Pavement Type Selection for Alternate Contracting

IAPA Annual Meeting
March 9, 2015
Overview

Contracting Types
- D-B-B, D-B, CM/GC, DBOM, DBFOM, P3

Pavement Type Selection Basics
- Economic and non-economic factors

Flexible vs. Rigid

Design Features
Why is this Illinois guy qualified to talk about things that are not common to Illinois?

Pavement Design Specialist
- $4B+ P3 Projects
- $700M DBOM
- $4B+ D-B Projects

FHWA Innovation Deployment Contractor
- Design-Build
- CM/GC
- Alternate Technical Concepts (ATC)
Historical Background: FHWA Procurement Requirements

- Mid-1800’s, many states adopt “low bid” requirements to protect taxpayers from extravagance, corruption and other improper practices by public officials

- 1938 Federal Highway Act required competitive bidding

- 1968 Federal Highway Act revised Title 23 USC to award construction contracts, “…only on the basis of the lowest responsive bid.”

- February 2, 1990, FHWA establishes “Special Experimental Project No. 14 – Innovative Contacting”

- 1998 TEA-21 authorizes design-build
There are many project delivery methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Delivery Type</th>
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<tbody>
<tr>
<td>Design – Bid – Bid</td>
<td>Traditional Delivery</td>
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<td>Design – Build</td>
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<td>Construction Manager / General Contractor</td>
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<td>SEP – 14 Cost Plus Time Bidding</td>
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<td>SEP – 14 Lane Rental</td>
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<td>Design – Build – Operate – Maintain</td>
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<tr>
<td>Design – Build – Finance – Operate – Maintain</td>
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<td>Public Private Partnership (P3)</td>
<td>Alternate Delivery</td>
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Alternate delivery encourages innovation

**Alternative Technical Concepts**

- Confidential proposals for consideration
- Advances new technology, materials, construction
- Allows owners to receive full competitive value
  - (vs. 50% share through value engineering change proposal)

**Use of best tools, materials, practices**
NCHRP 10-75 Project Objective

Develop a Guide for Pavement-Type Selection.

Include processes for consideration in making decisions regarding pavement-type selection, using:

• Agency-based (decision is internal to the highway agency) processes.

• Contractor-based (selection is made by the contractor using criteria stipulated by the agency) processes.
Economic Pavement Type Selection Factors

- Initial Cost
- Rehabilitation Cost
- Maintenance Cost
- User Cost
- Life Cycle Cost
Non-Economic Pavement Type Selection Factors

- Roadway/lane geometrics
- Continuity of adjacent pavements
- Continuity of adjacent lanes
- Traffic during construction
- Availability of local materials
- Conservation of materials
- Local preference
- Stimulation of competition

- Noise
- Safety
- Subgrade soils
- Experimental features
- Future needs
- Maintenance Capability
- Sustainability
The Operations and Maintenance Type in Alternate Delivery Drives Bidder Strategy

No Operations – Maintenance Component

• Be low responsive bidder
• Eliminate work items with high cost or long time

With O&M LCCA & Risk Management Key

• LCCA over period of O&M (considering turn back)
• Pavement performance risk
• Price risk
• O&M strategies
Discount rate drives decisions

Private Financing

FHWA Guidance

*OMB Circular No. A-94
Pavement Design Considerations

Some Limit Pavement Alternatives
• Prescriptive designs
• Prescriptive typical sections
• Little room for innovation

Most allow approved methods/technologies
• Local design method
• AASHTO Pavement ME Design
• Other design methods

With O&M, more innovation allowed
Pavement Type

Rigid Pavement vs. Flexible Pavement

- Team preference
- CRCP rarely selected

Most factors of safety are out

- D-B – Do what you can get approved through ATC
- Finance – Risk assessment
  - What will the failure mechanism be?
  - What are the maintenance requirements?
Pavement drainage – Yes or No?
Longitudinal Joints Handled Different Based on Alternate Contracting Type

No O&M

- Follow the specification

O&M

- Evaluate risk, cost, schedule
- Often increased attention to longitudinal joints
- Often consideration for echelon paving, cut back, etc.
Pavement ME is an analysis tool

Designer/contractor evaluates “what-if”

Results allow the evaluation of risk
Mechanistic-Empirical Design

Climate

Materials

Response

Damage Accumulation

Time

Damage

Structure

Traffic

Field Distress
Predicting Distress

- Fatigue Cracking
- Longitudinal Cracking
- Thermal Cracking
- IRI
- Rut Depth
- Depth
Design Parameters Over Pavement Life

- CTB Modulus
- Traffic
- Granular Base Modulus
- Subgrade Modulus

Each load application

Time, years
Base Stiffness Impacts Needed Thickness

![Graph showing the relationship between AC thickness and alligator cracking percentage for different values of SG Mr. The graph indicates that as AC thickness increases, the alligator cracking percentage decreases for all values of SG Mr.](image)

- SG Mr = 30 ksi
- SG Mr = 25 ksi
- SG Mr = 20 ksi
- SG Mr = 15 ksi
- SG Mr = 8,000
- SG Mr = 3,000
Effect of HMA Modulus ($E^*$) on Alligator Cracking

- Low $E^*$
- Medium $E^*$
- High $E^*$

Alligator Cracking, %

Subg. Mod = 30 ksi
Subg. Mod = 15 ksi
Subg. Mod. = 3 ksi
Mix Properties Matter

![Graph showing the relationship between Mix Effective Binder Content (by Volume) and Alligator Cracking percentage. The graph indicates a decreasing trend as the binder content increases.]
Mix Properties Matter

![Graph showing the relationship between Air Voids, Percent and Alligator Cracking, %]

- Y-axis: Alligator Cracking, %
- X-axis: Air Voids, Percent

The graph indicates a positive correlation between the percentage of air voids and the percentage of alligator cracking.
Mix Properties Matter

![Graph showing the relationship between HMA Air Voids and Rutting.](chart.png)
Mix Properties & Construction Practices Can Reduce Thickness at the Same Performance

10” Full-Depth HMA Section
• 6% in-place Voids in all mixes

9” Full-Depth HMA Section
• 5% in-place voids in all mixes

Similar Performance
Parting Thoughts

Pavement type selection is more complex under alternate contracting

Economic and non-economic factors are still part of the evaluation

Tools not same as Illinois standards

Designers/contractors can innovate
  • Leads to lower cost solutions
  • Equivalent or better performance
William R. Vavrik, Ph.D., P.E.
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Thank You!