Asphalt Repair and Maintenance Techniques Airfields

Alexander (Sandy) Brown, P.Eng.
Canadian Regional Engineer – Asphalt Institute
Technical Director – OHMPA
Repair and Maintenance Techniques
HMA Airfield Pavements

- Serviceability/Performance
- Local repairs
- Global Maintenance Alternatives
- Rehabilitation Strategies

- Short introduction
  - More detailed instruction at the 3 day FAA sponsored Airport Pavement Workshop taught by the Asphalt Institute
  - Nov 5 to 7 in Baltimore
Serviceability

- Ability of a pavement section to provide the intended service at a given point in time
- Method for quantifying the condition of a pavement section
Serviceability/Performance
Pavement Condition

Pavement Condition Index

Time or Traffic

Pavement Performance
Pavement Condition

Reactive Maintenance

Preventive Maintenance

Pavement Condition

Time or Traffic
Pavement Life Cycle

- Maintenance: $1.00/Sy
- Rehabilitation: >$10.00/SY
- Reconstruction: >$$$$

Condition (PCI): 70/60?
Pavement Life Cycle Theory

A Point In Time = Serviceability

PCI

Condition (PCI)

Time

Maint

Rehab

Reconstruct

www.asphaltinstitute.org
FAA Critical PCI

GAO Report No. 98-226
Airfield Pavement
Critical PCI Values

- Critical PCI for primary airports is 65
- Critical PCI for small airports is 55

Asphalt Airfield Pavement Performance

FAA - July 1999
Pavement Condition Index (PCI)

- Condition Survey - visual assessment of the pavement surface

<table>
<thead>
<tr>
<th>PCI Value</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Excellent</td>
</tr>
<tr>
<td>80</td>
<td>Good</td>
</tr>
<tr>
<td>60</td>
<td>Fair</td>
</tr>
<tr>
<td>40</td>
<td>Poor</td>
</tr>
<tr>
<td>20</td>
<td>Very Poor</td>
</tr>
<tr>
<td>0</td>
<td>Failed</td>
</tr>
</tbody>
</table>

- Survey quantifies the type, severity and extent of pavement distress

- Deduct valves for the distress provides a Pavement Condition Index (PCI)

65
55
Repair and Maintenance Techniques
HMA Airfield Pavements

- Serviceability/Performance
- Local repairs
- Global Maintenance Alternatives
- Rehabilitation Strategies
Pavement Repairs

- Reactive activities that keep pavement in adequate functional condition
- Localized - does not affect entire surface
  - Crack filling/sealing
  - Potholes
    - Filling
    - Patching
- Global - normally to improve drainage, surface friction or ride quality
Crack Repairs

- **Filling**
  - Minimal preparation
  - Short-term life
  - Does not keep water out

- **Sealing**
  - Careful preparation
  - Long-term
  - Keeps water out
# Crack Repair Guidelines

<table>
<thead>
<tr>
<th>Crack Width</th>
<th>Treatment Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1/8 inch (3 mm), non-working</td>
<td>• Do nothing</td>
</tr>
<tr>
<td></td>
<td>• Fog seal</td>
</tr>
<tr>
<td></td>
<td>• Surface treatment</td>
</tr>
<tr>
<td>1/8 – 3/4 inch (3 – 19 mm)</td>
<td>• Crack Fill (short life, prep for resurfacing)</td>
</tr>
<tr>
<td></td>
<td>• Crack Seal (&gt; 5 yr life)</td>
</tr>
<tr>
<td>&gt; 3/4 inch (19 mm)</td>
<td>• Filling (sand or sand-emulsion slurry)</td>
</tr>
<tr>
<td></td>
<td>• Patching (cut and replace material)</td>
</tr>
</tbody>
</table>
Crack Filling

- Pavements that will be resurfaced within 3 years
- Non-working cracks
- Cracks wider than ¾ inch
  - Often caused by cracking in underlying materials
Crack Filling – Steps

• Distress/crack survey
• Remove loose material from crack
  – Vegetation should be treated in advance using a strong herbicide (e.g., Round-Up, Finale)
  – Use compressed (preferably heated) air to clean and dry the crack
• Pour/apply sealant, preferably in flush-fill or over band configuration
Crack Preparation

- Cracks Must Be Clean & Dry
- Use Compressed Air
F.O.D. Containment
Crack Filling Techniques

Flush-Fill

Over Band

Crack Fill Material

Crack

3” - 5”

1/8”
Don’t do this!
Proper Crack Filling Technique
Crack Filling Materials

- Asphalt emulsions (CRS-2,-2h,-2P HFRS-2, -2P)
- Asphalt cements (PG 64-22, 67-22, etc)
- Fiber, mineral filled asphalts (proprietary)
- Sand-emulsion slurry
  - Particularly for wide cracks (>3/4 inch)
- Rubberized asphalt (ASTM D 3405)
Crack Sealing – Steps

- Distress/crack survey
- Routing (establishing sealant reservoir dimensions)
- Blowing
- Apply sealant
Routing

- Cut the pavement to a prescribed width and depth
- Improves sealant performance
  - Better adhesion
  - Reduced tensile stress on material
Hot Air Lance

- Up to 3000°F
- > 2000 ft/sec blast velocity
- Propane burner heats air
  – no flame

Comments:
- For wet conditions, lance can improve performance
- Otherwise, compressed air may be more effective
  (Québec study)
Crack Sealing

Typical Dimensions:

\[ W = 12 \text{ mm to } 19 \text{ mm} \]
\[ D = 12 \text{ mm to } 19 \text{ mm} \]
Crack Sealing Materials

• Rubberized asphalt
  – ASTM D1190
  – ASTM D3405
  – Manufacturers’ recommendations for specific climate conditions

• Cold-applied sealants
Finished Product
When do you choose to fill or seal the cracks?

- Crack Filling
  - Pavement to be resurfaced within 3 years
    - Or in preparation for resurfacing
    - Extremely wide cracks (actually patching)
- Crack Sealing
  - No intent to resurface in > 5 years
  - Sawcutting over existing PCC joints
Pavement Repairs – Patching

- Reactive activities that keep pavement in adequate functional condition
- Localized-do not affect entire surface
  - Crack filling/sealing
  - Potholes
    - Filling
    - Patching
- Global-normally to improve drainage, surface friction or ride quality
Patching vs. Filling Potholes

- **Filling** uses minimal preparation, can be viewed as “survival” treatments to maintain a safe riding surface
  - Often uses cold mix
  - When using cold mix, allow at least 6 months to cure before placing overlay or seal coat
- **Patching** is localized reconstruction that requires careful preparation
  - Normally use HMA in preparation for resurfacing or for “permanent” repairs
Full Depth Patching

• Removal of materials in failed area
  – Old pavement
  – Aggregate base
  – Subgrade
    • Remove materials down to firm support
    – Removal should extend 0.3 m (1 ft) beyond distressed area in all directions
Full Depth Patching

- Removal of materials (cont.)
  - Cut pavement with saw or hammer
  - Outline of area should be rectangular
    - Two faces perpendicular to traffic
    - Faces of excavation should be vertical, straight and solid

- Adequate drainage considerations
  - Wet base/subgrade corrections
Vertical, Straight and Solid Faces
Repair and Maintenance Techniques
HMA Airfield Pavements

- Serviceability/Performance
- Local repairs
- Global Maintenance Alternatives
- Rehabilitation Strategies
Global Maintenance Alternatives

- Thin HMA Overlay
- Surface Recycling (Hot-in-place)
- Microsurfacing
- Cape Seal
- Slurry Seal
- Rejuvenator/Sealer
- Fog Seal
Thin Lift HMA Overlays

- Usually not considered as structural
- Recent research at the FHWA ALF site
  - Rutting of thin lifts (new and aged)
  - Ability to resist reflective cracking (new and aged)
- Studied previously non-loaded and loaded sections
- Applied a 25 mm inlay of Superpave 4.75 mm mix
- ALF simulates hwy tire wander on a 425 super single and applies a 71 kN (15.9 ton) load with a tire inflation pressure of 827 kPa (119.9 psi)
Thin Lift HMA Overlays
Thin Lift HMA Overlays
Thin Lift HMA Overlays

• Conclusions
  – “Thin overlay allows 8-year-old-PLUS structure to perform like a 3-year-old structure
    • 425,000 passes to first crack new structure
    • 500,000 passes to first crack for overlay
  – Un-aged overlay had more binder volume with better cracking resistant properties
  – Without milling-and-overlay the structure performed significantly poorer
    • 50,000 passes to first crack”
Coal Tar-Based Products

- Resistant to damage from fuels and lubricants
- Best applied where there is routine exposure to fuels or lubricants
  - Aprons, refueling areas
- Different coefficient of thermal expansion than asphalt
  - Results in shrinkage cracks in the seal
- Environmental Concerns
Asphalt Rejuvenators

• Soften asphalt binder
• Reduce raveling
• Close and delay surface cracks

Performance 3-5 Years

Best on shoulders or lightly trafficked GA airports
4 Basic Steps for Hot In Place

• Soften pavement with heat
• Scarification or mechanical removal of softened material
• Mixing with recycling agent, new aggregate, new binder, or new mix
• Laydown and paving
Surface Recycling

- Rehabilitation process that restores cracked, brittle, and irregular pavement in preparation for a final thin wearing course
- Depth of 25 mm (1 inch) most common, 40 mm (1 1/2 inches possible)
Surface Recycling

- Radiant or infrared heating
  - New technology uses super-heated air and recirculating plenums
- Propane - most common fuel
- Spring loaded scarifiers
  - New technology uses a small milling head to cut to exact depth
Heating with Hot Air
Single Pass Remixing Equipment

Variable screed
Operating stand
Diesel engine
Gas tanks
Batch bin
Receiving hopper
Heated binder tank
Fuel tank
Distribution auger
Pugmill mixer
Infra-red heaters
Variable scarifiers
Infra-red heaters
HMA Compaction-Lift/Layer Thickness

• Lift thickness
  – At least 3x nominal maximum aggregate size (NMAS)
• Multiple lifts help achieve:
  – Smoothness
  – Grade control
• Thicker lifts
  – Conserve heat longer
  – Provide more time for compaction
  – Easier for aggregate to “seat” under rollers
Compaction

• Essential to good performance!
• Need to compact to desirable air voids level
  – conventional dense-grade mixtures: 4-8%
  – gap-grade mixtures: 3-6%
• Compaction can only achieved if:
  – mixture is confined
  – mixture is hot (workable)
Repair and Maintenance Techniques
HMA Airfield Pavements

- Serviceability/Performance
- Local repairs
- Global Maintenance Alternatives
- Rehabilitation Strategies
Rehabilitation With Asphalt Overlays

- Asphalt Pavement
  - Overlay
  - Mill & Inlay
  - Mill & Overlay
Structural HMA Overlays

- Often include partial removal of existing pavement
  - Cold milling
  - Generates Reclaimed Asphalt Pavement (RAP)

- Investigate cause of distress before to decide
  - Depth of milling
  - Selection of mixture components
  - Type of Mixture
Cold Milling

- Mill below depth of distress
  - Rutting
  - Surface-initiated cracking
- Avoid milling to within ½ inch of interface
  - Granular base
  - Intermediate lift
  - Existing PCC
- Consider properties of existing HMA before milling
  - Increase the value of RAP obtained
  - Separate sealers from RAP
Surface After Milling
Surface Preparation for HMA Overlays

Thorroughly clean the surface.

The blower removes the dust that has not been entirely swept off by the broom.
Surface Preparation for HMA Overlays

Thoroughly clean the surface
Tack Coat Application

- Surface & vertical faces of abutting pavement
- Light, uniform application
  - Cut 50% with water
  - 0.04-0.07 gal/sy, residual
- Typical materials:
  - SS-1h, CSS-1h
  - Special Tack emulsions
    - Proprietary
Fabric Interlayers

• Useful in sealing underlying pavement
• Can effectively delay reflection cracking provided:
  – Minimal lateral movement at joints or cracks
  – No vertical movement under loading
    • Excellent load transfer at PCC joints
    • No voids or evidence of pumping
• MUST BE INSTALLED PROPERLY!!!
Fabric Interlayers
When Installing Geotextile

- Fill cracks more than ¼ inch wide
  - Prefer recessed fill in advance
- Patch areas with alligator cracking
- If milling, place thin leveling course (1.5-2 in) using small-aggregate mixture
- Install fabric over compacted leveling course
- Place min 2 inches HMA
  - To adequately cover
- May eliminate recycling in the future
“Tack” for Geotextile

- Misnomer—should be called a membrane
- Essential for performance
  - 0.2-0.3 gal/sq yd of PG 58 or PG 64 asphalt binder
  - IMMEDIATELY behind distributor
    - Otherwise fabric becomes a bond breaker
  - Do not use emulsions or cutback!
Geotextile Application

- Easier to install
  - Isolated
  - Global
- Best on leveling course
  - Not bridging void
  - Reference joint/crack
- At least 2 in. HMA cover

- Interlayer Stress Absorbing Composite
  - ISAC®
Airplanes Love Asphalt!

Thank You!!