Sustainability and Concrete Pavement?

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Hampton Georgia
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“Sustainable development is like teenage sex – everybody claims they are doing it, but most people aren’t, and those that are, are doing it very badly.”

Dr. Chris Spray, Northumbrian Water
Sustainability?

- Highway Engineer will focus on:
  - Structural design
  - Pavement materials
  - Construction

- Items such as:
  - Recycling
  - Industrial byproducts
  - Resource conservation
  - Energy use

Are we missing significant opportunities?

Are we missing the target?
Sustainability?

Opportunities are missed by ignoring the operational or use-phase of the pavement!

Research suggests the long-term, cumulative benefits can be staggering.

Need LCA framework!

So, central question for engineers/administrators: In the context of sustainable practices...

Are we focusing on the right things?
Plastic Water Bottles

- Recycling = Good

.. right?

Not necessarily!

Source: Springwaterinfo.com
Sustainability and Roadways?

- ACPA Special Report on Green Roadways...
- Emphasizes longevity as the primary opportunity!!

Countless examples worldwide!

Image: Google Images
Sustainable Benefits *Beyond* Longevity

*Can be achieved through selection, design and mixture optimization!*

- Two-lift pavements
- Ternary Mixtures
- New Cements
- Overlays
- SCMs
- RCA

![Diagram showing sustainable benefits and features of pavement materials](image-url)
Sustainability and Roadways...

What to make of all these opportunities?

- Only with an accounting of the impacts will we ever know what is actually important!

- Need Life Cycle Assessment framework/tools
  - FHWA, MIT, IL Tollway, PE-2, Athena...

- Only way highway administrators be able to consider and properly account for the cumulative impacts of their decisions

- It's about tradeoffs and informed decisions!
Sustainability is about more than Environment...

- Economic sustainability... Often overlooked in context of sustainability discussions.

Opportunities with Competition!

• Not about highlighting superiority of concrete over asphalt – not constructive!
• About extending the purchasing power of the highway dollar
• This provides VALUE to the agency/owner
• Agencies benefit from presence of both pavement types!
Context

- Over $90 billion spent on highways in U.S. every year – nearly a TRILLION dollars every decade
- Agencies under enormous pressure to demonstrate good stewardship
  - Magnitude of investment
  - Growing needs
  - Aging infrastructure
  - MAP-21 perf. measures
  - Additional revenues....?
- However, this is nothing new...
Competitive Paving Program

- Early years of US Federal Aid Program
  - Public instances of fraud, abuse, collusion...
  - Congress and public lost confidence in administration of program (largest ever – estimated at $27 billion in 1956)
  - Investigations (FBI, GAO, Blatnik Committee)
  - BPR → AASHO compelled to develop guidelines to restore confidence in program
Competitive Paving Program

- 1960 AASHO Guide on Project Procedures
  - Includes *Pavement Type Selection*...
1960 AASHO Guide

• Covers a lot of information... aim “to assure the public of full value for their highway dollar.”
• Established process based on transparency, and sound engineering while leveraging benefits of free market dynamic through healthy and spirited competition (includes host of factors)
• Despite advancements in design and modeling, authors warn that PTS process only meaningful in presence of competition between industries.
1960 AASHO Guide

- In section on cost comparisons (LCCA): *doubt as to the validity [of such analysis] arises in the case where on[e] type of pavement has been given monopoly status by the long-term exclusion of a competitive type.*
- I.e., the cost-data is not meaningful...
- “...*desirable that monopoly situations be avoided...*”
- Often not recognized or considered appropriately by decision makers today
1960 AASHO Guide

- Guidelines basis for both FHWA policy, AASHTO Design Guides and 2011 NCHRP PTS guidance
Competitive Paving Program

ACPA analysis of current bid tabs confirm benefits

2013 weighted unit asphalt bid price vs. five-year average balance of DOT pavement type usage
Source: OMAN, Bid Tabs Software – Public Data.

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Increasing Competition ---
Competitive Paving Program

ACPA analysis of current bid tabs confirm benefits

Source: OMAN, Bid Tabs Software – Public Data.

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Increasing Competition

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Average unit price = $63.71
(with 100-90% asphalt share)

Average unit price = $31.94
(with 70-60% asphalt share)
Competitive Paving Program

• No US state spends less than 60% of paving dollar on asphalt – on average
• At least 18 states spend more than 90% of their paving dollars on one pavement type only (no diversification, higher exposure and risk)
• As competition increases between industries, unit bid prices (and variability) drop for both, regardless of PTS process...

CONFIRMS what officials recognized 58 years ago
Competitive Paving Program?

From 5-year rolling average balance of DOT pavement type, based on Oman Systems bid tabulations.
Competitive Paving Program

Same data viewed through a break-even analysis...

<table>
<thead>
<tr>
<th>Budget</th>
<th>Asphalt Portion of Budget</th>
<th>Expenditure on Asphalt (millions)</th>
<th>Asphalt Unit Price ($/ton)</th>
<th>Tons of Asphalt</th>
<th>Expenditure on Concrete</th>
<th>Concrete Unit Price ($/SY)</th>
<th>Square Yards of Concrete</th>
</tr>
</thead>
</table>

**Asphalt ($/ton)**
- Unit Price versus Share of Pavement Spending on Asphalt
- Average unit price = $76.72 (with 100-90% asphalt share)
- Average unit price = $61.85 (with 70-60% asphalt share)

**Concrete ($/SY)**
- Unit Price versus Share of Pavement Spending on Asphalt
- Average unit price = $63.71 (with 100-90% asphalt share)
- Average unit price = $31.94 (with 70-60% asphalt share)

MORE PAVEMENT FOR SAME INVESTMENT!
Parting Thoughts

Early Experiments in Transportation
Competitive Paving Program

- A competitive two-pavement system:
  - Lowers prices
  - Spurs innovation
  - Improves quality
- Allows agencies to build more pavements for same investment!
- At least half of US states can benefit significantly from instilling and enhancing competition – Georgia is probably one!
Competitive Paving Program

• Few other opportunities are likely to have such a pronounced positive effect on an agency's ability to address mounting infrastructure challenges with severely constrained resources...

• Can help agencies extend the purchasing power of the highway dollar

Image: actioncoach.com
Competitive Paving Program

• Competition can be a solution for an agency
  • Improve cost efficiency of program
  • Improve quality
  • Increase confidence in administration of program
  • Support increasing revenues...

• It's about enhanced stewardship... and economic sustainability!
“It is imperative that all possible and proper measures be taken to ensure the tax payers of this country that they are receiving full value of every highway dollar spent.”

AASHO 1960
Established Alliance for Pavement Competition

- Currently working with NRMCA and PCA (all are welcome!)

  - Website launched competitionpaves.org
  - Extending the Purchasing Power of the Highway Dollar using Competition Between Industries is central theme
  - Rollout at AASHTO 100th meeting
  - Engaging MIT CSH

- Exciting effort – opportunities for economic sustainability!
Context

- Start with a $100 bill – largest US denomination in general circulation!
A packet of one hundred $100 bills less than \( \frac{1}{2} \) inch thick amounts to $10,000.
What about $1$ million? Fits in a grocery bag!
$100 million? Fits neatly on a pallet.
One billion dollars! (these are all $100 bills)
Context

- This is what **one trillion dollars** looks like!
  (notice the pallets are double-stacked)