Rubblization

Rehabilitation for Concrete Pavements

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Rubblelization

Overview

• Effective rehab for PCC
  – Break PCC into small segments
  – Overlay with Hot Mix Asphalt Road-user-friendly
  – Rubblize and pave in off-peak hours
  – High production rates

• Final Product
What is rubblization?

• Fracturing:
  – Eliminates slab action
  – Destroys bond between concrete and steel

• Rubblized base responds as a tightly keyed, interlocked high-density, unbound layer
  – Layer cannot crack; already fractured
Why Rubblize?

- Fracturing PCC to segments less than 9” precludes reflection of:
  - Joints
  - Cracks
  - Faults
- Production Rates up to 1 lane-mile/day
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Purposes for Overlaying PCC Pavements

• Improve ride quality
• Correct surface defects
  – improve surface drainage
  – increase surface friction
• Delay/prevent structural deterioration
• Strengthen pavement structure (rehabilitation)
Pavement Rehabilitation Design Factors

- Pavement type
- Condition of existing pavement
  - Drainage
  - Distress
  - Response to load
- Foundation strength/stiffness
  - Subbase
  - Subgrade
- Future traffic loading
- Additional corrections (safety, capacity, etc)
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Reflection Cracking

• By far, the biggest problem in HMA overlays of PCC pavement
• Caused by movement at PCC joints and cracks
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Larger Pieces = Larger Movement = Cracking

- HMA
- PCC
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Smaller Pieces = Smaller Movement = No Cracking
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Benefits

• Time savings
  – Choose work hours
  – High production rates

• Economic Savings
  – Reduce user delay costs
  – Reduce construction costs
Benefits (continued)

- Environmentally friendly
  - Reduce landfill
  - Reduce fuel consumption/air pollution
- Smoothness
  - Eliminate reflection cracking/faulting
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Construction Procedure

• Install/replace existing edge drainage system as required
• Remove existing overlay (if present)
• Remove existing HMA patches, replace with aggregate base as required
• Fracture the concrete pavement
• Roll
• Place HMA overlay (multiple lifts)
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Resonant Pavement Breaker
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Multi-Head Breaker (MHB)
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Rolling

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**Particle Size**

- PCC fractured into 9 in.-minus pieces
- Most pieces are 1-4 in. diameter
- Aggregate interlock maintained beneath surface
- Rolling knits together surface particles
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When to Rubblize

- Patching $> 10\%$.
- Severe D-cracking.
- Severe ASR or ACR cracking.
- Dowel bar locking
- Severe joint deterioration
- Persistent faulting.
Precaution

• Weak soils may make construction difficult.

• Option 1
  – Adjust breaking pattern (12 - 18”) in soft areas.
  – Use normal seating rolling.
  – Resume smaller pattern after weak area.
Rubblezation

Precaution

• Option 2
  – Cease rubblezation
  – Define weak area
  – Remove/replace problem material
  – Resume normal operations when past weak area

• Perform a good soils evaluation prior to construction
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How Effective is Rubblization?

• Witczak and Rada, 1992
  – "Rubblization . . . is the preferred rehabilitation method for all types of PCC pavements."

• Thompson, 1999
  – Rubblization is a "viable and cost-effective rehabilitation option."
How Effective is Rubblization?

• 26 States have specifications for Rubblization

• Arkansas
  – 100 miles of rubblization this year
  – 300 miles over a 3-year period
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Projects

• I-440, Raleigh Beltway, North Carolina
  – $21.5 million contract
  – 3 1/2 mile project
  – AADT = 100,000+

• Awards
  – 1993 Sheldon G. Hayes Award - NAPA
  – 1993 Pinnacle Award - AGC
  – 1995 NQI Achievement
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I-440, Raleigh Beltway, North Carolina
Rubblization

I-65, Alabama

• Rubblize existing concrete pavement
• Widen overall roadway
• Place Permeable Asphalt Treated Base under new lanes
• Overlay with Superpave
• FHWA Showcase October 1997
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Projects

As of July 1999

- 20 + projects
- 1-4 projects
- 5 + projects
- 10 + projects

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Rubblizing Performance
All Data

PCR = 70 @ 22.4 years

y = -1.3149x + 99.439
R^2 = 0.5419
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Comparisons

Alternatives:

• Rubblize PCC, overlay with 10” HMA
• Remove PCC, replace with 12” Fast Track PCC
• Leveling course, 10” Fast Track PCC
### Rubblization

#### Comparisons

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Est. Cost</th>
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</thead>
<tbody>
<tr>
<td>Rubblize, 10&quot; HMA</td>
<td>$17-23/sy</td>
</tr>
<tr>
<td>10&quot; unbonded PCC (Fast Track)</td>
<td>$26-36/sy</td>
</tr>
<tr>
<td>Remove, replace w/12&quot; Fast Track PCC</td>
<td>$34-46/sy</td>
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</tbody>
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References

Guidelines For Use Of HMA Overlays To Rehabilitate PCC Pavements

Asphalt Overlays for Highway and Street Rehabilitation
Conclusions

- Rubblization is effective. Prevents reflective cracking.

- Rubblization can be done rapidly, minimizing delays.

- Researchers and agencies have concluded that rubblization is technically sound.