Webinar Objectives

- Concrete Overlays – What, When, How & Why?
  - SE Airfield Pavement Case Studies
  - Construction Lessons Learned
  - Tips (Design) to manage overlay costs
- Performance of Airfield Concrete Overlays
  - Pavement Condition Index (PCI) Review
  - Design for Improved Resilience

TYPES OF CONCRETE OVERLAYS

Bonded
- Bonded Concrete Overlays of Concrete Pavements
  - previously called slotted overlays
- Bonded Concrete Overlays of Asphalt Pavements
  - previously called ultrathin whitetopping

Unbonded
- Unbonded Concrete Overlays of Concrete Pavements
  - previously called conventional whitetopping
- Unbonded Concrete Overlays of Asphalt Pavements
  - previously called asphaltic whitetopping

NATIONWIDE CONCRETE OVERLAY USAGE IS GROWING

Source: From data submitted by ACPA chapters, state paving associations and other sources, including Oman Systems, Bid Express and DOT websites.

http://overlays.acpa.org
Timing is Important…

Restoration

Resurfacing

Reconstruction

Pavements with PCI indexes above 85, or 'Good' may require periodic joint/crack sealing and local patching.

Pavements with PCI conditions ranging from 'Satisfactory' to 'Good' may require surface treatments (seal coat), thin overlays, and/or joint/crack sealing.

Pavements that have deteriorated below a PCI 64, or within the range of 'Poor' to 'Fair' conditions may require major rehabilitation such as pavement mill and overlay.

Pavements that have deteriorated below a PCI 40, or within the range of 'Failed' to 'Very Poor' conditions may require major reconstruction.

Applying the Right Fix at the Right Time

Effectiveness of Treatments

Estimated Life Extension (years)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Good PCI &gt; 80</th>
<th>Fair PCI &gt; 50</th>
<th>Poor PCI &lt; 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fog Seal/Rejuvenator</td>
<td>&lt; 1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spray Appli Seal</td>
<td>3-5</td>
<td>1-3</td>
<td>1-2</td>
</tr>
<tr>
<td>Chip Seal*</td>
<td>5-7</td>
<td>3-5</td>
<td>1-3</td>
</tr>
<tr>
<td>Skurry Seal</td>
<td>5-7</td>
<td>3-5</td>
<td>1-3</td>
</tr>
<tr>
<td>Micro-surface</td>
<td>6-12</td>
<td>5-7</td>
<td>2-4</td>
</tr>
<tr>
<td>Thin HMA</td>
<td>10-12</td>
<td>5-7</td>
<td>2-4</td>
</tr>
</tbody>
</table>

NOTE:
- Table is based on AAPT Report 61-67 Table 4-1
- FDOT Policy in effect.
- For PCI < 40 typically do not recommend surface treatment but it can set the rehabilitation criteria such as mill and overlay.

* Typically not recommended on asphalt. PCC potential. Hard on films.

Unbonded Concrete Overlay on Asphalt Pavements

New unbonded overlay

New depth repair

New asphalt application

New length repair

New joint repair

New crack repair

New surface maintenance

New shoulder repair

New base support

Unbonded concrete profile due to research form base support.
Southeastern Airports - Unbonded Overlays

UBOC = Resurfacing of Distressed Concrete

<table>
<thead>
<tr>
<th>State / Year</th>
<th>AIRPORT</th>
<th>RW / TW / Apron</th>
<th>Engineering Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC / 2004</td>
<td>Williamsburg County</td>
<td>Apron (5-in)</td>
<td>Wilbur Smith Assoc</td>
</tr>
<tr>
<td>GA / Fall 2008</td>
<td>Cobb County</td>
<td>Runway (7-in)</td>
<td>Michael Baker Inc (LPA)</td>
</tr>
<tr>
<td>SC / 2009</td>
<td>Lancaster County</td>
<td>Runway (7.5-in)</td>
<td>Michael Baker Inc (LPA)</td>
</tr>
<tr>
<td>SC / 2009</td>
<td>Charleston Executive</td>
<td>Runway (11-in, UBOC)</td>
<td>ADC Engineers</td>
</tr>
<tr>
<td>SC / 2011</td>
<td>Berkeley County</td>
<td>Runway (9-in)</td>
<td>WK Dickson Inc</td>
</tr>
<tr>
<td>SC / 2012</td>
<td>Laurens County</td>
<td>Runway (5-in) &amp; Taxiway</td>
<td>Michael Baker Inc (LPA)</td>
</tr>
<tr>
<td>SC / 2014 - 18</td>
<td>Greenwood County</td>
<td>Runway (5-in) &amp; Taxiway</td>
<td>Michael Baker Inc</td>
</tr>
<tr>
<td>NC / 2016</td>
<td>Wilmington International</td>
<td>N. GA Apron (9-in, UBOC)</td>
<td>Talbert &amp; Bright Inc</td>
</tr>
<tr>
<td>SC / Fall 2018</td>
<td>Grand Strand (N Myrtle Beach)</td>
<td>Runway (7.5-in)</td>
<td>Holt Inc</td>
</tr>
<tr>
<td>SC / 2019</td>
<td>Darlington County</td>
<td>Runway (7-in)</td>
<td>Michael Baker Inc</td>
</tr>
<tr>
<td>TN / 2020</td>
<td>Jamestown Municipal</td>
<td>Runway (5-in)</td>
<td>Neel-Schaffer</td>
</tr>
</tbody>
</table>

UBOC = Resurfacing of Distressed Concrete

Southeastern Airports – Project Sizes

<table>
<thead>
<tr>
<th>State / Year</th>
<th>AIRPORT</th>
<th>RW / TW / Apron</th>
<th>Engineering Consultant</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC / 2004</td>
<td>Williamsburg County (7000 SY)</td>
<td>Apron (5-in)</td>
<td>$422K / $36.25</td>
</tr>
<tr>
<td>GA / Fall 2008</td>
<td>Cobb County (70,881 SY)</td>
<td>Runway (7-in, 6300 x 100)</td>
<td>$0.1M / $29.39</td>
</tr>
<tr>
<td>SC / 2009</td>
<td>Lancaster County (66,870 SY)</td>
<td>Runway (6.5-in, 6000 x 100)</td>
<td>$2.4M / $22.75</td>
</tr>
<tr>
<td>SC / 2009</td>
<td>Charleston Executive (59,700 SY)</td>
<td>Runway (7-in, 5350 x 100)</td>
<td>$6.6M / $39.45</td>
</tr>
<tr>
<td>GA / 2011</td>
<td>Augusta Regional</td>
<td>Runway 17-35 (14-in, 8000 x 150)</td>
<td>$3.8M / $73.00</td>
</tr>
<tr>
<td>SC / 2011</td>
<td>Berkeley County (36,260 SY)</td>
<td>Runway (9-in, 4350 x 75)</td>
<td>$2.9M / $32.90</td>
</tr>
<tr>
<td>SC / 2012</td>
<td>Laurens County (32,500 SY)</td>
<td>Runway (5-in, 4050 x 75) + TW</td>
<td>$1.7M / $29.00</td>
</tr>
<tr>
<td>SC / 2014 - 18</td>
<td>Greenwood County (55,586 SY)</td>
<td>Runway (5-in, 5000 x 100)</td>
<td>$2.9M / $28.75</td>
</tr>
<tr>
<td>NC / 2016</td>
<td>Wilmington International (24K SY)</td>
<td>N. GA Apron (9-in, UBOC)</td>
<td>$3.8M / $73.00</td>
</tr>
<tr>
<td>SC / Fall 2018</td>
<td>Grand Strand (66,640 SY)</td>
<td>Runway (7.5-in, 6000 x 100)</td>
<td>$6.9M / $79.40</td>
</tr>
<tr>
<td>SC / 2019</td>
<td>Darlington County (64,300 SY)</td>
<td>Runway (7-in, 5500 x 100) + TW</td>
<td>$4.2M / $38.00</td>
</tr>
<tr>
<td>TN / 2020</td>
<td>Jamestown Municipal (40,925 SY)</td>
<td>Runway (5-in, 3500 x 75) + TW</td>
<td>$6.0M / $79.40</td>
</tr>
</tbody>
</table>

UBOC = Resurfacing of Distressed Concrete

Cobb Co Open House Event (2008)

Opportunity to learn more about Concrete Overlays

What to do with Asphalt cracks?

Up-close view of Slipform Paver

Lancaster County (SC) Airport

April 2009 Bid

<table>
<thead>
<tr>
<th>TEN Contractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2 PCCP &amp; Asph</td>
</tr>
<tr>
<td>• 2 Asph only</td>
</tr>
<tr>
<td>• 6 PCCP only</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Alternative Bid Amount ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Asphalt / FDR</td>
</tr>
<tr>
<td>B</td>
<td>$2,453,970</td>
</tr>
<tr>
<td>C</td>
<td>$2,377,577</td>
</tr>
<tr>
<td>D</td>
<td>$2,497,931</td>
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</tbody>
</table>

Asphalt / FDR | Concrete
Asphalt or Fabric can be used as Sep Layer between distressed concrete and new concrete overlay.

**On-Site Batch Plant**

- **Reduction**
  - WW II Era PCCP
  - RW Width reduced to 100'

**CONCRETE OVERLAY COMPLETED**

- 59,700 SY of 11-inch P-501
Open House Events
Opportunities to see construction up close

Lancaster County Airport
Concrete Overlay of Asphalt

Charleston Exec Airport
Concrete Overlay of Concrete

Quotes from (JZI) Open House
Owner’s representative

- 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 (e.g. Improved Resilience)
- Inch per Inch concrete was less expensive than the asphalt leveling (sep) layer
- Our original concrete surface lasted 60+ years, no reason why this (new concrete) surface cannot last another 60 years!

Laurens County (SC) Airport
½ Width Paving - 37.5’

5-Inch, SCDOT 501 Spec (substituted for P-501), Min of 4400 psi

Pavement Sections - Laurens Co Runway
2012 Costs Breakdown per layer

<table>
<thead>
<tr>
<th>Layer</th>
<th>Asphalt Section</th>
<th>Concrete Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>4” P-401 Surface</td>
<td>$27.87 / SY</td>
<td>$29.00 / SY</td>
</tr>
<tr>
<td>Subgrade</td>
<td>$4.75/ SY</td>
<td>$7.93/ SY</td>
</tr>
<tr>
<td>8” P-301 FDR</td>
<td>$7.40/ SY</td>
<td>$9.04/ SY</td>
</tr>
<tr>
<td>Subgrade</td>
<td>$12.12/ SY</td>
<td>$7.93/ SY</td>
</tr>
</tbody>
</table>

Subgrade Costs reflect all “other” project related costs
Aged Asphalt Costs include Transition and grade correction costs
Two Years following RW Project

Greenwood County RW 9-27
- Asphalt was nearly one foot thick!
- PCCP Paving completed in 10 days!

Greenwood County RW 9-27
55,500 SY of 5-inch PCCP

Grand Strand Airport (CRE)
May 2018 Bid

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Project Bid</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$6,859,463</td>
<td>$46.50/SY</td>
</tr>
<tr>
<td>B</td>
<td>$7,001,427</td>
<td>$40.40/SY</td>
</tr>
<tr>
<td>C</td>
<td>$7,261,864</td>
<td>$47.71/SY</td>
</tr>
<tr>
<td>D</td>
<td>$8,174,051</td>
<td>$47.29/SY</td>
</tr>
</tbody>
</table>

4 Contractors
- 2 Base Bid (PCCP)
- Connectors
- 2 Additive Bids
- Parallel TW
Grand Strand Airport
2018 Construction / Prior PCI = 48-56
TW used for limited operations

Limited Operations on TW

Grand Strand Airport
7.5-inch RW 5-23 Overlay

Darlington County – Overlay (2019)

Prior to Construction RW PCI 70 (-)

Darlington County Airport
7-inch Runway Overlay
Slag Cement Association Award Winner (Sustainable)

Bid with alternate designs, a stated preference to award the low bid concrete alternate, provided funds made available.

In order to be Sustainable, a pavement should be:
- Long-lasting, 20+ year designs
- Resilient - able to withstand the impacts of climate change
- Higher Albedo and reduces urban heat island effects

Which ramp offers a cooler environment? Best for pre-flight checks?

- Higher Albedo Concrete
  - Higher reflectance!

- Low Albedo Asphalt
  - Radiant Heat absorbed within pavement.

Airfield Concrete Overlays

More Concrete Overlay Publicity
Construction Lessons Learned

- Paving directly over (most) asphalt cracks is OK
- Curing is extremely important with thinner overlays (pavement edges too)
- Remember to “block out” working joints that have opened wide (pilot lanes)
- There are more joints on thinner overlays...saw timing is critical

Design Tips to Manage Overlay Costs
Overlays are often less $$ than reconstruction

1. No Surprises: Communicate Early and Often with Industry Partners inc. ACPA Chapters
2. Be Flexible with Contract Starts and Completions (e.g. Fall 2022 or Spring 2023)
3. When possible, minimize the construction phases (thus mobilizations)
4. Be (somewhat) Flexible with Jointing Details – Let the contractor propose an alternate way
5. Bid Materials by the CY / Labor by the SY – Reduces contractor risk and thus lower costs

Design psi > Acceptance psi
- Round thickness to the nearest 0.5 inch and it may be down, not up
- Use as much type D (dummy) joints as allowed – steel costs can be volatile
- When 30k aircraft or less (table 3-4)
  - Use 5-inches
  - Type D (dummy) and Type F (butt) Joints

Cement / Concrete follow CPI Index, Asphalt much more volatile!

Cement, Concrete, Aggregate, CPI & PPI Indexes

Asphalt Inflation Rates are significantly higher than Concrete
Not accounting for them when estimating Rehab Costs biases the results

The Opportunities...
Where are the Best Places to start?

- Existing Asphalt (or Concrete) in FAIR to POOR Condition
  - Rutting / Cracks in the pavement are normal – can be addressed
- Areas where competitive bids have been lacking
  - Resulting in High Asphalt (P-401) prices
- Enough pavement structure where milling (profiling) can be accomplished that helps with project economics
- Looking to improve pavement resiliency
  - Harden the system and Raise the grade (off high water table)
**FUTURE CLIMATE CONDITIONS WILL NOT RESEMBLE THE PAST**

**U.S. severe storms, heavy precipitation events:**
Greater intensity and frequency
Continued increases expected

**Projected change in sea level for 2100 under the intermediate scenario:**

**Global mean sea level:**
7–8 inches higher since 1900 - about half since 1993
Expected to rise by 1–4 feet by 2100

**Increased Extreme heat events and drought:**
Increased incidence of large forest fires

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**NEW FAA AC 150/5320-6G (June 2021)**

- The term “water inundation” used **TWO** times within new circular
- The term “water table” used **Five** times within new circular
- Added discussion regarding subgrade stabilization (Chapter 2)
- Expanded discussion of stabilized base course and drainage layers
- P-207 Full Depth Reclamation (FDR) shown as a viable stabilized base course when certain conditions are met

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**Improved Resilience**

**Henderson Field (Wallace, NC)**

**Offutt AFB (Omaha, NE)**

- FAA Design Circular offers support of stabilized base & subgrade layers.
- Aggregate bases perform best when NOT saturated (5320-6G: 3.5.2)
- When a concrete overlay is used, it **takes the old pavement and turns it into a good stabilized base** for the new surface... It hardens the system!
- It also RAISES the pavement surface off of possible high water table

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**ACTIVITIES THAT CAN BE USED TO “HARDEN THE PAVEMENT SYSTEM”**

**Use Concrete Overlays**

- **7000 lbs load.**

  - **Concrete**
    - **Asphalt**
      - **Base**
        - **Subbase**
          - **Subgrade**
    - **Concrete**
      - Pressure ~3 - 7 psi at the top of the Asphalt layer
      - Base & subgrade pressures are even lower

  - RW Elevation raised the height of the overlay

  - **Concrete overlay increases both the height and the structural strength of the runway**

  - **Asphalt**
    - **Base**
      - **Subbase**
        - **Subgrade**

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Charleston Executive Airport
Johns Island, SC

2016 PCI Data
Pavement Management Report

2010 LCD-RW 9/27
Concrete Overlay range from 93 to 96
weighted average 94, 1 point per year drop

2010 LCD-TW Connectors (Tie-Ins) Asphalt
range from 77 - 86
weighted average 82, 3 pts / year drop

2008 LCD – Taxiway A Asphalt = 75 drop of
3.1 points per year

Stono River

Asphalt Deterioration Rates Accelerate when Agg Base kept Moist

Asphalt pavements deteriorate at rate of 1.5 to 2.5 PCI points per year (avg = 2)
JZI Asphalt (TW) deteriorating at 3 points per year (50% faster than typical)


North Platte (NE) Regional Airport

Runway 17/35 overlay in 2011.
Before the project, the pavement consisted of
70-year-old concrete overlaid with four to 12
inches of asphalt of various ages.
In addition, the airport is adjacent
to the Platte River where a high-
water table contributed to frost
heave.
Our team evaluated a number of options,
including complete reconstruction, asphalt
overlay, and whitetopping (concrete overlay).
Whitetopping with eight inches of concrete was
selected.
Dowel bars were installed at every
joint to reduce frost heave.

10 years later (2021), PCI = 96

Olsson Engineers project writeup…

Concrete Overlay was less than ½ the cost of reconstruction!

High Water / Flood Inundation Matters
Asphalt Deterioration Rates Accelerate when Agg Base kept Moist

Charleston Exec (JZI)

Asphalt

Concrete

0 0.5 1 1.5 2 2.5 3

PCI High

PCI Low

3X faster deterioration
Asphalt vs PCCP

Concrete pavements deteriorate at rate of 0.5 to 1.2 PCI points per year
JZI Concrete (RW) deteriorating at 1 point per year

Asphalt pavements deteriorate at rate of 1.5 to 2.5 PCI points per year (avg = 2)
JZI Asphalt (TW) deteriorating at 3 points per year (50% faster than typical)


Airfield Concrete Overlays

Performance?
Pavement Condition Indexes

✓ How are the SE Airport Overlays performing?
✓ Limited data (earliest projects are not that old)
✓ Performance of overlay projects in other states
✓ In-Service 20+ years
Cobb Co Airport – McCollum Field (RYY)
- Construction in 2008
- 7-in concrete overlay of asphalt (RW)
- 12.5’ x 12.5’ slab sizes (RW)
- PCI = 98 (as of 2018) / 100 (as of 2012)

Lancaster County Airport (LKR)
- Construction of RW 6/24 in 2010
- 7.5-inch concrete overlay of asphalt
- 12.5’ x 12.5’ slab sizes
- PCI = 99 (as of 2016)

Fort Madison
- Construction in 1991
- Nominal 6-inch concrete overlay of asphalt (RW)
- 12.5’ x 12.5’ slab sizes (RW)
- PCI = 94 (as of 2017)

Iowa Airports
PCI Trends for Overlays Constructed in 1980’s - 1990’s

Concrete Overlays have survived well beyond the FAA (20-year) design life!
ACPA Local Affiliates
http://www.acpa.org/ournetwork/

TWENTY local ACPA Chapters ready to assist!

Grand Strand Ramp – Although not an overlay, the consultant did allow the aggregate base to be recycled back under the P-501

Thank You!