.15			
17				
18			$88.48	
19				
20			$1,749.55	
21				
22				
23			$88.48	
24	$96.15			
25				
26			$88.48	
27				
28				
29			$88.48	
30	$1,776.52			
31				
32			$88.48	
33	$88.48			
34				
35			$812.54	
36	$88.48			
37				
38			$88.48	
39	$88.48			
40				
41			$88.48	
42	$835.22			
43				
44			$88.48	
45	$88.48			
46				
47			$88.48	
48	$88.48			
49				
50				

Appendix C

US 31 (IR-28974)

Six (6) contractors participated in the bidding (6 PCCP options and 4 HMA options were bid) and all bids were substantially below the engineer's estimate. Four (4) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. US 31 mainline
    a. 10.5 inches of PCCP or
    b. 12.5 inches of HMA

2. SR 38 Ramps
    a. 10.5 inches of PCCP or
    b. 12.5 inches of HMA.

Bid Analysis Summary

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$2,899,968.25	+	$871,316.37	+	$16,702,484.14	=	$20,473,768.76
B	$2,989,653.60	+	$871,316.37	+	$16,775,835.78	=	$20,636,805.75
C	$3,143,082.56	+	$871,316.37	+	$16,972,037.02	=	$20,986,435.95
F	$3,303,074.75	+	$871,316.37	+	$17,259,968.31	=	$21,434,359.43

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
B	$3,493,306.93	+	$562,647.03	+	$16,775,835.78	=	$20,831,789.64
A	$3,631,538.61	+	$562,647.03	+	$16,702,484.14	=	$20,896,669.78
C	$3,474,751.54	+	$562,647.03	+	$16,972,037.02	=	$21,009,435.59
D	$3,505,608.35	+	$562,647.03	+	$17,226,555.59	=	$21,294,810.97
E	$3,619,726.25	+	$562,647.03	+	$17,358,754.27	=	$21,541,127.55
F	$3,750,988.31	+	$562,647.03	+	$17,259,968.31	=	$21,573,603.65

The low bid amount, out of all 6 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, HMA option was the low bid (Bidder A). HMA pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA-HMA, 4, 76, Surface	5,059 TON	$68.00	$69.00	$69.00 - $79.00*	$75.60	HMA
QC/QA-HMA, 4, 76, Intermediate	8,411 TON	$52.80	$46.00	$46.00 - $58.00*	$51.22	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	8,411 TON	$50.20	$47.00	$47.00 - $54.00	$50.00	HMA
QC/QA-HMA, 4, 64, Base	20,111 TON	$45.40	$42.00	$41.10 - $50.00*	$44.78	HMA
QC/QA PCCP, 10.5 IN.	61,005 yd^2	$27.39	$29.50	$28.81 - $33.00	$30.38	PCCP
Subbase for PCCP	16,088 yd^3	$30.78	$30.5	$29.00 - $31.00	$29.75	PCCP
D-1 Contraction Joint	31,296 ft	$9.04	$11.05	$9.00 - $12.00	$10.39	PCCP

* Bidder F was higher on these HMA items.

The above table shows that average bid cost and low bid cost of pavement items on HMA bids are lower than the estimates used in evaluation except for one, but on PCCP all items are higher than the estimates except for one. This indicates that a true cost savings was realized by INDOT in this process.

The table below compares some of the HMA items on the common section of the contract to check for unbalanced bids. All low bid cost of items was close to the average bid cost items except for a few where bidder F was higher on these items. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
HMA, Surface, Type A	1,245 TON	58.00	$58.00 - $70.00*	$65.58	Both
HMA, Surface, Type B	1,345 TON	52.00	$52.00 - $68.00*	$62.07	Both
HMA, Surface, Type C	1,306 TON	65.00	$63.00 - $68.00*	$64.36	Both
HMA, Intermediate, Type A	2,068 TON	$52.00	$50.00 - $56.00	$53.42	Both
HMA, Intermediate, Type C	2,172 TON	$44.00	$44.00 - $50.00*	$47.00	Both
HMA, Base, Type B	2,079 TON	$50.00	$45.00 - $50.00	$46.47	Both
HMA, Base, Type C	5,194 TON	$51.00	$42.00 - $51.00	$45.17	Both

Conclusion

INDOT did realize a savings of $632,690.32 immediately, at the bid opening, Bidder B's amount (PCCP Low Bid + common section) – Bidder A's amount (HMA Low Bid + common section). Using the Bid Analysis amounts (after PW costs applied), INDOT saved the tax payers approximately $324,020.88 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $34,000.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bid and which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

US 31 (IR-28974)

PW of HMA Section = $871,316.37

PW of PCCP Section = $562,647.03

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	47,050.50	41,827.72
6	Joint Seal	47,050.50	37,184.69
9	Joint Seal	47,050.50	33,057.06
12	Joint Seal	47,050.50	29,387.60
15	Joint Seal	47,050.50	26,125.47
18	Joint Seal	47,050.50	23,225.45
20	Mill and Functional Overlay	1,007,286.35	459,712.34
23	Joint Seal	47,050.50	19,089.63
26	Joint Seal	47,050.50	16,970.61
29	Joint Seal	47,050.50	15,086.81
32	Joint Seal	47,050.50	13,412.12
35	Mill and Resurface	475,067.48	120,389.45
38	Joint Seal	47,050.50	10,599.79
41	Joint Seal	47,050.50	9,423.18
44	Joint Seal	47,050.50	8,377.17
47	Joint Seal	47,050.50	7,447.27
Total HMA PW Cost			$871,316.37

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	65,721.60	48,022.13
16	Reseal the Joint	65,721.60	35,089.30
24	Reseal the Joint	65,721.60	25,639.41
30	Mill and Functional Overlay	1,007,475.52	310,623.51
33	Joint Seal	47,050.50	12,896.27
36	Joint Seal	47,050.50	11,464.74
39	Joint Seal	47,050.50	10,192.11
42	Mill and Resurface	485,544.83	93,503.76
45	Joint Seal	47,050.50	8,054.97
48	Joint Seal	47,050.50	7,160.84
Total PCCP PW Cost			$562,647.03

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 12.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$1,925.34*	*$0.00*	*$2,141.05*	*$0.00*
Present Value	**$562.63**	**$0.00**	**$871.31**	**$0.00**
EUAC	$26.19	$0.00	$40.56	$0.00
Lowest Present Value Agency Cost		Alternative 1: 10.5 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 10.5 inches PCCP		

Expenditure Stream				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 12.5 inches HMA	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$47.05	
4				
5				
6			$47.05	
7				
8	$65.72			
9			$47.05	
10				
11				
12			$47.05	
13				
14				
15			$47.05	
16	$65.72			
17				
18			$47.05	
19				
20			$1,007.29	
21				
22				
23			$47.05	
24	$65.72			
25				
26			$47.05	
27				
28				
29			$47.05	
30	$1,007.47			
31				
32			$47.05	
33	$47.05			
34				
35			$475.07	
36	$47.05			
37				
38			$47.05	
39	$47.05			
40				
41			$47.05	
42	$485.54			
43				
44			$47.05	
45	$47.05			
46				
47			$47.05	
48	$47.05			
49				
50				

Appendix D

I-65 (IR-30692)

This project was bid as a design build contract. INDOT received three (3) bids (3 PCCP options and 1 HMA option) and all bids were substantially below the engineer's estimate. One (1) contractor participated in both pavement type HMA and PCCP options. All contractors had the option to bid either HMA section or PCCP section or both. The low bidder was determined from:

1. Bid of HMA section + PW cost of HMA or
2. Bid of PCCP section + PW cost of PCCP.

INDOT provided the following pavement design thickness for this project:

1) I-65 mainline
   a. 14.5 inches of PCCP or
   b. 16.5 inches of HMA

2) SR 32 and SR 39 Ramps
   a. 10.5 inches of PCCP or
   b. 12.5 inches of HMA.

3) CR 100 E Ramps
   a. 9 inches of PCCP or
   b. 12.5 inches of HMA

Bid Analysis Summary

PCCP Option

Bidders	Initial Bid		PW Cost for PCCP		Bid Analysis
A	$41,455,610.00	+	$2,586,127.64	=	$44,041,737.64
B	$44,049,790.00	+	$2,586,127.64	=	$46,635,917.64
C	$49,132,070.39	+	$2,586,127.64	=	$51,718,198.03

HMA Option

Bidders	Initial Bid		PW Cost for HMA		Bid Analysis
B	$42,309,690.00	+	$3,359,261.45	=	$45,668,951.45

The low bid amount, out of all 3 bids, was for PCCP option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, PCCP option was the low bid (Bidder A). PCCP option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT is unable to compare the estimated cost of pavement pay items with actual low bid costs of both HMA and PCCP pavement types since this contract was not let as an itemized proposal. All other pavement types such as “S”-lines in the bids were common to both pavement options.

Conclusion

INDOT saved the tax payers approximately $833,700.00 immediately, at the bid opening, (HMA Low Bid – PCCP Low Bid). Using the Bid Analysis amounts (after PW costs applied); INDOT saved the tax payers approximately $1,606,833.81 over the 50 year service life of the pavement. These savings include the reduction of INDOT’s consultant cost of $20,380.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bids and which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

IR-30692 (I-65 & Ramps)

PW of HMA Section = $3,359,261.45 ($3,096,003.50 + $263,257.95)

PW of PCCP Section = $2,586,127.64 ($2,407,069.54 + $179,058.10)

1) PW of Future Maintenance of the Pavement I-65 (Mainline & Shoulders)

PW of HMA Section = $3,096,003.50

PW of PCCP Section = $2,407,069.54

2) PW of Future Maintenance of the Pavement Ramps (SR 32, SR 39, and CR 100 E)

PW of HMA Section = $263,257.95

PW of PCCP Section = $179,058.10

I-65 Mainline and Shoulders HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	196,406.70	174,604.84
6	Joint Seal	196,406.70	155,223.07
9	Joint Seal	196,406.70	137,992.74
12	Joint Seal	196,406.70	122,675.05
15	Joint Seal	196,406.70	109,057.67
18	Joint Seal	196,406.70	96,951.87
21	Joint Seal	196,406.70	86,189.86
24	Joint Seal	196,406.70	76,622.47
25	Mill and Functional Overlay	4,050,665.50	1,519,472.69
28	Joint Seal	196,406.70	65,497.21
31	Joint Seal	196,406.70	58,226.78
34	Joint Seal	196,406.70	51,763.40
37	Joint Seal	196,406.70	46,017.47
40	Mill and Resurface	1,848,171.54	384,953.88
43	Joint Seal	196,406.70	36,368.28
46	Joint Seal	196,406.70	32,331.26
49	Joint Seal	196,406.70	28,742.38
50	Salvage Value	-616,060.00	-86,687.41
Total HMA PW Cost			$3,096,003.50

I-65 Mainline and Shoulders PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	350,324.24	255,978.49
16	Reseal the Joint	350,324.24	187,040.98
24	Reseal the Joint	350,324.24	136,669.01
30	Mill and Functional Overlay	4,065,424.43	1,253,446.25
33	Joint Seal	196,406.70	53,833.93
36	Joint Seal	196,406.70	47,858.17
39	Joint Seal	196,406.70	42,545.74
42	Mill and Resurface	1,901,495.67	366,180.40
45	Joint Seal	196,406.70	33,624.52
48	Joint Seal	196,406.70	29,892.07
Total PCCP PW Cost			$2,407,069.54

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

SR 32, SR 39, and CR 100 E Ramps HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	14,114.10	12,547.38
6	Joint Seal	14,114.10	11,154.58
9	Joint Seal	14,114.10	9,916.38
12	Joint Seal	14,114.10	8,815.63
15	Joint Seal	14,114.10	7,837.06
18	Joint Seal	14,114.10	6,967.12
20	Mill and Functional Overlay	305,944.61	139,629.13
23	Joint Seal	14,114.10	5,726.46
26	Joint Seal	14,114.10	5,090.80
29	Joint Seal	14,114.10	4,525.71
32	Joint Seal	14,114.10	4,023.34
35	Mill and Resurface	143,128.39	36,270.95
38	Joint Seal	14,114.10	3,179.70
41	Joint Seal	14,114.10	2,826.74
44	Joint Seal	14,114.10	2,512.96
47	Joint Seal	14,114.10	2,234.02
Total HMA PW Cost			$263,257.95

SR 32, SR 39, and CR 100 E Ramps PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	25,289.43	18,478.74
16	Reseal the Joint	25,289.43	13,502.23
24	Reseal the Joint	25,289.43	9,865.95
30	Mill and Functional Overlay	305,063.88	94,056.89
33	Joint Seal	14,114.10	3,868.59
36	Joint Seal	14,114.10	3,439.16
39	Joint Seal	14,114.10	3,057.40
42	Mill and Resurface	146,564.90	28,224.73
45	Joint Seal	14,114.10	2,416.31
48	Joint Seal	14,114.10	2,148.09
Total PCCP PW Cost			$179,058.10

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (I-65)				
	Alternative 1: 14.5 inches PCCP		Alternative 2: 16.5 inches HMA (SMA)	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$7,999.92*	*$0.00*	*$8,228.87*	*$0.00*
Present Value	**$2,407.07**	**$0.00**	**$3,096.00**	**$0.00**
EUAC	$112.05	$0.00	$144.12	$0.00
Lowest Present Value Agency Cost		Alternative 1: 14.5 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 14.5 inches PCCP		

Expenditure Stream				
	Alternative 1: 14.5 inches PCCP		Alternative 2: 16.5 inches HMA (SMA)	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$196.41	
4				
5				
6			$196.41	
7				
8	$350.32			
9			$196.41	
10				
11				
12			$196.41	
13				
14				
15			$196.41	
16	$350.32			
17				
18			$196.41	
19				
20				
21			$196.41	
22				
23				
24	$350.32		$196.41	
25			$4,050.67	
26				
27				
28			$196.41	
29				
30	$4,065.42			
31			$196.41	
32				
33	$196.41			
34			$196.41	
35				
36	$196.41			
37			$196.41	
38				
39	$196.41			
40			$1,848.17	
41				
42	$1,901.49			
43			$196.41	
44				
45	$196.41			
46			$196.41	
47				
48	$196.41			
49			$196.41	
50			($616.06)	

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (Ramps)				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 12.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$598.06*	*$0.00*	*$646,.67*	*$0.00*
Present Value	**$179.06**	**$0.00**	**$263.26**	**$0.00**
EUAC	$8.34	$0.00	$12.25	$0.00
Lowest Present Value Agency Cost		Alternative 1: 10.5 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 10.5 inches PCCP		

Expenditure Stream				
	Alternative 1: 10.5 inches PCCP		**Alternative 2: 12.5 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$14.11	
4				
5				
6			$14.11	
7				
8	$25.29			
9			$14.11	
10				
11				
12			$14.11	
13				
14				
15			$14.11	
16	$25.29			
17				
18			$14.11	
19				
20			$305.94	
21				
22				
23			$14.11	
24	$25.29			
25				
26			$14.11	
27				
28				
29			$14.11	
30	$305.06			
31				
32			$14.11	
33	$14.11			
34				
35			$143.13	
36	$14.11			
37				
38			$14.11	
39	$14.11			
40				
41			$14.11	
42	$146.56			
43				
44			$14.11	
45	$14.11			
46				
47			$14.11	
48	$14.11			
49				
50				

Appendix E

SR 11 (IR-30672)

Five (5) contractors participated in the bidding (3 PCCP options and 5 HMA options were bid) and all bids were substantially below the engineer's estimate. Three (3) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. SR 11 mainline
    a. 11 inches of PCCP or
    b. 11 inches of HMA

Bid Analysis Summary

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$636,684.15	+	$200,881.00	+	$486,917.47	=	$1,324,482.62
B	$596,316.30	+	$200,881.00	+	$551,501.93	=	$1,348,699.23
C	$692,533.23	+	$200,881.00	+	$616,634.67	=	$1,510,048.90
D	$744,779.80	+	$200,881.00	+	$572,212.20	=	$1,517,873.00
E	$939,036.70	+	$200,881.00	+	$640,219.05	=	$1,780,136.75

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$920,406.08	+	$132,297.64	+	$486,917.47	=	$1,539,621.19
B	$936,525.00	+	$132,297.64	+	$551,501.93	=	$1,620,324.57
E	$862,041.05	+	$132,297.64	+	$640,219.05	=	$1,634,557.74

The low bid amount, out of all 5 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, HMA option was the low bid (Bidder A). HMA pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and “S” Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA-HMA, 3, 70, Surface	940 TON	$62.25	$68.00	$58.00 - $96.00*	$70.45	HMA
QC/QA-HMA, 3, 70, Intermediate	1,565 TON	$48.20	$50.00	$44.00 - $75.00*	$54.70	HMA
QC/QA-HMA, 3, 64, Base	4,383 TON	$44.90	$42.00	$41.50 - $73.50*	$50.75	HMA
QC/QA PCCP, 11 IN.	12,643 yd^2	$28.06	$42.7	$33.25 - $43.90	$39.95	PCCP
Dense Graded Subbase for PCCP	3,162 yd^3	$48.80	$24.50	$24.50 - $34.00	$28.50	PCCP
D-1 Contraction Joint	7,375 ft	$9.04	$9.90	$9.90 - $11.20	$10.37	PCCP

* Bidder E was higher on these HMA items.

The above table shows that average bid cost of pavement items on the HMA bids were higher than the estimates used in evaluation, this was due to bidder E having a very high bid on all HMA items. It was the same case for PCCP bidders, the average bid cost was higher than the estimate used in evaluation. The low bid cost of pavement items on HMA bids were still higher than the estimates except for one item, which is a large quantity, so still overall in this contract INDOT realized a true savings but not significant compare to other contracts in this process.

There were not any HMA items on the common section for the contract.

Conclusion

INDOT did realize a savings of $273,721.93 immediately, at the bid opening, Bidder A’s amount (PCCP Low Bid + common section) – Bidder A’s amount (HMA Low Bid + common section). Using the Bid Analysis amounts (after PW costs applied), INDOT saved the tax payers approximately $205,138.57 over the 50 year service life of the pavement. These savings include the reduction of INDOT’s in-house design cost of $10,000.00 for producing two sets of typical plan sheets and quantities.

The PW cost for future maintenance did not impact the bid and which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

SR 11 (IR-30672)

PW of HMA Section = $200,881.00

PW of PCCP Section = $132,297.64

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	10,476.90	9,313.93
6	Joint Seal	10,476.90	8,280.05
9	Joint Seal	10,476.90	7,360.93
12	Joint Seal	10,476.90	6,543.84
15	Joint Seal	10,476.90	5,817.45
18	Joint Seal	10,476.90	5,171.69
20	Mill and Functional Overlay	241,425.21	110,183.31
23	Joint Seal	10,476.90	4,250.75
26	Joint Seal	10,476.90	3,778.91
29	Joint Seal	10,476.90	3,359.43
32	Joint Seal	10,476.90	2,986.52
35	Mill and Resurface	102,013.95	25,851.91
38	Joint Seal	10,476.90	2,360.29
41	Joint Seal	10,476.90	2,098.29
44	Joint Seal	10,476.90	1,865.37
47	Joint Seal	10,476.90	1,658.31
Total HMA PW Cost			$200,881.00

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	15,487.50	11,316.56
16	Reseal the Joint	15,487.50	8,268.90
24	Reseal the Joint	15,487.50	6,042.01
30	Mill and Functional Overlay	244,314.13	75,326.61
33	Joint Seal	10,476.90	2,871.66
36	Joint Seal	10,476.90	2,552.89
39	Joint Seal	10,476.90	2,269.51
42	Mill and Resurface	105,212.74	20,261.34
45	Joint Seal	10,476.90	1,793.63
48	Joint Seal	10,476.90	1,594.53
Total PCCP PW Cost			$132,297.64

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-30672)				
	Alternative 1: 11 inches PCCP		Alternative 2: 11 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$448.37*	*$0.00*	*$490.10*	*$0.00*
Present Value	**$132.30**	**$0.00**	**$200.88**	**$0.00**
EUAC	$6.16	$0.00	$9.35	$0.00

Lowest Present Value Agency Cost	**Alternative 1: 11 inches PCCP**
Lowest Present Value User Cost	**Alternative 1: 11 inches PCCP**

Expenditure Stream				
	Alternative 1: 11 inches PCCP		**Alternative 2: 11 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$10.48	
4				
5				
6			$10.48	
7				
8	$15.49			
9			$10.48	
10				
11				
12			$10.48	
13				
14				
15			$10.48	
16	$15.49			
17				
18			$10.48	
19				
20			$241.43	
21				
22				
23			$10.48	
24	$15.49			
25				
26			$10.48	
27				
28				
29			$10.48	
30	$244.31			
31				
32			$10.48	
33	$10.48			
34				
35			$102.01	
36	$10.48			
37				
38			$10.48	
39	$10.48			
40				
41			$10.48	
42	$105.21			
43				
44			$10.48	
45	$10.48			
46				
47			$10.48	
48	$10.48			
49				
50				

Appendix F

US 31 (IR-30128)

Five (5) contractors participated in the bidding (4 PCCP options and 4 HMA option were bid) and low bid was well below the engineer's estimate. Three (3) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. US 31 mainline
    a. 10 inches of PCCP or
    b. 12.5 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$3,193,535.72	+	$374,947.73	+	$2,889,166.01	=	$6,457,649.46
B	$3,459,347.33	+	$374,947.73	+	$3,590,230.25	=	$7,424,525.31
D	$3,725,782.90	+	$374,947.73	+	$4,215,547.30	=	$8,316,277.93
E	$3,830,813.09	+	$374,947.73	+	$4,328,494.17	=	$8,534,254.99

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$2,976,407.11	+	$599,632.90	+	$2,889,166.01	=	$6,465,206.02
B	$2,702,298.26	+	$599,632.90	+	$3,590,230.25	=	$6,892,161.41
C	$2,736,502.00	+	$599,632.90	+	$3,834,626.21	=	$7,170,761.11
D	$3,243,072.64	+	$599,632.90	+	$4,215,547.30	=	$8,058,252.84

The low bid amount, out of all 5 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, PCCP option was the low bid (Bidder A). PCCP pay items option was awarded for this contract. The PW cost factor **did** affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA PCCP, 10 IN.	33,201 yd^2	$26.71	$27.00	$27.00 - $34.00	$28.79	PCCP
Subbase for PCCP	9,358 yd^3	$30.78	$38.00	$35.82 - $40.50	$37.93	PCCP
D-1 Contraction Joint	18,676 ft	$9.04	$10.00	$9.00 - $11.00	$9.75	PCCP
QC/QA-HMA, 4, 70, Surface	3,168 TON	$61.40	$62.00	$56.00 - $62.00	$57.50	HMA
QC/QA-HMA, 4, 70, Intermediate	5,316 TON	$47.00	$51.00	$39.00 - $51.00	$42.00	HMA
QC/QA-HMA, 4, 64, Base	14,038 TON	$45.40	$42.00	$37.00 - $42.00	$38.25	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	5,514 TON	$50.20	$48.00	$38.00 - $48.00	$40.50	HMA

The above table shows that average and low bid cost of pavement items on the PCCP option were higher than the estimates used in evaluation, this might be because of low quantities or maintenance of traffic or other reasons. For the HMA option, the average bid cost of all pavement items are lower than the estimates used in evaluation. INDOT did not realized any saving at bid opening but the difference between the cost of pavement items for PCCP and HMA option were less than 7 percent of low bidder, it showed that INDOT realized some saving for the service life of the pavement.

There were not any HMA items on the common section for the contract.

Conclusion

INDOT did not realize a savings immediately, at the bid opening, (HMA Low Bid – PCCP Low Bid = -$236,428.61). However after using the Bid Analysis amounts (after PW costs applied), it cost INDOT only $11,743.44 over the 50 year service life of the pavement. These costs include the INDOT's consultant cost of $19,300.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance **did** impact the bid but not which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was not successful.

PW of Future Maintenance of the Pavement

IR-30128 (US 31)

PW of HMA Section = $599,632.90

PW of PCCP Section = $374,947.48

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	34,259.40	30,456.48
6	Joint Seal	34,259.40	27,075.70
9	Joint Seal	34,259.40	24,070.20
12	Joint Seal	34,259.40	21,398.32
15	Joint Seal	34,259.40	19,023.03
18	Joint Seal	34,259.40	16,911.40
20	Mill and Functional Overlay	672,601.81	306,966.69
23	Joint Seal	34,259.40	13,899.94
26	Joint Seal	34,259.40	12,357.00
29	Joint Seal	34,259.40	10,985.33
32	Joint Seal	34,259.40	9,765.91
35	Mill and Resurface	318,137.37	80,620.93
38	Joint Seal	34,259.40	7,718.14
41	Joint Seal	34,259.40	6,861.40
44	Joint Seal	34,259.40	6,099.76
47	Joint Seal	34,259.40	5,422.67
Total HMA PW Cost			$599,632.90

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitation	Cost $	Present Worth Cost $
8	Reseal the Joint	39,219.60	28,657.38
16	Reseal the Joint	39,219.60	20,939.67
24	Reseal the Joint	39,219.60	15,300.41
30	Mill and Functional Overlay	683,573.52	210,758.48
33	Joint Seal	34,259.40	9,390.30
36	Joint Seal	34,259.40	8,347.94
39	Joint Seal	34,259.40	7,421.29
42	Mill and Resurface	327,419.34	63,052.76
45	Joint Seal	34,259.40	5,865.15
48	Joint Seal	34,259.40	5,214.10
Total PCCP PW Cost			$374,947.48

$PW = F\,[1/(1+i)^n]$

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-30128)				
Total Cost	**Alternative 1: 10 inches PCCP**		**Alternative 2: 12.5 inches HMA**	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$1,299.94*	*$0.00*	*$1,470.36*	*$0.00*
Present Value	**$374.95**	**$0.00**	**$599.63**	**$0.00**
EUAC	$17.45	$0.00	$27.91	$0.00
Lowest Present Value Agency Cost		**Alternative 1: 10 inches PCCP**		
Lowest Present Value User Cost		**Alternative 1: 10 inches PCCP**		

Expenditure Stream				
Year	**Alternative 1: 10 inches PCCP**		**Alternative 2: 12.5 inches HMA**	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$34.26	
4				
5				
6			$34.26	
7				
8	$39.22			
9			$34.26	
10				
11				
12			$34.26	
13				
14				
15			$34.26	
16	$39.22			
17				
18			$34.26	
19				
20			$672.60	
21				
22				
23			$34.26	
24	$39.22			
25				
26			$34.26	
27				
28				
29			$34.26	
30	$683.57			
31				
32			$34.26	
33	$34.26			
34				
35			$318.14	
36	$34.26			
37				
38			$34.26	
39	$34.26			
40				
41			$34.26	
42	$327.42			
43				
44			$34.26	
45	$34.26			
46				
47			$34.26	
48	$34.26			
49				
50				

Appendix G

PR 69 (IR-33042)

Six (6) contractors participated in the bidding (6 PCCP options and 1 HMA option were bid) and all bids were below the engineer's estimate except one. One (1) contractor participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. PR 69 mainline
    a. 11 inches of PCCP or
    b. 13.5 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$7,874,984.92	+	$741,876.98	+	$12,098,505.08	=	$20,715,367.88
B	$7,811,751.14	+	$741,876.98	+	$12,277,793.69	=	$20,831,421.81
C	$7,741,719.88	+	$741,876.98	+	$12,804,034.10	=	$21,287,630.96
D	$8,546,103.65	+	$741,876.98	+	$12,875,383.97	=	$22,163,364.60
E	$7,997,103.38	+	$741,876.98	+	$13,996,392.48	=	$22,735,372.84
F	$9,535,153.99	+	$741,876.98	+	$14,174,135.01	=	$24,451,165.98

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
B	$7,727,636.30	+	$1,198,949.31	+	$12,277,793.69	=	$21,204,379.30

The low bid amount, out of all 6 bids, was for PCCP pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, PCCP option was the low bid (Bidder A). PCCP pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA PCCP, 11 IN.	62,689 yd^2	$28.06	$26.30	$25.23 - $28.22[1]	$26.32	PCCP
Subbase for PCCP	15,673 yd^3	$30.78	$34.00	$32.50 - $39.00[1]	$35.62	PCCP
D-1 Contraction Joint	35,152 ft	$9.04	$10.50	$9.80 - $11.33[1]	$10.22	PCCP
QC/QA-HMA, 4, 76, Surface	9,790 TON	$68.05	$77.33	-	$77.33[2]	HMA
QC/QA-HMA, 4, 76, Intermediate	16,317 TON	$52.84	$54.23	-	$54.23[2]	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	14,834 TON	$50.18	$56.24	-	$56.24[2]	HMA
QC/QA-HMA, 4, 64, Base	45,687 TON	$45.36	$51.22	-	$51.22[2]	HMA

Note:

1) Bidder D was higher on all PCCP items.
2) Only one bidder bid HMA option.

The above table shows that average bid and low bid cost of pavement items on the PCCP bids were higher than the estimates used in evaluation except "QC/QA PCCP 11 inches". It was the same case for the HMA bidder; the average or low bid cost was higher than the estimate used in evaluation for all pavement items. The major PCCP pavement item (QC/QA PCCP 11 inches), which is a large quantity, was still lower than estimate used for evaluation and all HMA pavement items were higher than estimate, so still overall in this contract INDOT realized a true savings but not significant compare to other contracts in this process.

The table below compares some of the HMA items on the common section of the contract to check for unbalanced bids. All low bid cost of items was higher than the average bid cost item, this may be because of low bid quantities or other reasons but overall all common items for low bidder's on this contract is low. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
QC/QA-HMA, 2, 64, Surface	590 TON	$74.00	$63.00 - $76.00	$67.12	Both
QC/QA-HMA, 2, 64, Intermediate	984 TON	$62.00	$53.00 - $64.00	$56.43	Both
HMA, Surface, Type A	1,618 TON	$72.00	$60.00 - $72.00	$62.78	Both
HMA, Intermediate, Type A	1,820 TON	$70.00	$54.00 - $70.00	$57.27	Both

Conclusion

INDOT did realize a savings of $24,839.99 immediately, at the bid opening, Bidder B's amount (HMA Low Bid + common section) – Bidder A's amount (PCCP Low Bid + common section). Using the Bid Analysis amounts (after PW costs applied); INDOT saved the tax payers approximately $481,912.32 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $7,100.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bid or which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

IR-33042 (PR 69)

PW of HMA Section = $1,198,949.31

PW of PCCP Section = $741,876.98

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	68,355.00	60,767.35
6	Joint Seal	68,355.00	54,021.95
9	Joint Seal	68,355.00	48,025.32
12	Joint Seal	68,355.00	42,694.33
15	Joint Seal	68,355.00	37,955.11
18	Joint Seal	68,355.00	33,741.95
20	Mill and Functional Overlay	1,349,807.13	616,034.35
23	Joint Seal	68,355.00	27,733.42
26	Joint Seal	68,355.00	24,654.91
29	Joint Seal	68,355.00	21,918.13
32	Joint Seal	68,355.00	19,485.14
35	Mill and Resurface	630,735.82	159,838.21
38	Joint Seal	68,355.00	15,399.39
41	Joint Seal	68,355.00	13,690.00
44	Joint Seal	68,355.00	12,170.36
47	Joint Seal	68,355.00	10,819.40
Total HMA PW Cost			$1,198,949.31

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	73,819.20	53,938.97
16	Reseal the Joint	73,819.20	39,412.67
24	Reseal the Joint	73,819.20	28,798.46
30	Mill and Functional Overlay	1,370,608.98	422,584.34
33	Joint Seal	68,355.00	18,735.71
36	Joint Seal	68,355.00	16,655.98
39	Joint Seal	68,355.00	14,807.10
42	Mill and Resurface	648,257.91	124,838.22
45	Joint Seal	68,355.00	11,702.27
48	Joint Seal	68,355.00	10,403.27
Total PCCP PW Cost			$741,876.98

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-33042)				
	Alternative 1: 11 inches PCCP		Alternative 2: 13.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$2,582.10*	*$0.00*	*$2,937.51*	*$0.00*
Present Value	**$741.88**	**$0.00**	**$1,198.95**	**$0.00**
EUAC	$34.53	$0.00	$55.81	$0.00
Lowest Present Value Agency Cost		**Alternative 1: 11 inches PCCP**		
Lowest Present Value User Cost		**Alternative 1: 11 inches PCCP**		

Expenditure Stream				
	Alternative 1: 11 inches PCCP		**Alternative 2: 13.5 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$68.36	
4				
5				
6			$68.36	
7				
8	$73.82			
9			$68.36	
10				
11				
12			$68.36	
13				
14				
15			$68.36	
16	$73.82			
17				
18			$68.36	
19				
20			$1,349.81	
21				
22				
23			$68.36	
24	$73.82			
25				
26			$68.36	
27				
28				
29			$68.36	
30	$1,370.61			
31				
32			$68.36	
33	$68.36			
34				
35			$630.73	
36	$68.36			
37				
38			$68.36	
39	$68.36			
40				
41			$68.36	
42	$648.26			
43				
44			$68.36	
45	$68.36			
46				
47			$68.36	
48	$68.36			
49				
50				

Appendix H

SR 25 (IR-30845)

Seven (7) contractors participated in the bidding (7 PCCP options and 5 HMA options were bid) and all bids were below the engineer's estimate. Five (5) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. SR 25 mainline
    a. 10.5 inches of PCCP or
    b. 12.5 inches of HMA

2. US 421 Ramps
    a. 10.5 inches of PCCP or
    b. 12.5 inches of HMA

Bid Analysis Summary

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$8,602,557.52	+	$1,535,349.54	+	$8,430,690.72	=	$18,568,597.78
B	$8,878,521.70	+	$1,535,349.54	+	$8,852,144.65	=	$19,266,015.89
D	$9,233,766.67	+	$1,535,349.54	+	$9,478,896.69	=	$20,248,012.90
E	$7,755,707.91	+	$1,535,349.54	+	$11,216,259.18	=	$20,507,316.63
G	$9,313,600.16	+	$1,535,349.54	+	$11,051,244.64	=	$21,900,194.34

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$9,295,246.95	+	$977,998.63	+	$8,430,690.72	=	$18,703,936.30
B	$9,176,024.74	+	$977,998.63	+	$8,852,144.65	=	$19,006,168.02
C	$9,091,421.19	+	$977,998.63	+	$9,463,468.97	=	$19,532,888.79
E	$8,420,023.99	+	$977,998.63	+	$11,216,259.18	=	$20,614,281.80
D	$10,180,195.76	+	$977,998.63	+	$9,478,896.69	=	$20,637,091.08
F	$10,663,231.36	+	$977,998.63	+	$9,058,174.75	=	$20,699,404.74
G	$9,822,209.00	+	$977,998.63	+	$11,051,244.64	=	$21,851,452.27

The low bid amount, out of all 7 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, HMA option was the low bid (Bidder A). HMA pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and “S” Lines are to be HMA

Cost Comparison of Unique Items

Bid Item	Bid Quantities	Estimated Cost of Item Per Unit	Low Bid Cost of Item Per Unit	Range of Bid Costs of Item Per Unit	Average Bid Cost of Item Per Unit	HMA or PCCP Option
QC/QA-HMA, 3, 70, Surface	8,972 TON	$62.25	$65.00	$62.25 - $67.32*	$64.06	HMA
QC/QA-HMA, 3, 70, Intermediate	15,166 TON	$48.20	$47.00	$41.50 - $53.65*	$45.19	HMA
QC/QA-HMA, 3, 64, Base	36,116 TON	$44.90	$45.00	$44.00 - $49.83*	$45.54	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	15,374 TON	$50.18	$47.00	$47.00 - $53.04	$51.32	HMA
QC/QA PCCP, 10.5 IN.	108,740 yd^2	$27.39	$29.40	$24.55 - $29.40	$26.27	PCCP
Subbase for PCCP	29,602 yd^3	$30.78	$25.50	$23.00 - $38.15*	$29.27	PCCP
D-1 Contraction Joint	54,350 ft	$9.04	$8.30	$8.30 - $10.54*	$8.95	PCCP

* Bidder D was higher on these HMA and PCCP items.

The above table shows that average and low bid cost of pavement items for both HMA and PCCP option were close to estimate used in evaluation. The major quantities for low bid cost of pavement items on HMA bid were still lower than the estimates used in evaluation, while in the PCCP major quantities for low bid of pavement items was higher than estimates used in evaluation. The difference in pay items cost between low HMA and low PCCP bid, realized a true savings in this contract for INDOT in this process.

The table below compares some of the HMA items on the common section of the contract to check for unbalanced bids. All low bid cost of items was close or higher than the average bid cost item, this may be because of low bid quantities or other reasons but overall all common items for low bidder's on this contract is low. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
HMA, Surface, Type A	747 TON	$65.00	$59.00 - $73.38	$63.07	Both
HMA, Surface, Type B	654 TON	$65.00	$59.80 - $74.14	$63.70	Both
HMA, Surface, Type C	869 TON	$66.00	$62.00 - $70.03	$64.40	Both
HMA, Intermediate, Type A	1,469 TON	$50.00	$41.00 - $57.37	$46.07	Both
HMA, Intermediate, Type B	1,090 TON	$50.00	$47.50 - $61.36	$50.77	Both
HMA, Intermediate, Type C	1,448 TON	$51.00	$41.00 - $56.47	$46.09	Both
HMA, Base, Type C	1,383 TON	$53.00	$41.00 - $56.53	$46.50	Both

Conclusion

INDOT did realize a savings of $671,689.43 immediately, at the bid opening, Bidder A's amount (PCCP Low Bid + common section) – Bidder A's amount (HMA Low Bid + common section). Using the Bid Analysis amounts (after PW costs applied), INDOT saved the tax payers approximately $114,338.52 over the 50 year service life of the pavement. These savings include the reduction of INDOT's in-house design cost of $21,000.00 for producing two sets of typical plan sheets and quantities.

The PW cost for future maintenance did not impact the bid or which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

IR-30845 (SR 25)

PW of HMA Section = $1,535,349.54

PW of PCCP Section = $977,998.63

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	86,631.30	77,014.91
6	Joint Seal	86,631.30	68,465.97
9	Joint Seal	86,631.30	60,866.00
12	Joint Seal	86,631.30	54,109.65
15	Joint Seal	86,631.30	48,103.29
18	Joint Seal	86,631.30	42,763.65
20	Mill and Functional Overlay	1,732,130.96	790,521.96
23	Joint Seal	86,631.30	35,148.60
26	Joint Seal	86,631.30	31,246.98
29	Joint Seal	86,631.30	27,778.45
32	Joint Seal	86,631.30	24,694.94
35	Mill and Resurface	823,278.16	208,631.42
38	Joint Seal	86,631.30	$9,516.77
41	Joint Seal	86,631.30	17,350.34
44	Joint Seal	86,631.30	15,424.39
47	Joint Seal	86,631.30	13,712.22
Total HMA PW Cost			$1,535,349.54

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	114,135.00	83,397.33
16	Reseal the Joint	114,135.00	60,937.61
24	Reseal the Joint	114,135.00	44,526.51
30	Mill and Functional Overlay	1,735,524.85	535,094.71
33	Joint Seal	86,631.30	23,745.13
36	Joint Seal	86,631.30	21,109.34
39	Joint Seal	86,631.30	18,766.12
42	Mill and Resurface	843,338.73	162,405.90
45	Joint Seal	86,631.30	14,831.14
48	Joint Seal	86,631.30	13,184.83
Total PCCP PW Cost			$977,998.63

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-30845)				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 12.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$3,354.42*	*$0.00*	*$3,768.24*	*$0.00*
Present Value	**$978.00**	**$0.00**	**$1,535.35**	**$0.00**
EUAC	$45.53	$0.00	$71.47	$0.00
Lowest Present Value Agency Cost		Alternative 1: 10.5 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 10.5 inches PCCP		

Expenditure Stream				
	Alternative 1: 10.5 inches PCCP		**Alternative 2: 12.5 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$86.63	
4				
5				
6			$86.63	
7				
8	$114.14			
9			$86.63	
10				
11				
12			$86.63	
13				
14				
15			$86.63	
16	$114.14			
17				
18			$86.63	
19				
20			$1,732.13	
21				
22				
23			$86.63	
24	$114.14			
25				
26			$86.63	
27				
28				
29			$86.63	
30	$1,735.52			
31				
32			$86.63	
33	$86.63			
34				
35			$823.28	
36	$86.63			
37				
38			$86.63	
39	$86.63			
40				
41			$86.63	
42	$843.34			
43				
44			$86.63	
45	$86.63			
46				
47			$86.63	
48	$86.63			
49				
50				

Appendix I

Dowling St (R-30254)

This is a Local Public Agency (LPA) project, City of Kendallville, Noble County. Six (6) contractors participated in either PCCP options or HMA options bidding (2 PCCP options and 4 HMA options were bid) and none of the contractors participated on both options. The total bid amounts of all bidders were above the engineer's estimate except one. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

City of Kendallville design consultant provided and INDOT reviewed the following pavement design thickness for this project:

1. Dowling Street mainline
    a. 8 inches of PCCP or
    b. 10.5 inches of HMA

Bid Analysis Summary

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$1,346,874.03	+	$351,656.94	+	$1,670,633.34	=	$3,369,164.31
B	$1,499,275.64	+	$351,656.94	+	$1,975,079.00	=	$3,826,011.58
D	$1,594,191.82	+	$351,656.94	+	$1,961,190.42	=	$3,907,039.18
E	$1,341,058.10	+	$351,656.94	+	$2,237,310.88	=	$3,930,025.92

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
C	$1,635,919.96	+	$205,783.31	+	$2,007,773.43	=	$3,849,476.70
F	$1,917,922.58	+	$205,783.31	+	$2,302,766.95	=	$4,426,472.84

The low bid amount, out of all 6 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, HMA option was the low bid (Bidder A). HMA pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA-HMA, 2, 64, Surface	1,886 TON	$53.17	$54.00	$54.00 - $70.00*	$64.50	HMA
QC/QA-HMA, 2, 64, Intermediate	3,123 TON	$52.49	$48.00	$48.00 - $60.00	$55.06	HMA
QC/QA-HMA, 2, 64, Base	8,693 TON	$49.39	$44.00	$44.00 - $52.50*	$47.62	HMA
QC/QA PCCP, 8 IN.	25,094 yd^2	$24.27	$25.50	$25.50 - $34.00	$29.75	PCCP
Subbase for PCCP	9,102 yd^3	$30.78	$35.00	$35.00 - $35.00	$35.00	PCCP
D-1 Contraction Joint	13,000 ft	$9.04	$12.00	$8.50 - $12.00	$10.25	PCCP

* Bidder D was higher on these HMA items.

The above table shows that low bid cost of pavement items for HMA option was below the estimate used in evaluation on most items and close to estimate used on some items. The average bid cost of pavement items for HMA option were above the estimates used in evaluation, this was due to all the HMA bidders' bids being higher than the estimates except the low bidder. The PCCP option low and average bid cost of pavement items is higher than estimates used in evaluation. The difference in pay items cost between low HMA and low PCCP bid, realized a true savings in this contract for the LPA and the tax payers in this process.

There were not any HMA or PCCP items on the common section for the contract.

Conclusion

LPA did realize a savings of $606,186.02 immediately, at the bid opening, Bidder C's amount (PCCP Low Bid + common section) – Bidder A's amount (HMA Low Bid + common section). Using the Bid Analysis amounts (after PW costs applied), INDOT saved the tax payers approximately $460,312.39 over the 50 year service life of the pavement. These savings include the reduction of estimated design consultant cost of $20,000.00 for producing two sets of typical plan sheets and quantities.

The PW cost for future maintenance did not impact the bid or which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

R-30254 (Dowling St)

PW of HMA Section = $351,656.94

PW of PCCP Section = $205,783.31

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	30,240.00	26,883.25
6	Joint Seal	30,240.00	23,899.11
9	Joint Seal	30,240.00	21,246.22
12	Joint Seal	30,240.00	18,887.81
15	Joint Seal	30,240.00	16,791.20
18	Joint Seal	30,240.00	14,927.31
20	Mill and Functional Overlay	286,460.42	130,736.80
23	Joint Seal	30,240.00	12,269.16
26	Joint Seal	30,240.00	10,907.24
29	Joint Seal	30,240.00	9,696.50
32	Joint Seal	30,240.00	8,620.15
35	Mill and Resurface	133,190.56	33,752.55
38	Joint Seal	30,240.00	6,812.63
41	Joint Seal	30,240.00	6,056.40
44	Joint Seal	30,240.00	5,384.12
47	Joint Seal	30,240.00	4,786.46
Total HMA PW Cost			$351,656.94

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	27,300.00	19,947.84
16	Reseal the Joint	27,300.00	14,575.69
24	Reseal the Joint	27,300.00	10,650.32
30	Mill and Functional Overlay	321,692.17	99,183.70
33	Joint Seal	30,240.00	8,288.61
36	Joint Seal	30,240.00	7,368.54
39	Joint Seal	30,240.00	6,550.61
42	Mill and Resurface	152,868.21	29,438.58
45	Joint Seal	30,240.00	5,177.04
48	Joint Seal	30,240.00	4,602.37
Total PCCP PW Cost			$205,783.31

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (R-30254)				
	Alternative 1: 8 inches PCCP		Alternative 2: 10.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$707.66*	*$0.00*	*$843.01*	*$0.00*
Present Value	**$205.78**	**$0.00**	**$351.66**	**$0.00**
EUAC	$9.58	$0.00	$16.37	$0.00
Lowest Present Value Agency Cost		Alternative 1: 8 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 8 inches PCCP		

Expenditure Stream				
	Alternative 1: 8 inches PCCP		**Alternative 2: 10.5 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$30.24	
4				
5				
6			$30.24	
7				
8	$27.30			
9			$30.24	
10				
11				
12			$30.24	
13				
14				
15			$30.24	
16	$27.30			
17				
18			$30.24	
19				
20			$286.46	
21				
22				
23			$30.24	
24	$27.30			
25				
26			$30.24	
27				
28				
29			$30.24	
30	$321.69			
31				
32			$30.24	
33	$30.24			
34				
35			$133.19	
36	$30.24			
37				
38			$30.24	
39	$30.24			
40				
41			$30.24	
42	$152.87			
43				
44			$30.24	
45	$30.24			
46				
47			$30.24	
48	$30.24			
49				
50				

Appendix J

US 31 (IR-31218)

Eight (8) contractors participated in the bidding (8 PCCP options and 5 HMA options were bid) and all bids were below the engineer's estimate except one. Five (5) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. US 31 mainline
    a. 10 inches of PCCP or
    b. 12.5 inches of HMA
2. Touby Pike
    a. 10 inches of PCCP or
    b. 12.5 inches of HMA
3. Touby Pike Ramps
    a. 10 inches of PCCP or
    b. 12.5 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$4,637,100.56	+	$755,848.60	+	$6,380,988.95	=	$11,773,938.11
B	$5,971,729.74	+	$755,848.60	+	$5,481,705.60	=	$12,209,283.94
C	$5,644,216.78	+	$755,848.60	+	$5,918,238.86	=	$12,318,304.24
D	$5,191,093.44	+	$755,848.60	+	$6,379,356.39	=	$12,326,298.43
E	$5,729,418.17	+	$755,848.60	+	$6,450,534.26	=	$12,935,801.03
F	$6,577,588.50	+	$755,848.60	+	$6,255,029.52	=	$13,588,466.62
G	$6,665,770.22	+	$755,848.60	+	$6,321,717.67	=	$13,743,336.49
H	$7,121,227.57	+	$755,848.60	+	$6,147,582.43	=	$14,024,658.60

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$4,298,881.05	+	$1,147,985.52	+	$6,380,988.95	=	$11,827,855.52
C	$5,307,846.46	+	$1,147,985.52	+	$5,918,238.86	=	$12,374,070.84
B	$5,751,457.42	+	$1,147,985.52	+	$5,481,705.60	=	$12,381,148.54
D	$5,102,330.87	+	$1,147,985.52	+	$6,379,356.39	=	$12,629,672.78
G	$6,419,970.85	+	$1,147,985.52	+	$ 6,321,717.67	=	$13,889,674.04

The low bid amount, out of all 8 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, PCCP option was the low bid (Bidder A). PCCP pay items option was awarded for this contract. The PW cost factor **did** affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items

Bid Item	Bid Quantities	Estimated Cost of Item Per Unit	Low Bid Cost of Item Per Unit	Range of Bid Costs of Item Per Unit	Average Bid Cost of Item Per Unit	HMA or PCCP Option
QC/QA PCCP, 10 IN.	81,584 yd^2	$26.71	$26.51	$24.80 - $35.30[1]	$28.34	PCCP
Subbase for PCCP	21,785 yd^3	$30.78	$29.24	$22.10 - $32.25[1]	$26.37	PCCP
D-1 Contraction Joint	45,862 ft	$9.04	$8.46	$8.25 - $12.40[1]	$8.89	PCCP
QC/QA-HMA, 4, 70, Surface	3,403 TON	$61.38	$68.40	$68.40 - $70.25[2]	$68.77	HMA
QC/QA-HMA, 2, 64, Surface	3,367 TON	$53.17	$59.75	$59.75 - $62.00[2]	$60.20	HMA
QC/QA-HMA, 4, 70, Intermediate	5,725 TON	$46.95	$46.90	$46.90 - $49.00[2]	$47.32	HMA
QC/QA-HMA, 2, 64, Intermediate	5,581 TON	$45.65	$46.85	$45.85 - $48.00[2]	$46.28	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	11,337 TON	$50.18	$48.70	$48.70 - $49.50[2]	$48.86	HMA
QC/QA-HMA, 4, 64, Base	13,643 TON	$45.36	$44.60	$44.50 - $44.60[2]	$44.54	HMA
QC/QA-HMA, 2, 64, Base	13,532 TON	$43.26	$47.00	$46.75 - $47.00	$46.95	HMA

Note:
1) Bidder F and H were higher on all PCCP items.
2) Bidder C was higher on these HMA items.

The above table shows that low bid and average bid cost of pavement items on the PCCP bids were lower than or close to the estimates used in evaluation. It was the same case for HMA bidders except "QC/QA-HMA, Surface" items, but these are not big quantities. Low bidders pavement items were close to estimate used in evaluation for both HMA and PCCP bidders, so overall in this contract, INDOT realized a savings not immediately at the bid opening but over 50 years of service life of pavement in this process.

The table below compares some of the common HMA items on the HMA, PCCP, and common item sections of the contract to check for unbalanced bids. All low bid cost of items on all sections was close to the average bid cost items. On PCCP section low bid "HMA surface" item was a little higher than HMA section, this may be due to fewer HMA items and low bid quantities on PCCP section but overall these bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
HMA, Surface, Type A	795 TON	$67.50	$58.75 - $76.00	$66.85	PCCP
HMA, Surface, Type A	751 TON	$60.65	$60.65 - $63.25	$61.17	HMA
HMA, Intermediate, Type A	1,233 TON	$46.10	$46.10 - $60.00	$49.49	Both

Conclusion

INDOT did not realize a savings immediately, at the bid opening, (HMA Low Bid – PCCP Low Bid = -$374,059.51). However after using the Bid Analysis amounts (after PW costs applied), INDOT saved the tax payers approximately $18,077.41 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $35,840 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance **did** impact the bid but not which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was successful.

PW of Future Maintenance of the Pavement

IR-31218 (US 31)

PW of HMA Section = $1,147,985.52

PW of PCCP Section = $755,848.60

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	65,369.85	58,113.56
6	Joint Seal	65,369.85	51,662.74
9	Joint Seal	65,369.85	45,927.99
12	Joint Seal	65,369.85	40,829.82
15	Joint Seal	65,369.85	36,297.56
18	Joint Seal	65,369.85	32,268.40
20	Mill and Functional Overlay	1,294,275.95	590,690.65
23	Joint Seal	65,369.85	26,522.27
26	Joint Seal	65,369.85	23,578.20
29	Joint Seal	65,369.85	20,960.93
32	Joint Seal	65,369.85	18,634.19
35	Mill and Resurface	602,545.80	152,694.43
38	Joint Seal	65,369.85	14,726.87
41	Joint Seal	65,369.85	13,092.14
44	Joint Seal	65,369.85	11,638.86
47	Joint Seal	65,369.85	10,346.91
Total HMA PW Cost			$1,147,985.52

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	100,417.80	73,374.30
16	Reseal the Joint	100,417.80	53,613.88
24	Reseal the Joint	100,417.80	39,175.14
30	Mill and Functional Overlay	1,301,692.94	401,336.23
33	Joint Seal	65,369.85	17,917.49
36	Joint Seal	65,369.85	15,928.59
39	Joint Seal	65,369.85	14,160.46
42	Mill and Resurface	618,991.98	119,202.34
45	Joint Seal	65,369.85	11,191.21
48	Joint Seal	65,369.85	9,948.95
Total PCCP PW Cost			$755,848.60

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-31218)				
	Alternative 1: 10 inches PCCP		Alternative 2: 12.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$2,548.78*	*$0.00*	*$2,811.99*	*$0.00*
Present Value	**$755.85**	**$0.00**	**$1,147.98**	**$0.00**
EUAC	$35.18	$0.00	$53.44	$0.00
Lowest Present Value Agency Cost		**Alternative 1: 10 inches PCCP**		
Lowest Present Value User Cost		**Alternative 1: 10 inches PCCP**		

Expenditure Stream				
	Alternative 1: 10 inches PCCP		**Alternative 2: 12.5 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$65.37	
4				
5				
6			$65.37	
7				
8	$100.42			
9			$65.37	
10				
11				
12			$65.37	
13				
14				
15			$65.37	
16	$100.42			
17				
18			$65.37	
19				
20			$1,294.28	
21				
22				
23			$65.37	
24	$100.42			
25				
26			$65.37	
27				
28				
29			$65.37	
30	$1,301.69			
31				
32			$65.37	
33	$65.37			
34				
35			$602.54	
36	$65.37			
37				
38			$65.37	
39	$65.37			
40				
41			$65.37	
42	$618.99			
43				
44			$65.37	
45	$65.37			
46				
47			$65.37	
48	$65.37			
49				
50				

Appendix K

US 31 (IR-30201)

Three (3) contractors participated in the bidding (3 PCCP options and 3 HMA option were bid) and the low bid was below the engineer's estimate, but all other bids were above. All three (3) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. This bid was cost of pay items (Part A) plus closure user cost (Part B). The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section + Closure user cost or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section + Closure user cost.

INDOT provided the following pavement design thickness for this project:

1. US 31 mainline
   a. 10 inches of PCCP or
   b. 12.5 inches of HMA

2. 146th Street Ramps
   a. 10 inches of PCCP/8.5 inches PCCP or
   b. 12.5 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$4,386,725.20	+	$827,369.16	+	$31,382,949.21	=	$36,597,043.57
B	$4,908,979.15	+	$827,369.16	+	$35,082,437.34	=	$40,819,785.65
C	$5,631,448.99	+	$827,369.16	+	$35,296,085.27	=	$41,754,903.42

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
A	$4,111,838.96	+	$1,291,561.31	+	$31,382,949.21	=	$36,786,349.48
B	$4,488,472.50	+	$1,291,561.31	+	$35,082,437.34	=	$40,862,471.15
C	$4,648,414.25	+	$1,291,561.31	+	$35,296,085.27	=	$41,236,060.83

Total A+B Bid

Bidder	Low PCCP or HMA Options (A)		Cost of user (B)		Bid Analysis
A	$36,597,043.57	+	$3,000,000	=	$39,597,043.57
B	$40,819,785.65	+	$2,700,000	=	$43,519,785.65
C	$41,236,060.83	+	$3,750,000	=	$44,986,060.83

The low bid amount, out of all 3 bids, was for HMA pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options plus adding closure user cost to respective bidder's, PCCP option was the low bid (Bidder A). PCCP pay items option was awarded for this contract. The PW cost factor did affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items

Bid Item	Bid Quantities	Estimated Cost of Item Per Unit	Low Bid Cost of Item Per Unit	Range of Bid Costs of Item Per Unit	Average Bid Cost of Item Per Unit	HMA or PCCP Option
QC/QA PCCP, 10 IN.	72,102.2 yd^2	$26.71	$28.99	$28.99 - $36.00[1]	$31.89	PCCP
QC/QA PCCP, 8.5 IN.	11,895 yd^2	$24.95	$26.85	$26.85 - $39.00[1]	$31.11	PCCP
Subbase for PCCP	23,594 yd^3	$30.78	$26.09	$26.09 - $35.00[1]	$31.69	PCCP
D-1 Contraction Joint	47,248.19 ft	$9.04	$9.58	$9.00 - $15.35[1]	$10.31	PCCP
QC/QA-HMA, 4, 70, Surface	3,966 TON	$61.38	$67.50	$67.50 - $81.00[2]	$72.50	HMA
QC/QA-HMA, 3, 70, Surface	3,050 TON	$62.25	$65.00	$65.00 - $82.00[2]	$74.00	HMA
QC/QA-HMA, 4, 70, Intermediate	6,984 TON	$46.95	$50.00	$50.00 - $53.00[2]	$51.67	HMA
QC/QA-HMA, 3, 70, Intermediate	5,085 TON	$48.20	$50.00	$50.00 - $56.00	$53.33	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	12,163 TON	$50.18	$43.75	$43.75 - $55.00[2]	$50.58	HMA
QC/QA-HMA, 4, 64, Base	16,574 TON	$45.36	$50.00	$47.00 - $50.00[2]	$49.33	HMA
QC/QA-HMA, 3, 64, Base	11,619 TON	$44.91	$44.00	$44.00 - $54.00[2]	$50.00	HMA

Note:
1) Bidder C was higher on all PCCP items.
2) Bidder C was higher on all HMA items.

The above table shows that average bid and low bid cost of pavement items on the PCCP bids were higher than or close to the estimates used in evaluation except "Subbase for PCCP". It was the same case for HMA bidder, the average or low bid cost was higher than the estimate used in evaluation for all pavement items except "QC/QA-HMA, 5, 76, Intermediate, OG". The majority of low bid cost of pavement items for both HMA and PCCP options were above the estimates used in evaluation due to this being an urban area project and because of the closure user cost. INDOT did not realize a savings immediately at the time of the bid opening but there will be a savings over the 50 year service life of pavement in this process.

The table below compares some of the HMA and PCCP items on the common section of the contract to check for unbalanced bids. All low bid cost of items was lower than the average bid cost items. The average bid cost of items on the common section for similar pay items were higher than HMA or PCCP section due to Bidder C's bid being very high on these items and this was the same case for Bidder C on both options. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
QC/QA-HMA, 3, 70, Surface	496.8 TON	$78.00	$67.00 - $92.16	$79.05	Both
HMA, Surface, Type A	203.1 TON	$76.00	$74.00 - $98.59	$82.86	Both
HMA, Surface, Type D	990.7 TON	$72.50	$68.00 - $89.18	$76.56	Both
QC/QA-HMA, 3, 70, Intermediate	828.8 TON	$60.00	$60.00 - $77.65	$69.21	Both
HMA, Intermediate, Type A	370 TON	$58.00	$50.00 - $68.13	$58.71	Both
HMA, Intermediate, Type D	1,321 TON	$57.00	$53.00 - $63.50	$57.83	Both
QC/QA-HMA, 3, 64, Base	2,105.1 TON	$50.00	$50.00 - $68.48	$56.82	Both
QC/QA-HMA, 5, 76, Intermediate, OG	2,772.7 TON	$55.00	$55.00 - $71.44	$60.48	Both
D-1 Contraction Joint	9,930.35 ft	$8.78	$8.78 - $19.30	$13.02	Both

Conclusion

INDOT did not realize a savings immediately, at the bid opening, (HMA Low Bid – PCCP Low Bid = -$308,886.24). However after using the Bid Analysis amounts (after PW costs applied), INDOT saved the tax payers approximately $155,305.91 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $34,000 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance **did** impact the bid but not which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was successful.

PW of Future Maintenance of the Pavement

IR-30201 (US 31)

PW of HMA Section = $1,291,561.31

PW of PCCP Section = $827,369.16

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	75,692.40	67,290.27
6	Joint Seal	75,692.40	59,820.80
9	Joint Seal	75,692.40	53,180.48
12	Joint Seal	75,692.40	47,277.25
15	Joint Seal	75,692.40	42,029.30
18	Joint Seal	75,692.40	37,363.90
20	Mill and Functional Overlay	1,431,852.80	653,478.93
23	Joint Seal	75,692.40	30,710.40
26	Joint Seal	75,692.40	27,301.43
29	Joint Seal	75,692.40	24,270.88
32	Joint Seal	75,692.40	21,576.72
35	Mill and Resurface	669,223.17	169,591.50
38	Joint Seal	75,692.40	17,052.39
41	Joint Seal	75,692.40	15,159.52
44	Joint Seal	75,692.40	13,476.76
47	Joint Seal	75,692.40	11,980.79
Total HMA PW Cost			$1,291,561.31

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	99,221.20	72,499.96
16	Reseal the Joint	99,221.20	52,975.01
24	Reseal the Joint	99,221.20	38,708.32
30	Mill and Functional Overlay	1,458,628.84	449,722.50
33	Joint Seal	75,692.40	20,746.85
36	Joint Seal	75,692.40	18,443.87
39	Joint Seal	75,692.40	16,396.53
42	Mill and Resurface	692,705.52	133,397.72
45	Joint Seal	75,692.40	12,958.42
48	Joint Seal	75,692.40	11,519.99
Total PCCP PW Cost			$827,369.16

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-30201)				
	Alternative 1: 10 inches PCCP		Alternative 2: 12.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$2,827.46*	*$0.00*	*$3,160.76*	*$0.00*
Present Value	**$827.37**	**$0.00**	**$1,291.56**	**$0.00**
EUAC	$38.51	$0.00	$60.12	$0.00
Lowest Present Value Agency Cost		Alternative 1: 10 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 10 inches PCCP		

Expenditure Stream				
	Alternative 1: 11 inches PCCP		Alternative 2: 13.5 inches HMA	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$75.69	
4				
5				
6			$75.69	
7				
8	$99.22			
9			$75.69	
10				
11				
12			$75.69	
13				
14				
15			$75.69	
16	$99.22			
17				
18			$75.69	
19				
20			$1,431.85	
21				
22				
23			$75.69	
24	$99.22			
25				
26			$75.69	
27				
28				
29			$75.69	
30	$1,458.63			
31				
32			$75.69	
33	$75.69			
34				
35			$669.22	
36	$75.69			
37				
38			$75.69	
39	$75.69			
40				
41			$75.69	
42	$692.71			
43				
44			$75.69	
45	$75.69			
46				
47			$75.69	
48	$75.69			
49				
50				

Appendix L

PR 69 (IR-33734)

This project was bid as a design build contract. INDOT received seven (7) bids (7 PCCP options and 2 HMA option) and all bids were substantially below the engineer's estimate. Two (2) contractors participated in both pavement type HMA and PCCP options. All contractors had the option to bid either HMA section or PCCP section or both. There was a third section in this bid that was comprised of all the common items for the contract. Another section in this bid was comprised of all general items which are not associate with actual work. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1) I-69 mainline
    a. 10.5 inches of PCCP or
    b. 13 inches of HMA

Bid Analysis Summary

PCCP Pay item Option

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$26,798,700.00	+	$1,581,122.98	+	$84,840.00	=	$28,464,662.98
B	$27,262,000.00	+	$1,581,122.98	+	$83,280.00	=	$28,926,402.98
C	$27,526,803.23	+	$1,581,122.98	+	$104,400.24	=	$29,212,326.45
D	$27,510,723.86	+	$1,581,122.98	+	$455,333.24	=	$29,547,180.08
E	$30,235,000.00	+	$1,581,122.98	+	$97,225.36	=	$31,913,348.34
F	$30,370,000.00	+	$1,581,122.98	+	$99,990.00	=	$32,051,112.98
G	$31,250,000.00	+	$1,581,122.98	+	$174,100.00	=	$33,005,222.98

HMA Pay item Option

Bidders	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
B	$27,600,000.00	+	$2,523,099.45	+	$83,280.00	=	$30,206,379.45
D	$28,440,704.00	+	$2,523,099.45	+	$455,333.24	=	$31,419,136.69

The low bid amount, out of all 7 bids, was for PCCP option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, PCCP option was the low bid (Bidder A). PCCP option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT is unable to compare the estimated cost of pavement pay items with actual low bid costs of both HMA and PCCP pavement types since this contract was not let as an itemized proposal. All other pavement types such as “S”-lines in the bids were common to both pavement options.

Conclusion

INDOT saved the tax payers approximately $789,740.00 immediately, at the bid opening, (HMA Low Bid – PCCP Low Bid). Using the Bid Analysis amounts (after PW costs applied); INDOT saved the tax payers approximately $1,731,716.47 over the 50 year service life of the pavement. These savings include the reduction of INDOT’s consultant cost of $10,000.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bids or which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

IR-33734 (PR 69)

PW of HMA Section = $2,523,099.45

PW of PCCP Section = $1,581,122.98

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	144,591.30	128,541.14
6	Joint Seal	144,591.30	114,272.60
9	Joint Seal	144,591.30	101,587.93
12	Joint Seal	144,591.30	90,311.30
15	Joint Seal	144,591.30	80,286.42
18	Joint Seal	144,591.30	71,374.33
20	Mill and Functional Overlay	2,832,258.32	1,292,605.73
23	Joint Seal	144,591.30	58,664.50
26	Joint Seal	144,591.30	52,152.53
29	Joint Seal	144,591.30	46,363.40
32	Joint Seal	144,591.30	41,216.90
35	Mill and Resurface	1,324,148.39	335,559.69
38	Joint Seal	144,591.30	32,574.31
41	Joint Seal	144,591.30	28,958.45
44	Joint Seal	144,591.30	25,743.95
47	Joint Seal	144,591.30	22,886.28
Total HMA PW Cost			$2,523,099.45

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	167,083.28	122,086.12
16	Reseal the Joint	167,083.28	89,207.13
24	Reseal the Joint	167,083.28	65,182.78
30	Mill and Functional Overlay	2,883,673.37	889,090.33
33	Joint Seal	144,591.30	39,631.63
36	Joint Seal	144,591.30	35,232.38
39	Joint Seal	144,591.30	31,321.46
42	Mill and Resurface	1,363,683.83	262,611.32
45	Joint Seal	144,591.30	24,753.80
48	Joint Seal	144,591.30	22,006.04
Total PCCP PW Cost			$1,581,122.98

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-33734)				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 13 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$5,471.56*	*$0.00*	*$6,180.68*	*$0.00*
Present Value	**$1,581.12**	**$0.00**	**$2,523.10**	**$0.00**
EUAC	$73.60	$0.00	$117.45	$0.00
Lowest Present Value Agency Cost		**Alternative 1: 10.5 inches PCCP**		
Lowest Present Value User Cost		**Alternative 1: 10.5 inches PCCP**		

Expenditure Stream				
	Alternative 1: 10.5 inches PCCP		**Alternative 2: 13 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$144.59	
4				
5				
6			$144.59	
7				
8	$167.08			
9			$144.59	
10				
11				
12			$144.59	
13				
14				
15			$144.59	
16	$167.08			
17				
18			$144.59	
19				
20			$2,832.26	
21				
22				
23			$144.59	
24	$167.08			
25				
26			$144.59	
27				
28				
29			$144.59	
30	$2,883.67			
31				
32			$144.59	
33	$144.59			
34				
35			$1,324.15	
36	$144.59			
37				
38			$144.59	
39	$144.59			
40				
41			$144.59	
42	$1,363.68			
43				
44			$144.59	
45	$144.59			
46				
47			$144.59	
48	$144.59			
49				
50				

Appendix M

US 31 (IR-30107)

Nine (9) contractors participated in the bidding (9 PCCP options and 4 HMA options were bid) and all bids were substantially below the engineer's estimate. Four (4) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a third section in this bid that was comprised of all the common items for the contract. The low bidder was determined from:

1. Bid of HMA pay items section + PW cost of HMA + Bid of common items section. or
2. Bid of PCCP pay items section + PW cost of PCCP + Bid of common items section.

INDOT provided the following pavement design thickness for this project:

1. US 31 mainline
    a. 10 inches of PCCP or
    b. 14 inches of HMA

Bid Analysis Summary

PCCP Pay item Options

Bidders	PCCP Section		PW Cost for PCCP		Common Section		Bid Analysis
A	$4,070,560.23	+	$379,269.52	+	$10,008,644.59	=	$14,458,474.34
B	$4,481,154.35	+	$379,269.52	+	$10,089,959.38	=	$14,950,383.25
C	$4,525,669.33	+	$379,269.52	+	$10,432,620.61	=	$15,337,559.46
D	$4,948,310.28	+	$379,269.52	+	$10,219,042.26	=	$15,168,352.54
E	$5,145,759.18	+	$379,269.52	+	$11,092,468.55	=	$16,617,497.25
F	$4,975,808.39	+	$379,269.52	+	$10,382,709.10	=	$16,737,787.01
G	$4,822,796.17	+	$379,269.52	+	$11,675,879.08	=	$16,877,944.77
H	$5,230,159.94	+	$379,269.52	+	$11,273,366.10	=	$16,882,795.56
I	$6,586,941.42	+	$379,269.52	+	$12,172,820.58	=	$19,139,031.52

HMA Pay item Options

Bidder	HMA Section		PW Cost for HMA		Common Section		Bid Analysis
C	$4,561,216.70	+	$629,053.36	+	$10,432,620.61	=	$15,622,890.67
E	$5,321,062.50	+	$629,053.36	+	$11,092,468.55	=	$17,042,584.41
H	$5,472,702.01	+	$629,053.36	+	$11,273,366.10	=	$17,375,121.47
I	$6,780,422.50	+	$629,053.36	+	$12,172,820.58	=	$19,582,296.44

The low bid amount, out of all 9 bids, was for PCCP pay items option (Bidder A) and after adding PW cost of HMA and PCCP to the respective pavement type options, PCCP option was the low bid (Bidder A). PCCP pay items option was awarded for this contract. The PW cost factor did not affect the outcome of the bidding.

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and “S” Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA PCCP, 10 IN.	34,055 yd^2	$26.71	$26.44	$25.15 - $27.95[1]	$25.75	PCCP
Subbase for PCCP	8,514 yd^3	$30.78	$24.41	$24.41 - $58.64[1]	$31.56	PCCP
D-1 Contraction Joint	17,028 ft	$9.04	$7.88	$7.88 - $9.95[1]	$9.42	PCCP
QC/QA-HMA, 3, 70, Surface	3,242 TON	$62.25	$65.00	$65.00 - $65.00	$65.00	HMA
QC/QA-HMA, 3, 70, Intermediate	5,484 TON	$48.20	$50.75	$50.75 - $50.75	$50.75	HMA
QC/QA-HMA, 5, 76, Intermediate, OG	6,661 TON	$50.18	$48.60	$48.00 - $48.60	$48.45	HMA
QC/QA-HMA, 3, 64, Base	15,348 TON	$44.91	$48.00	$48.00 - $48.00	$48.00	HMA

Note:

1) Bidder I was higher on all PCCP items.

The above table shows that low bid cost of pavement items on the PCCP option were lower than the estimates used in evaluation, and the average bid cost of items were also lower or close to estimates used in evaluation. It was the opposite case for HMA option, the low and average bid cost were higher than the estimate used in evaluation for all pavement items except “QC/QA-HMA, 5, 76, Intermediate, OG”. This indicates that a true cost savings was realized by INDOT in this process.

The table below compares some of the HMA and PCCP items on the common section of the contract to check for unbalanced bids. All bidders were the same on cost of HMA items on the common section. PCCP items in the common section, shows that the low bidder cost of items were lower than the average bid cost of items. The average bid cost of items on the common section for similar pay items were higher than PCCP section due to bidder I bidding very high on these items. These bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
HMA, Surface, Type A	62 TON	$77.00	$77.00 - $77.00	$77.00	Both
HMA, Surface, Type B	479.30 TON	$65.00	$65.00 - $65.00	$65.00	Both
HMA, Intermediate, Type A	103 TON	$58.00	$58.00 - $58.00	$58.00	Both
HMA, Intermediate, Type B	753.70 TON	$47.30	$47.30 - $47.30	$47.30	Both
PCCP, 14 IN	2,288 TON	$32.79	$32.79 - $67.00[1]	$36.84	Both
D-1 Contraction Joint	1,850 ft	$9.01	$9.01 - $20.00[1]	$10.13	Both

Note:

1) Bidder I was higher on all PCCP items.

Conclusion

INDOT saved the tax payers approximately $893,472.49 immediately, at the bid opening, (HMA Low Bid – PCCP Low Bid). Using the Bid Analysis amounts (after PW costs applied); INDOT saved the tax payers approximately $1,143,256.33 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $21,160 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bid or which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was very successful.

PW of Future Maintenance of the Pavement

IR-30107 (US 31)

PW of HMA Section = $629,053.36

PW of PCCP Section = $379,269.52

HMA PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	37,138.50	33,015.99
6	Joint Seal	37,138.50	29,351.10
9	Joint Seal	37,138.50	26,093.02
12	Joint Seal	37,138.50	23,196.60
15	Joint Seal	37,138.50	20,621.69
18	Joint Seal	37,138.50	18,332.61
20	Mill and Functional Overlay	692,740.74	316,157.83
23	Joint Seal	37,138.50	15,068.07
26	Joint Seal	37,138.50	13,395.46
29	Joint Seal	37,138.50	11,908.51
32	Joint Seal	37,138.50	10,586.62
35	Mill and Resurface	327,645.07	83,030.33
38	Joint Seal	37,138.50	8,366.76
41	Joint Seal	37,138.50	7,438.02
44	Joint Seal	37,138.50	6,612.37
47	Joint Seal	37,138.50	5,878.38
Total HMA PW Cost			$629,053.36

PCCP PW for Future Rehabilitation Work			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	35,758.80	26,128.60
16	Reseal the Joint	35,758.80	19,091.92
24	Reseal the Joint	35,758.80	13,950.28
30	Mill and Functional Overlay	700,865.19	216,089.82
33	Joint Seal	37,138.50	10,179.45
36	Joint Seal	37,138.50	9,049.49
39	Joint Seal	37,138.50	8,044.96
42	Mill and Resurface	336,101.21	64,724.67
45	Joint Seal	37,138.50	6,358.05
48	Joint Seal	37,138.50	5,652.29
Total PCCP PW Cost			$379,269.52

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-30201)				
	Alternative 1: 10 inches PCCP		Alternative 2: 14 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$1,329.93*	*$0.00*	*$1,540.32*	*$0.00*
Present Value	**$379.27**	**$0.00**	**$629.05**	**$0.00**
EUAC	$17.65	$0.00	$29.28	$0.00
Lowest Present Value Agency Cost		Alternative 1: 10 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 10 inches PCCP		

Expenditure Stream				
	Alternative 1: 10 inches PCCP		Alternative 2: 14 inches HMA	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$37.14	
4				
5				
6			$37.14	
7				
8	$35.76			
9			$37.14	
10				
11				
12			$37.14	
13				
14				
15			$37.14	
16	$35.76			
17				
18			$37.14	
19				
20			$692.74	
21				
22				
23			$37.14	
24	$35.76			
25				
26			$37.14	
27				
28				
29			$37.14	
30	$700.86			
31				
32			$37.14	
33	$37.14			
34				
35			$327.64	
36	$37.14			
37				
38			$37.14	
39	$37.14			
40				
41			$37.14	
42	$336.10			
43				
44			$37.14	
45	$37.14			
46				
47			$37.14	
48	$37.14			
49				
50				

Appendix N

PR 69 (IR-33737)

Six (6) contractors participated in the bidding (6 PCCP options and 5 HMA options were bid) and all bids were below the engineer's estimate except one. Five (5) contractors participated in both pavement type pay options. All contractors had the option to bid either HMA pay items section or PCCP pay items section or both. There was a common section in this bid that was comprised of all the non pavement items for the contract. This bid was cost of pay items (Part A) plus closure user cost (Part B). In this contract, there were five pay item sections as follows:

1) HMA option on PR 69 mainline, shoulders and SR 45 ramps.
2) PCCP option on PR 69 mainline, shoulders and SR 45 ramps.
3) HMA option on Intersection of SR 45/SR 445.
4) PCCP option on Intersection of SR 45/SR 445.
5) Common section.

The low bidder was determined from the sum of following combinations of section bids, corresponding PW cost, and closure user cost (Part B).

a. Section 1, 3, & 5; or
b. Section 1, 4, & 5; or
c. Section 2, 3, & 5; or
d. Section 2, 4, & 5.

INDOT provided the following pavement design thickness for this project:

1. PR 69 mainline and shoulders
    a. 10.5 inches of PCCP with Composite HMA shoulder (4.5 inches HMA on 6 inches of Compacted Aggregate) or
    b. 13 inches of HMA with Composite HMA shoulder (6 inches HMA on 7 inches of Compacted Aggregate)
2. SR 45 ramps
    a. 8.5 inches of PCCP or
    b. 10 inches of HMA
3. Intersection of SR 45/SR 445
    a. 8.5 inches of PCCP or
    b. 12.5 inches of HMA

Bid Analysis Summary

1) HMA Pay item Options (PR 69 and SR 45 Ramps)

No contractor bid on HMA option for this section. The PW cost for HMA on PR 69 was determined to be $2,971,993.83.

2) PCCP Pay item Options (PR 69 and SR 45 Ramps)

Bidders	PCCP Section		PW Cost for PCCP		Bid Analysis
F	$8,807,206.61	+	$1,897,162.61	=	$10,704,369.22
D	$8,917,267.80	+	$1,897,162.61	=	$10,814,430.41
A	$9,127,886.10	+	$1,897,162.61	=	$11,025,048.71
B	$9,243,897.35	+	$1,897,162.61	=	$11,141,059.96
C	$9,816,908.92	+	$1,897,162.61	=	$11,714,071.53
E	$9,981,421.25	+	$1,897,162.61	=	$11,878,583.86

3) HMA Pay item Options (Intersection of SR 45/SR 445)

Bidders	HMA Section		PW Cost for HMA		Bid Analysis
D	$815,169.95	+	$251,831.13	=	$1,067,001.08
A	$828,599.19	+	$251,831.13	=	$1,080,430.32
B	$841,212.69	+	$251,831.13	=	$1,093,043.82
E	$843,743.19	+	$251,831.13	=	$1,095,574.32
C	$844,746.26	+	$251,831.13	=	$1,096,577.39

4) PCCP Pay item Options (Intersection of SR 45/SR 445)

Bidders	PCCP Section		PW Cost for PCCP		Bid Analysis
F	$863,495.84	+	$167,972.32	=	$1,031,468.16
B	$898,667.28	+	$167,972.32	=	$1,066,639.60
D	$977,645.11	+	$167,972.32	=	$1,145,617.43

5) Common Section

Bidders	Common Section
A	$63,210,734.60
B	$63,874,981.73
C	$67,966,462.23
D	$72,957,145.36
E	$72,431,556.16
F	$86,085,421.81

Low Bidder					
Bidders	Section 2 + PW (PCCP PR 69)	Section 3 + PW (HMA SR 45)	Section 4 + PW (PCCP SR 45)	Section 5 (Common Section)	Bid Analysis
A	$11,025,048.71	$1,080,430.32	--	$63,210,734.60	$75,316,213.63
B	$11,141,059.96	--	$1,066,639.60	$63,874,981.73	$76,082,681.29
	$11,141,059.96	$1,093,043.82	--	$63,874,981.73	$76,109,085.51
C	$11,714,071.53	$1,096,577.39	--	$67,966,462.23	$80,777,111.15
D	$10,814,430.41	$1,067,001.08	--	$72,957,145.36	$84,838,576.85
	$10,814,430.41	--	$1,145,617.43	$72,957,145.36	$84,917,193.20
E	$11,878,583.86	$1,095,574.32	--	$72,431,556.16	$85,405,714.34
F	$10,704,369.22	--	$1,031,468.16	$86,085,421.81	$97,821,259.19

Low Bid Ranks are sum of section 2 + section 3 or section 4 + section 5.

Total A+B Bid Analysis

Bidder	Low Combined Sections		Cost of user (B)		Bid Analysis
A	$75,316,213.63	+	$1,000,000	=	$76,316,213.63
B	$76,082,681.29	+	$1,050,000	=	$77,132,681.29
C	$80,777,111.15	+	$875,000	=	$81,652,111.15
D	$84,838,576.85	+	$500,000	=	$85,338,576.85
E	$85,405,714.34	+	$3,375,000	=	$88,780,714.34
F	$97,821,259.19	+	$2,125,000	=	$99,946,259.19

The low bid amount, out of all 6 bids combined sections including user cost, was Bidder A. After adding PW cost of HMA and PCCP to the respective pavement type options plus adding closure user cost to respective bidder's, PCCP option on PR 69 and SR 45 ramps and HMA pay items option on intersection of SR 45/SR 445 was the low (Bidder A). PCCP pay items option was awarded on PR 69 and SR 45 ramps and HMA option was awarded on intersection of SR 45/SR 445 for this contract. The PW cost factor did not affect the outcome of the bidding

INDOT compared the estimated cost with actual low bid costs of both pavement types. The following table shows the cost comparison with low bid of those pavement items that were relative to the mainline pavements and relative to this alternate bid for pavement type.

All other items in the bids were common to both types of pavement. Shoulders and "S" Lines are to be HMA.

Cost Comparison of Unique Items						
Bid Item	**Bid Quantities**	**Estimated Cost of Item Per Unit**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Option**
QC/QA PCCP, 10.5 IN.	142,311 yd^2	$27.39	$24.00	$24.00 - $30.50	$26.37	PCCP

QC/QA PCCP, 8.5 IN.	25,571 yd^2	$24.94	$23.00	$21.00 - $24.50	$22.70	PCCP
Subbase for PCCP	41,971 yd^3	$30.78	$28.00	$26.10 - $30.00	$28.51	PCCP
D-1 Contraction Joint	99,722 ft	$9.04	$8.00	$8.00 - $10.04	$9.25	PCCP
QC/QA-HMA, 3, 70, Surface	1,329 TON	$62.25	$71.50	$65.00 - $71.50	$68.91	HMA[1]
QC/QA-HMA, 3, 70, Intermediate	2,289 TON	$48.20	$52.00	$51.00 - $53.82	$52.16	HMA[1]
QC/QA-HMA, 5, 76, Intermediate, OG	2,296 TON	$50.18	$49.00	$49.00 - $59.10	$54.12	HMA[1]
QC/QA-HMA, 3, 64, Base	5,460 TON	$44.91	$51.25	$49.00 - $51.71	$50.64	HMA[1]
QC/QA PCCP, 8.5 IN.	16,107 yd^2	$24.94	$31.06	$31.06 - $36.00	$32.85	PCCP[1]
Subbase for PCCP	4,861 yd^3	$30.78	$27.42	$27.42 - $30.00	$29.14	PCCP[1]
D-1 Contraction Joint	9,309 ft	$9.04	$7.37	$6.00 - $8.40	$7.25	PCCP[1]

Note:

1) These pay items are for intersection of SR 45/SR 445 options.

The above table shows that on mainline PR 69 and SR 45 ramps, average bid and low bid cost of pavement items on the PCCP option were lower than the estimates used in evaluation. This shows that INDOT realized true saving on mainline PR 69. The majority of low bid and average bid cost of pavement items for both HMA and PCCP options on Intersection of SR 45/SR 445 were above the estimates used in evaluation due to maintenance of traffic and closure user cost. INDOT did not realize a savings at that location but overall on this contract true saving was realized by this process.

The table below compares some of the HMA and PCCP items on the common section of the contract to check for unbalanced bids. All low bid cost of items were higher than the average bid cost items. This may be due to low quantities or other reasons, but these bids appear to be consistent and no anomalies were found.

Cost Comparison of Some Common Items Used in Both PCCP and HMA					
Bid Item	**Bid Quantities**	**Low Bid Cost of Item Per Unit**	**Range of Bid Costs of Item Per Unit**	**Average Bid Cost of Item Per Unit**	**HMA or PCCP Bid**
HMA, Surface, Type A	1,158 TON	$71.00	$61.00 - $71.00	$65.66	Both
HMA, Surface, Type B	924 TON	$69.00	$61.00 - $69.00	$65.16	Both
HMA, Surface, Type C	127 TON	$88.00	$75.00 - $88.00	$80.02	Both
HMA, Intermediate, Type A	773 TON	$70.00	$53.00 - $70.00	$59.66	Both
HMA, Intermediate, Type B	1,512 TON	$63.00	$53.00 - $63.00	$57.33	Both

Conclusion

Since, none of the contractors participated in the HMA option on Mainline PR 69 and SR 45 Ramps, INDOT did not realize any savings by comparing the HMA and PCCP bids, immediately after the bid opening. However after using the PW cost factor difference for four sections and awarded bid (PW cost of HMA on PR 69 and PCCP on Intersection SR 45/SR 445 ($2,971,993.83 + $167,972.32) minus PW cost of PCCP on PR 69 and HMA on Intersection of SR 45/SR 445 ($1,897,162.61 + $251,831.13)), INDOT saved the tax payers approximately $978,972.41 over the 50 year service life of the pavement. These savings include the reduction of INDOT's consultant cost of $12,000.00 for producing two sets of typical plan sheets and quantities. The in-house costs for INDOT were determined negligible.

The PW cost for future maintenance did not impact the bid or which contractor received the contract. INDOT believes using this process of alternate bids for pavement type selection on this project was successful.

PW of Future Maintenance of the Pavement

IR-33737 (PR 69)

PW of HMA Section (PR 69) = $2,971,993.83

PW of PCCP Section (PR 69) = $1,897,162.13

PW of HMA Section (Intersection SR 45/SR 445) = $251,831.13

PW of PCCP Section (Intersection SR 45/SR 445) = $167,972.32

HMA PW for Future Rehabilitation Work PR 69 Mainline and Ramps			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	164,778.60	146,487.58
6	Joint Seal	164,778.60	130,226.92
9	Joint Seal	164,778.60	115,771.26
12	Joint Seal	164,778.60	102,920.23
15	Joint Seal	164,778.60	91,495.71
18	Joint Seal	164,778.60	81,339.35
20	Mill and Functional Overlay	3,394,463.66	1,549,188.90
23	Joint Seal	164,778.60	66,855.02
26	Joint Seal	164,778.60	59,433.87
29	Joint Seal	164,778.60	52,836.49
32	Joint Seal	164,778.60	46,971.45
35	Mill and Resurface	1,589,972.06	402,923.52
38	Joint Seal	164,778.60	37,122.22
41	Joint Seal	164,778.60	33,001.52
44	Joint Seal	164,778.60	29,338.23
47	Joint Seal	164,778.60	26,081.58
Total HMA PW Cost			$2,971,993.83

PCCP PW for Future Rehabilitation Work PR 69 Mainline and Ramps			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	209,416.20	153,018.37
16	Reseal the Joint	209,416.20	111,809.02
24	Reseal the Joint	209,416.20	81,697.76
30	Mill and Functional Overlay	3,442,672.47	1,061,440.19
33	Joint Seal	164,778.60	45,164.85
36	Joint Seal	164,778.60	40,151.39
39	Joint Seal	164,778.60	35,694.44
42	Mill and Resurface	1,635,198.89	314,898.31
45	Joint Seal	164,778.60	28,209.83
48	Joint Seal	164,778.60	25,078.44
Total PCCP PW Cost			$1,897,162.61

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

HMA PW for Future Rehabilitation Work Intersection of SR 45/SR 445			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
3	Joint Seal	13,868.40	12,328.96
6	Joint Seal	13,868.40	10,960.40
9	Joint Seal	13,868.40	9,743.75
12	Joint Seal	13,868.40	8,662.16
15	Joint Seal	13,868.40	7,700.63
18	Joint Seal	13,868.40	6,845.83
20	Mill and Functional Overlay	289,188.12	131,981.68
23	Joint Seal	13,868.40	5,626.78
26	Joint Seal	13,868.40	5,002.18
29	Joint Seal	13,868.40	4,446.92
32	Joint Seal	13,868.40	3,953.30
35	Mill and Resurface	134,215.62	34,012.31
38	Joint Seal	13,868.40	3,124.35
41	Joint Seal	13,868.40	2,777.53
44	Joint Seal	13,868.40	2,469.22
47	Joint Seal	13,868.40	2,195.13
Total HMA PW Cost			$251,831.13

PCCP PW for Future Rehabilitation Work Intersection of SR 45/SR 445			
Age in Years	Rehabilitations	Cost $	Present Worth Cost $
8	Reseal the Joint	19,548.90	14,284.19
16	Reseal the Joint	19,548.90	10,437.32
24	Reseal the Joint	19,548.90	7,626.45
30	Mill and Functional Overlay	295,128.81	90,993.72
33	Joint Seal	13,868.40	3,801.25
36	Joint Seal	13,868.40	3,379.30
39	Joint Seal	13,868.40	3,004.18
42	Mill and Resurface	155,580.85	29,960.97
45	Joint Seal	13,868.40	2,374.25
48	Joint Seal	13,868.40	2,110.70
Total PCCP PW Cost			$167,972.32

PW = F [1/(1+i)n]

Where: F = Future Construction Cost
i = Discount rate (4%)
n = Number of years from year zero

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-33737) PR 69 and SR 45 Ramps				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 13 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$6,530.01*	*$0.00*	*$7,291.33*	*$0.00*
Present Value	**$1,897.16**	**$0.00**	**$2,971.99**	**$0.00**
EUAC	$88.31	$0.00	$138.35	$0.00
Lowest Present Value Agency Cost		Alternative 1: 10.5 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 10.5 inches PCCP		

Expenditure Stream				
	Alternative 1: 10.5 inches PCCP		Alternative 2: 13 inches HMA	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$164.78	
4				
5				
6			$164.78	
7				
8	$209.42			
9			$164.78	
10				
11				
12			$164.78	
13				
14				
15			$164.78	
16	$209.42			
17				
18			$164.78	
19				
20			$3,394.46	
21				
22				
23			$164.78	
24	$209.42			
25				
26			$164.78	
27				
28				
29			$164.78	
30	$3,442.67			
31				
32			$164.78	
33	$164.78			
34				
35			$1,589.97	
36	$164.78			
37				
38			$164.78	
39	$164.78			
40				
41			$164.78	
42	$1,635.20			
43				
44			$164.78	
45	$164.78			
46				
47			$164.78	
48	$164.78			
49				
50				

Probabilistic Life Cycle Cost Analysis Worksheet

Total Cost (IR-33737) Intersection of SR 45/SR 445				
	Alternative 1: 8.5 inches PCCP		Alternative 2: 12.5 inches HMA	
Total Cost	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$578.69*	*$0.00*	*$617.55*	*$0.00*
Present Value	**$167.97**	**$0.00**	**$251.83**	**$0.00**
EUAC	$7.82	$0.00	$11.72	$0.00
Lowest Present Value Agency Cost		Alternative 1: 8.5 inches PCCP		
Lowest Present Value User Cost		Alternative 1: 8.5 inches PCCP		

Expenditure Stream				
	Alternative 1: 8.5 inches PCCP		**Alternative 2: 12.5 inches HMA**	
Year	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
0				
1				
2				
3			$13.87	
4				
5				
6			$13.87	
7				
8	$19.55			
9			$13.87	
10				
11				
12			$13.87	
13				
14				
15			$13.87	
16	$19.55			
17				
18			$13.87	
19				
20			$289.19	
21				
22				
23			$13.87	
24	$19.55			
25				
26			$13.87	
27				
28				
29			$13.87	
30	$295.13			
31				
32			$13.87	
33	$13.87			
34				
35			$134.21	
36	$13.87			
37				
38			$13.87	
39	$13.87			
40				
41			$13.87	
42	$155.58			
43				
44			$13.87	
45	$13.87			
46				
47			$13.87	
48	$13.87			
49				
50				