Airfield Concrete Pavement Maintenance and Rehabilitation Strategies

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CAPTG Workshop, Minneapolis
Rico Fung, P.Eng., Cement Association of Canada
Gary Mitchell, P.E., American Concrete Pavement Assoc.
3 Types of Rehabilitation

- **Restoration**
- **Resurfacing**
- **Reconstruction**

**Min. Acceptable Rating**

**Age or Traffic**

**Structural/Functional Condition**
Pavement Maintenance Logic

- Correct Repair Procedures
  - Minimize FOD
- Airfield Rigid Pavement Distress Identification
  - Load Related vs. Environmental or Materials Related
Concrete Pavement Repair Manual

Full-Depth Repair
Partial-Depth Repair
Slabjacking
Subsealing
Diamond Grinding
Load Transfer Restoration
Polymer Concrete
Retrofit Edge Drains
Heat-Resistant Concrete

American Concrete Pavement Association

JP002P, May 2003
www.acpa.org
Performance Issues

• Airfield Functional Condition
  – FOD potential
  – Friction/Hydroplaning

• Airfield Distress
  – cracking (saw & sealing)
  – corner breaks, shattered panels (full depth)
  – spalling (partial depth)
  – roughness / polished (grinding)
Distress Classification

**Cracking**
- Extends through the depth of a slab
- Caused by:
  - Poor Design - Long joint spacing
  - Poor Construction (Over Finished Surfaces)
  - Curling / warping (Stabilized bases)
  - Dowel Restraint
  - Load
Cracks and Causes

- **Full Width of Panel (Slab)**
  - Environmental Distress
  - Sealing (Sawing) Most Effective

- **Corner Cracks (Diagonal)**
  - Load Distress
  - Full Depth Replacement Mandatory

- **Shattered Slabs - More than Four Pieces**
  - Full Depth Replacement Required
Rules of Thumb for Concrete Cracks (Environmental)

- to $\frac{1}{4}''$ (6mm) Leave alone
- $\frac{1}{4}''$ to $\frac{1}{2}''$ (6 to 12.5mm) Saw and Seal
- $\frac{3}{8}''$ to $\frac{3}{4}''$ (9.5 to 19mm, Spalled) Partial Depth Repair
- $\frac{3}{4}''$ to 1-1/2” (19 to 38mm) Saw and Seal
- 3/4 to 1-1/2 (19 to 38mm, Spalled) Full Depth Patching
- More than 1-1/2” (38mm) Full Depth Patching
Concrete Slab Repair
Depth of Repairs

• Partial Depth - Intent is to bond repair material to existing concrete and be compatible in characteristics
• Full Depth - Intent is to make the repair a functional part of the existing slab.
Distress Classification-Spalling

• Breaking, cracking, or chipping at joints or cracks
  – Incompressible in Joint/Crack
  – Material Durability Problems
  – Poor Construction Techniques

• Full Depth Repair Required when unsound material deeper than 1/3 thickness
Partial Depth Repairs

- Generally spall repairs
- Repairs localized distress in the top 1/3 of the slab
- Generally located at joints, but can be placed anywhere surface defects occur
Minors Sliver Spalling

Will not affect performance of new sealant

Serious Compression Spalling

Will not provide reasonable surfaces for sealing

Up to 6 mm (1/4"")
Partial Depth Repairs

Finding Unsound Concrete

Sounding the pavement:

- Hammer
- Steel rod
- Steel chain

DULL | SHARP

Unsound-Delaminated | Solid
Partial Depth Repairs

Defining Repair Boundaries

- 75 mm/3” min.
- 75 mm/3” min.
- 50 mm/2” min - t/3 (max.)

Spall

Patch
Partial Depth Repairs

Placing Materials

• Applying bonding agent
  – Cement grout or Epoxy
  – Coat all surfaces (horizontal & vertical)
  – Do not allow bonding agent to set
Partial Depth Repairs

Finishing

- Match surrounding elevation
- Work tool from center toward edges
Full Depth Repairs

- Repairs distresses greater than 1/3 the slab depth.
- Consists of removing and replacing at least a portion of the existing slab to the bottom of the concrete.
Full Depth Repairs

- Minimum Repair 600 mm/2 feet
- Full Depth Cut at Joints
- Diamond-Blades
- Tie to Existing
Gang Drill
Cleaning Holes (Air Blast)
Dowel Bar Placement for Full Depth Repairs

- Thin circular disk
- Anchoring material
- Hole dia. = d+a
- d = dowel diameter
- a = 2 mm for epoxy
- a = 6 mm for cement grout

Existing slab

Repair area

Subbase

Subgrade Soil
Inject grout to back of hole

Twist one turn while pushing in dowel

Place grout retention disk to hold in grout
Repair Materials

Ideal Repair Materials

- Good workability
- Quick mixing time
- Fast setting time
- Rapid strength development
- Low shrinkage

- Strong bonding capability
- Durability
- Thermal compatibility with concrete
Cementitious Materials

- High early strength concrete
  - CSA A3001 Type HE cement
  - With or without admixture
  - Reach 20.7 MPa/3000 psi in 24 hours
  - Use cement grout/epoxy bonding agent
Cross-Stitching

• Grouting of tiebars in holes drilled across nonworking longitudinal cracks at an angle to the pavement surface

• Prevents horizontal and vertical crack movements
Cross-Stitching Schematic

Deformed Tiebars Inserted and Grouted Into Drilled Holes (typically 19 mm/3/4” bars)

Longitudinal Crack

PCC Slab

Base

Fig. 8.5 on p. 8.14
Cross-Stitching

Drilling of Holes
Cross-Stitching

Grout Insertion
Cross-Stitching
Bar Insertion
Cross-Stitching
Final Grouting
Diamond Grinding

• Improves safety and roughness by:
  – Smoothing the ride
  – Reestablishing the friction properties
  – Correcting the cross-slope
Concrete Overlays for Airfield Pavements – A Long-Life Rehabilitation Alternative

Gary L. Mitchell, P.E.
Vice President – Airports and Pavement Technology
American Concrete Pavement Association
Concrete Overlays

Airport Sponsors are asked to do more with less

Airport Sponsor needs
- proactive, sustainable pavement maintenance
- Longer lasting rehabilitation strategies
- Reasonable cost

Concrete overlays represent such strategies
HISTORICAL REVIEW

• Began in late forties and early fifties
• First used on Airports and Secondary Roads
• In mid-seventies acceptance grew
• By late eighties this was normal practice
• Then in early nineties Ultra-Thin Whitetopping
• Today concrete overlays are often used strategy
<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Whitetopping</th>
<th>Agency</th>
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<tr>
<td>1971</td>
<td>Storm Lake</td>
<td>5”</td>
<td>IDOT</td>
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<tr>
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<td>5”</td>
<td>IDOT</td>
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<td>1983</td>
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<tr>
<td>1987</td>
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<tr>
<td>1988</td>
<td>Carroll</td>
<td>5”</td>
<td>IDOT</td>
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<tr>
<td>1991</td>
<td>Fort Madison</td>
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<td>6”</td>
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<td>FAA</td>
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Benefits of Concrete Overlays

- Cost-effective solution
- Quick and convenient
- Easy to repair
- Durable rehabilitation tool
- Sustainability
  - Albedo
  - Longevity, and
  - Surface profile stability
THE ADVANTAGE OF CONCRETE APRONS & TAXIWAYS

- Concrete is resistant to deformation, rutting, “birdbaths”, etc.
- Concrete is not damaged by fuel spillage, oil drippings, or jet heat and blast.
3-Year old Reconstruction

3-Year old Asphalt overlay
Reflective cracks
Family of Concrete Overlays

Bonded Overlay Family
- Bonded Concrete Overlay of Concrete Pavements
- Bonded Concrete Overlay of Asphalt Pavements
- Bonded Concrete Overlay of Composite Pavements

Unbonded Overlay Family
- Unbonded Concrete Overlay of Concrete Pavements
- Unbonded Concrete Overlay of Asphalt Pavements
- Unbonded Concrete Overlay of Composite Pavements

Bond is integral to design
Old pavement is base
Existing Asphalt
## Recent Overlay Projects

<table>
<thead>
<tr>
<th>Airport Name</th>
<th>Bid Date</th>
<th>Type</th>
<th>PCCP SY &amp; Depth</th>
<th>Price per SY</th>
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<tr>
<td>Williamsburg Co (SC) - apron</td>
<td>June 2004</td>
<td>WT = Unbonded over asphalt</td>
<td>7000 (5-inch)</td>
<td>$41.96 (Bid SY/CY)</td>
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<td>Cobb County (GA) - runway</td>
<td>Apr 2008</td>
<td>WT</td>
<td>70,881 (7-inch)</td>
<td>$29.39</td>
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<tr>
<td>Lancaster County (SC) - runway</td>
<td>Apr 2009</td>
<td>WT</td>
<td>66,870 (6.5-inch)</td>
<td>$22.75</td>
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<tr>
<td>Charleston (SC) Executive - runway</td>
<td>June 2009</td>
<td>Unbonded over PCCP</td>
<td>59,700 (11-inch)</td>
<td>$39.45</td>
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<tr>
<td>Berkeley County (SC) - runway</td>
<td>June 2010</td>
<td>WT</td>
<td>36,260 (9-inch)</td>
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<tr>
<td>Augusta (GA) Regional - runway</td>
<td>Sept 2010</td>
<td>WT</td>
<td>141,308 (14-inch)</td>
<td>$37.84</td>
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Charleston Executive

WW II (1940's)

T = 5.7 - 9"
Batch Plant On-Site
Crushing Operation – Base Material

350’ Extension

WW II Era PCCP

RW Width reduced to 100’

Asphalt Sep Layer
Quotes from Open House

• A Concrete Overlay kept us “out of the subgrade” vs. reconstruction option.

• A Concrete Overlay raised our pavement elevation out of the high water table

• Inch per Inch concrete was less expensive than the asphalt leveling (separation) layer

• Our original PCCP surface lasted 60+ years, no reason why this surface cannot last another 60 years!
**Williamsburg Co Apron Whitetopping**

**Asphalt PCI = 53/16**

**Project Details / 2004**
Two Alternatives
Volatile Material Cost
Alternate BidsAccepted

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<th>Contractor</th>
<th>Alternative Bid Amount ($)</th>
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<tr>
<td></td>
<td>Asphalt</td>
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<tr>
<td>A</td>
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<tr>
<td>B</td>
<td>$482,725</td>
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<tr>
<td>C</td>
<td>-</td>
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<tr>
<td>D</td>
<td>-</td>
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</table>
Berkeley County Whitetopping
March, 2011
John F. Kennedy International Airport

RUNWAY 13R-31L

The Port Authority
Of New York & New Jersey
John F. Kennedy International Airport
Final Project Design

120 Days - Paved over 12,000 feet
Concrete Runway Typical Section

Runway Cross Section
Construction Progress: Slipform Paving
Questions & Comments
THANK YOU!

gmitchell@acpa.org

ACPA

www.acpa.org

Pavements 4life

www.pavements4life.com