A Strategic Approach to Concrete Pavement Preservation/Maintenance

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The Preservation Concept
State of Current Practice
Concrete Pavement Performance Curves and Intervention Cycles
Using PMS for Concrete Preservation
Concrete Preservation Solutions
“Pavement Preservation is a program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost effective set of practices that extend pavement life, improve safety and meet motorist expectations.” (FHWA 2005)

The right design, the right material, and the right quality
The Preservation Concept

Three Clear Expectation/Outcomes

- Pavement Life Extension
- Improved Safety
- Customer Satisfaction
The Preservation Concept
 Defines How Process Must Be Accomplished

- Through Long-Term Network Approach
- Using Integrated, cost-effective practices

“Now, if you can find the power switch, flip it on.”
Pavement Life Extension

- Treatment life vs pavement life
- Does the treatment extend the pavement life?
- Is the treatment cost-effective?
Improved Safety

- Often “addressed through pothole or spall repair
- What is the definition of a safe pavement?
- How is safety incorporated into pavement preservation?

![Bar chart showing 43,200 fatalities on U.S. highways and 13,000 fatalities linked solely to road conditions. Data sources: National Highway Traffic Safety Administration and American Road and Transportation Builders Assn.]
Customer Satisfaction

- Best achieved through smooth roadways and minimizing construction & maintenance delays
- Road roughness is measurement of choice
- Long-life preservation treatments provide least customer interruption
“Long Term and Cost Effective”

- These terms imply LCCA should be incorporated into process
- Ensures resources are properly utilized and roadway investment is managed adequately
- This requires accurate performance, construction, and cost data
Classic curve infers investments made early are more beneficial
Assumes that all pavement types and strategies perform equally
Leads to over simplification and anecdotal approaches in lieu of solid data/analysis
ME Design allows prediction of future intervention levels
Holistic Preservation Approach

- Must select preservation strategies A-priori, cradle to grave
- Must allocate funding for planned preservation cycles from concept
- Must develop feedback loop between design, construction, maintenance and administration
Concrete Preservation State-of-the-Practice

- PCCP traditionally used in urban, high traffic areas where long life pavements are warranted to reduce delays and congestion associated with construction and maintenance activities.
- Specifiers are not accustomed to “preserving” PCCP.
Concrete For Heavy Loads Only
And It Works Well For Heavy Loads

U.S. ECONOMY

IF YOU'D CARRIED AS MANY LOADS AS IT HAS YOU'D BE SHOWING YOUR AGE, TOO.

INTERSTATE HIGHWAY SYSTEM
The Original Definition of Sustainability – 1st Concrete Pavement 1891(3)
Purpose of Concrete Pavement Preservation

- Used early when pavement has little deterioration and consistently throughout its life if needed.
  - Repairs isolated areas of distress.
  - Repairs some construction defects.
  - Manages the rate of deterioration.
Intervention Timing

- Preservation
- Resurfacing
- Reconstruction

Structural / Functional Condition

Min. Acceptable Rating

Age or Traffic
Pavement Life Extension

- Original Pavement
- Preserved Pavement

- Structural / Functional Condition
- Terminal Condition

- Age or Traffic

CPP

Additional Life
Concrete Performance is Different

- Typical preservation curves used for both PCC and ACP
- Concrete treatment generally effective for longer intervals than other preservation strategies
- Owner/agencies must develop realistic performance curves for both original life and preservation treatments
Concrete Preservation (120 yrs Later)

- **Original Pavement**
- **Preserved Pavement**
- **CPP**
- **Terminal Condition**
- **Additional Life**
- **Age or Traffic**

**Structural / Functional Condition**
Concrete Pavement Intervention Cycles

- Due to long life of PCCP many owners/agencies have ignored Concrete Preservation
- Tight funding and “worst first” principles exacerbate the problem
- Intervention cycles must be shifted earlier in the performance period
- Owner/agency must improve data collection and analysis process to justify this shift

Great Tune, But Can’t Dance To It!
Life Extension Through Improved Design and Construction

- Most concrete maintenance activities are determined after the fact.
- Little opportunity to prevent poor performance created by design or construction.
- Better built PCCP lasts longer.
- Must identify features that cause performance differences and attempt to extend pavement life from the onset.
FHWA ETG Survey Of State Practices

Survey of State DOT PMS Trigger Values for Concrete Pavement Preservation

Preliminary Draft Not for Distribution

The FHWA Pavement Preservation ETG Rigid Subcommitte conducted a survey of the state DOT PMS practices to determine the state of the practice of concrete pavement preservation. Thirty-eight states responded to the survey and 23 states (61%) used trigger values for managing concrete pavements within the PMS system. Recommendations for follow-up activities are included.

Map of the United States showing states with and without trigger values for concrete pavement preservation.
## Trigger/Limit Values for Pavement Preservation (JPCP)

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Trigger Value</th>
<th>Limit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trans. Cracking</td>
<td>1.5-2.5% of slabs cracked</td>
<td>5-15% of slabs cracked</td>
</tr>
<tr>
<td>Joint Spalling</td>
<td>1.5-2.5% of joints</td>
<td>15-20% of joints</td>
</tr>
<tr>
<td>Joint Faulting</td>
<td>0.10 inches</td>
<td>0.50-0.70 inches</td>
</tr>
<tr>
<td>Roughness</td>
<td>63-90 in/mi</td>
<td>160-220 in/mi</td>
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Recent FHWA Study of AZ LTPP SPS-2

11” PCCP

8” PCCP

Figure 10. Left IRI progression, section 0213.

Figure 11. Right IRI progression, section 0213.

Curl and Warp Analysis of the LTPP SPS-2 Site in Arizona

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Concrete Pavement Preservation

- Is a series of engineered techniques developed over the past 40 years to manage the rate of deterioration on aging PCCP.
- It is a non-overlay option used to repair distress without changing the grade that restores the pavement to a condition close to or better than original.
Typical Concrete Preservation Activities

- Diamond Grinding or Diamond Grooving
- Partial Depth or Full Depth Patching
- Dowel Bar Retrofit
- Joint Sealing or Resealing
- Slab Jacking
- Slab Replacement
- Longitudinal Crack Stitching
Partial Depth Repairs

If distress less than 1/3 D
Things to Watch For

- Point Bearing
- Pop out & Breakage
- Joint Closure
- Debonding

Expansion ➡️ Expansion
Full-Depth Patching

- **Purpose**
  - Restore structure
  - Restore ride
  - Prevent further deterioration

- **Used for**
  - Joint/crack deterioration
  - Broken slabs
  - Corner breaks
Full Depth Patching

May also need to:
Slab Stabilize
Base

If distress greater than 1/3 D
Full Depth Patching
Purpose of Dowel Bar Retrofit

- Reestablish load-transfer across joints or cracks
  - Load-transfer is a slab’s ability to transfer part of its load to its neighboring slab
- Used in JRC and JPC pavements to limit future faulting
Dowel Bar Retrofit

Also need to:
Reseal Joints
Dowel Slot Alignment

- Must always be parallel to centerline
- Must be cut so at least one-half of dowel can be on each side of the joint or crack
Slab Stabilization / Undersealing / Slab Jacking

- Fills voids underneath the pavement.
- Reestablishes uniform support.
- Reduces stresses and deflections.

Injected Material
Effectiveness of Slab Stabilization

- Most effective on pavements with little structural damage
- Perform only where voids are known to exist
- Effective at reducing deflections for up to 10 years
- Effective at Leveling Up Slabs
Injection Process
Longitudinal Joint & Crack Repair
Cross Stitching

Top View

See Note A 24 in. min.

Cross-sectional View

35°-45°

See Note B

0.75-in. dia. Rebar
Epoxy into Place

Transverse Joint

Cross-stitch Holes (Typ.)
(Alternate sides of crack)

Note A: Distance between holes is 24 in. for heavy traffic; 36 in. for light traffic
Note B: Determine distance from longitudinal crack to hole based on slab thickness T and drill angle. Slabs less than 12 inches thick require a 35° insertion angle.
Sealing and Resealing

Sealant Nozzle

Reservoir

Backer Rod
Buried Treasure

Removed by Diamond Grinding
Finished Buried Treasure

RT 21
1931
1958
1970

30 % Ride Improvement
Commodity Price Increases

Concrete PPI
Asphalt PPI
CPI
3.6% inflation
5.5% inflation
3.9% inflation

Index Value (1958 = 100)
Its Cost Effective and Predictable

National CDG Cost for Projects
> Than 7,000 SY
Many available treatments for PCC pavements

Each strategy has advantages and limitations

Performance and cost vary with given conditions

PMS and Design guide are critical to establishing life extension

Take advantage of local contractor experience
Questions?
THANK YOU

Keeping good roads good!!

Let's have one more and then we'll go!!