



Concrete Overlays for Airfield Rehabilitations

CP Tech Center Webinar
May 10, 2022

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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 bonded overlays–



Bonded Concrete Overlays of Asphalt Pavements
–previously called ultra-thin whitetopping–



Bonded Concrete Overlays of Composite Pavements



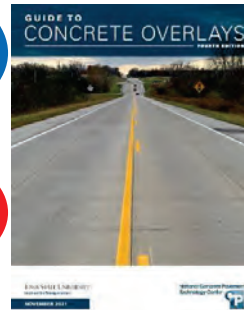
Unbonded
Unbonded Concrete Overlays of Concrete Pavements
–previously called unbonded overlays–



Unbonded Concrete Overlays of Asphalt Pavements
–previously called conventional whitetopping–

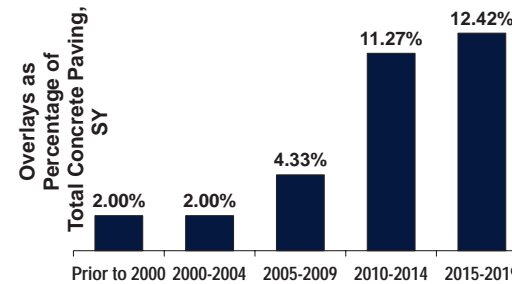


Unbonded Concrete Overlays of Composite Pavements



November 2021, 4th edition

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.

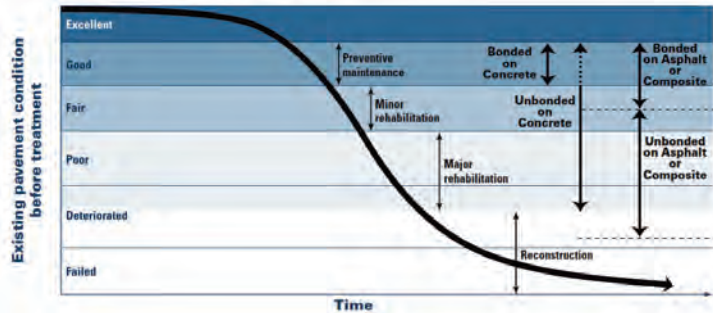
Overlay Examples



Colorado SH-121, Wadsworth Ave
Constructed in 2001
Photo in 2013

<http://overlays.acpa.org>

Timing is Important...



	PCI	REPRESENTATIVE PAVEMENT SURFACE	REHABILITATION ACTIVITIES
ROUTINE MAINTENANCE	86 - 100	90	Pavements with PCI indexes above 85, or 'Good' may require periodic joint/crack sealing and local patching.
PAVEMENT PRESERVATION	65 - 85	70	Pavements with PCI conditions ranging from 'Satisfactory' to 'Good' may require surface treatments (seal coat), thin overlays, and/or joint/crack sealing.
MAJOR REHABILITATION	40 - 64	40	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.
MAJOR RECONSTRUCTION	0 - 39	15	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

Treatment	Estimated Life Extension (years)		
	Good PCI > 80	Fair PCI > 60	Poor PCI > 40
Fog Seal/Rejuvenator	< 1	-	-
Spray Applied Seal	3-5	1-3	1-2
Chip Seal*	5-7	3-5	1-3
Slurry Seal	5-7	3-5	1-3
Micro-surface	8-12	5-7	2-4
Thin HMA	10-12	5-7	2-4

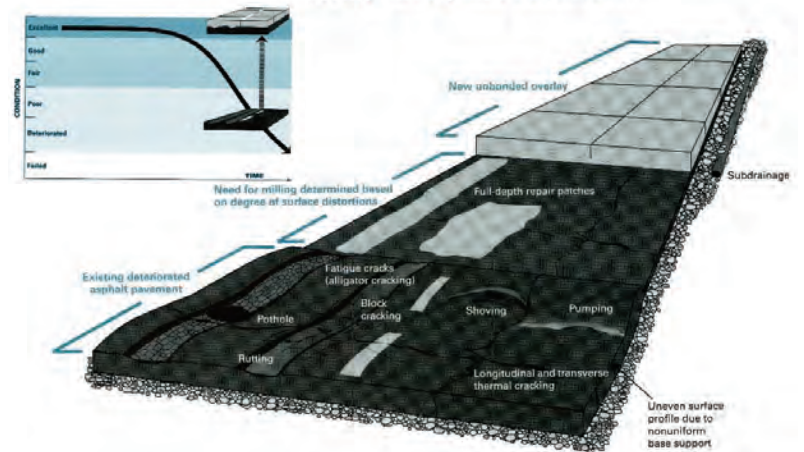
NOTE:

- Table is based on AASHTO Report 05-07 Table 4-1
- Not FAA Policy to date.
- For PCI < 60 typically do not recommend surface treatment but if can not do rehabilitation/reconstruction - will buy a little time.

* Typically not recommended on airports...FOD potential...Hard on tires



Unbonded Concrete Overlay on Asphalt Pavements



Southeastern Airports - Unbonded Overlays

UBOC = Resurfacing of Distressed Concrete

State / Year	AIRPORT	RW / TW / Apron	Engineering Consultant
SC / 2004	Williamsburg County	Apron (5-in)	Wilbur Smith Assoc
GA / Fall 2008	Cobb County	Runway (7-in)	Michael Baker Inc (LPA)
SC / 2009	Lancaster County	Runway (7.5-in)	Michael Baker Inc (LPA)
SC / 2009	Charleston Executive	Runway (11-in, UBOC)	ADC Engineers
GA / 2011	Augusta Regional	Runway 17-35 (14-in)	Campbell & Paris
SC / 2011	Berkeley County	Runway (9-in)	WK Dickson Inc
SC / 2012	Laurens County	Runway (5-in) & Taxiway	Michael Baker Inc (LPA)
SC / 2014 - 18	Greenwood County	Runway (5-in) & Taxiway	Michael Baker Inc
NC / 2016	Wilmington International	N. GA Apron (9-in,UBOC)	Talbert & Bright Inc
SC / Fall 2018	Grand Strand (N Myrtle Beach)	Runway (7.5-in)	Holt Inc
SC / 2019	Darlington County	Runway (7-in)	Michael Baker Inc
TN / 2020	Jamestown Municipal	Runway (5-in)	Neel-Schaffer

Southeastern Airports – Project Sizes

UBOC = Resurfacing of Distressed Concrete

State / Year	AIRPORT	RW / TW / Apron	Cost / PCCP
SC / 2004	Williamsburg County (7000 SY)	Apron (5-in)	\$422K / \$36.25
GA / Fall 2008	Cobb County (70,881 SY)	Runway (7-in, 6300 x 100)	\$5.1M / \$29.39
SC / 2009	Lancaster County (66,870 SY)	Runway (6.5-in, 6000 x 100)	\$2.4M / \$22.75
SC / 2009	Charleston Executive (59,700 SY)	Runway (11-in, 5350 x 100)	\$6.6M / \$39.45
GA / 2011	Augusta Regional	RW 17-35 (14-in, 8000 x 150)	
SC / 2011	Berkeley County (36,260 SY)	Runway (9-in, 4350 x 75)	\$2.9M / \$32.90
SC / 2012	Laurens County (32,500 SY)	Runway (5-in, 4050 x 75) + TW	\$1.7M / \$29.00
SC / 2014 - 18	Greenwood County (55,586 SY)	Runway (5-in, 5000 x 100)	\$2.9M / \$28.75
NC / 2016	Wilmington International (24K SY)	N. GA Apron (9-in,UBOC)	\$3.8M / \$73.00
SC / Fall 2018	Grand Strand (66,640 SY)	Runway (7.5-in, 6000 x 100)	\$6.9M / \$46.50
SC / 2019	Darlington County (64,300 SY)	Runway (7-in, 5500 x 100) + TW	\$4.2M / \$38.00
TN / 2020	Jamestown Municipal (40,925 SY)	Runway (5-in, 3500 x 75) + TW	\$6.0M / \$79.40

Cobb Co Open House Event (2008)

Opportunity to learn more about Concrete Overlays

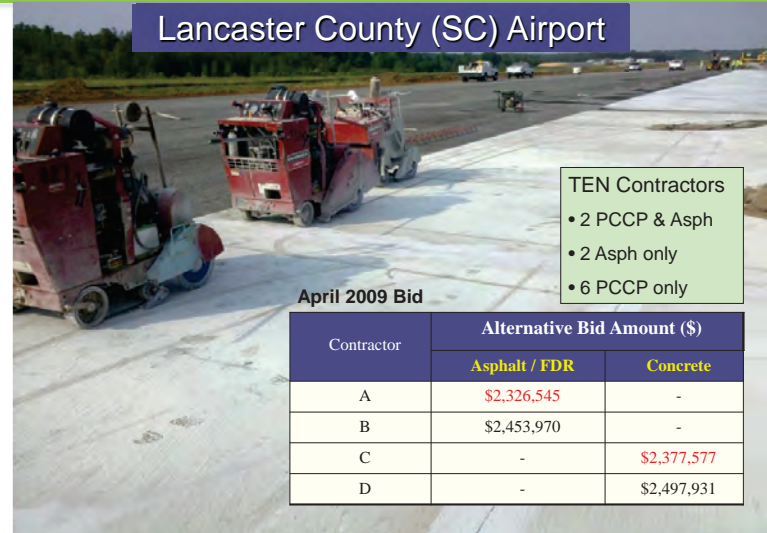
What to do with Asphalt cracks?



Up-close view of Slipform Paver



Lancaster County (SC) Airport



TEN Contractors

- 2 PCCP & Asph
- 2 Asph only
- 6 PCCP only

April 2009 Bid

Contractor	Alternative Bid Amount (\$)	
	Asphalt / FDR	Concrete
A	\$2,326,545	-
B	\$2,453,970	-
C	-	\$2,377,577
D	-	\$2,497,931

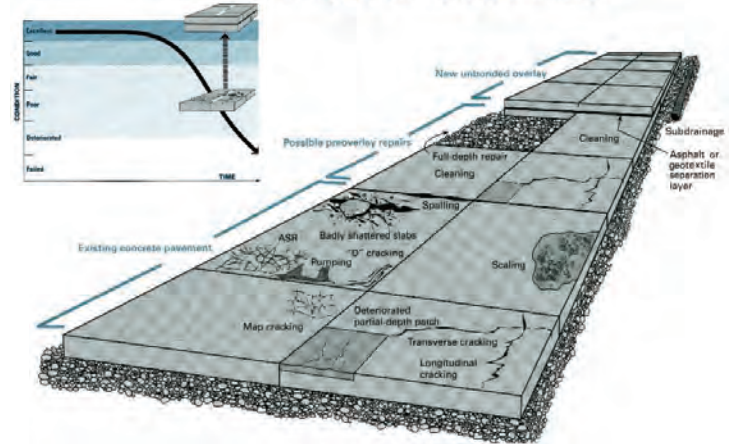
Lancaster County Completed - 7.5"



On-Site Batch Plant



Unbonded Concrete Overlay on Concrete Pavements



Asphalt or Fabric can be used as Sep Layer between distressed concrete and new concrete overlay

350' Extension

Batch Plant On-Site

Crushing Operation - Base Material
RW Width reduced to 100'

WW II Era PCCP

Asphalt Sep Layer

Charleston Executive
(JZI)
RW 9-27



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'

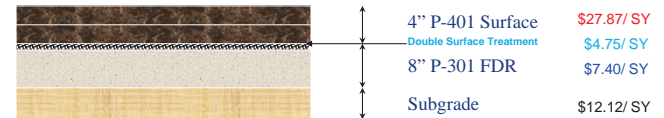


5-Inch, SCDOT 501 Spec (substituted for P-501), Min of 4400 psi

Pavement Sections - Laurens Co Runway

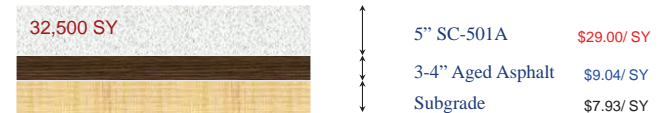
2012 Costs Breakdown per layer

Asphalt Section \$52.14 / SY



Subgrade Costs reflect all “other” project related costs

Concrete Section \$45.97 / SY



Aged Asphalt Costs include Transition and grade correction costs

Two Years following RW Project



Successful projects breed additional projects!

Greenwood County RW 9-27

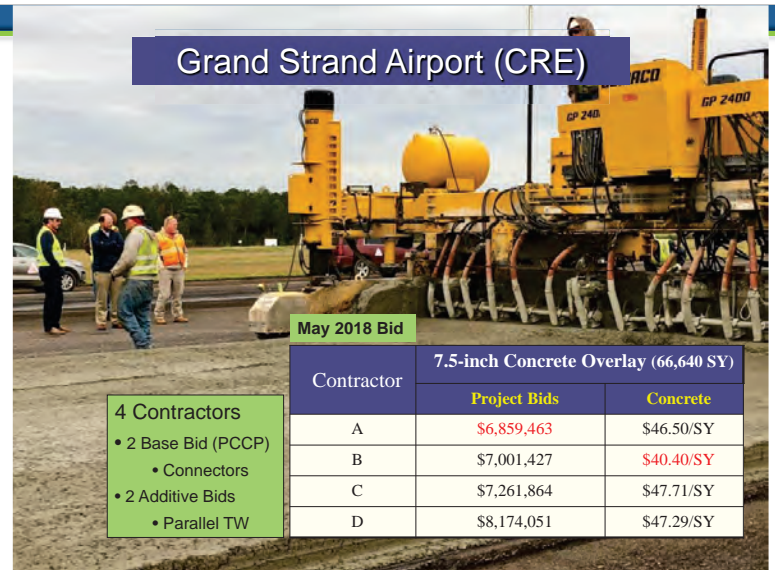


- Asphalt was nearly one foot thick!
- PCCP Paving completed in 10 days!

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



Grand Strand Airport (CRE)



May 2018 Bid

4 Contractors

- 2 Base Bid (PCCP)
 - Connectors
- 2 Additive Bids
 - Parallel TW

Contractor	7.5-inch Concrete Overlay (66,640 SY)	
	Project Bids	Concrete
A	\$6,859,463	\$46.50/SY
B	\$7,001,427	\$40.40/SY
C	\$7,261,864	\$47.71/SY
D	\$8,174,051	\$47.29/SY



Jamestown (TN) Municipal Airport
40,925 SY of 3-inch P-501

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



Carolinas Ready Mixed Concrete Assn



Dixie Contractor – March 2009



Roads & Bridges – April 2011

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

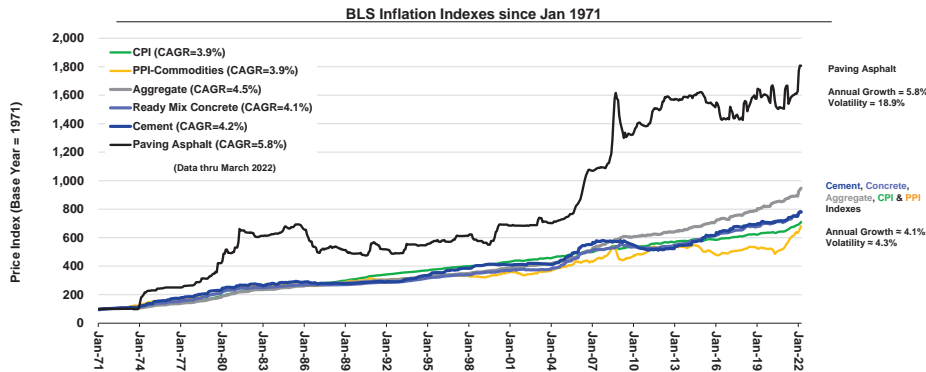
FAA Design AC 150/5320-6G

- 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

FAA Const AC 150/5370-10H

- Design psi > Acceptance psi
- 650psi / 620psi for acceptance
- When 60K aircraft or less....
 - Use compressive acceptance
 - Easy substitution, great if R/M
 - Use state highway specs
 - May enable local aggregates
 - May enable less cement contents

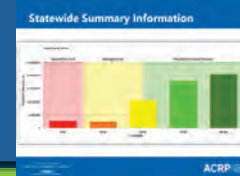
Cement / Concrete follow CPI Index, Asphalt much more volatile!



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

1. Real Price change is also known as aka changes in relative prices, differential inflation rates, material specific inflation, & constant dollar changes.
2. U.S. Department of Labor, Bureau of Labor Statistics, <http://www.bls.gov/fop/home.htm>
3. CAGR = Compound Annual Growth Rate

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



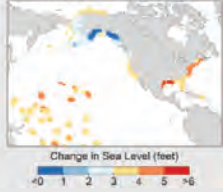
Airfield Applications
Finding a good overlay candidate...

- 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)

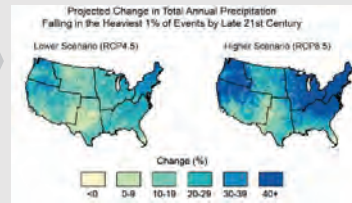
FUTURE CLIMATE CONDITIONS WILL NOT RESEMBLE THE PAST

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

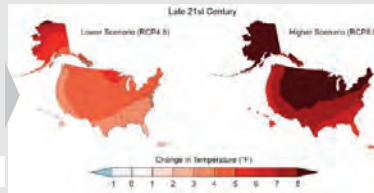
Projected Relative Sea Level Change for 2100
 under the Intermediate Scenario



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



USGCRP. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief (Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)). U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

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



Improved Resilience

Henderson Field (Wallace, NC)



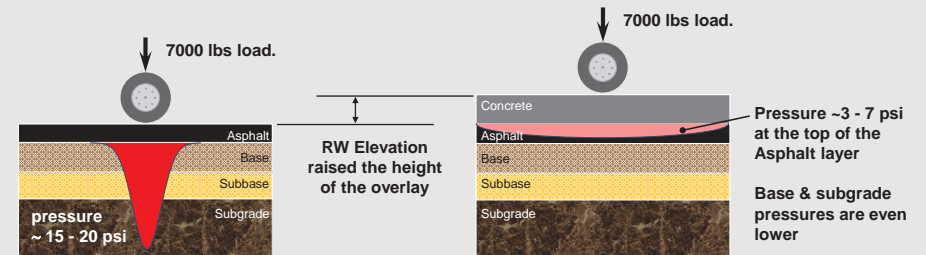
Offutt AFB (Omaha, NE)



- 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

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

Use Concrete Overlays



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



Charleston Executive Airport Johns Island, SC

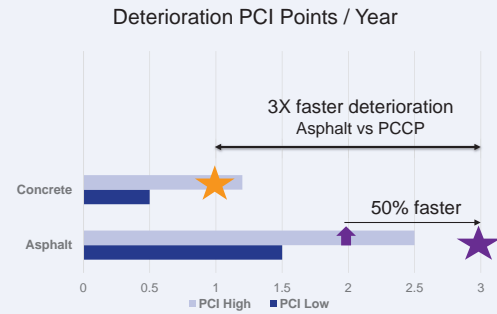
2016 PCI Data Pavement Management Report

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

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



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)

Source: Performance Trends in Airport Runway Pavements (2014 FAA Worldwide Airport Tech Transfer Conference) and SC 2016 Airfield Pavement Management Report (JZI PCI data)

Olsson Engineers project writeup...

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 = 98

North Platte (NE) Regional Airport



Concrete Overlay was less than 1/2 the cost of reconstruction!

Airfield Concrete Overlays

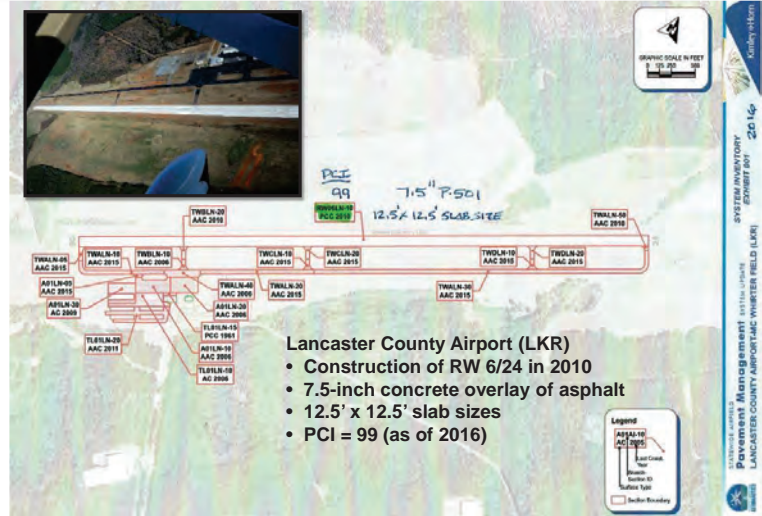
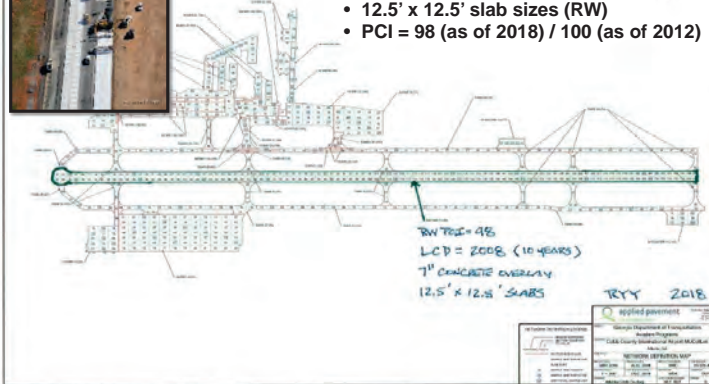


Performance? Pavement Condition Indexes

- ✓ 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)

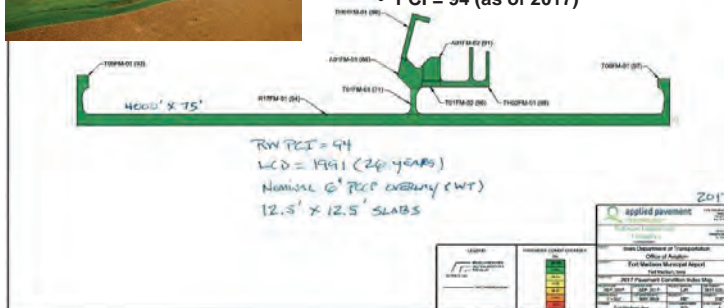


- Lancaster County Airport (LKR)**
- Construction of RW 6/24 in 2010
 - 7.5-inch concrete overlay of asphalt
 - 12.5' x 12.5' slab sizes
 - PCI = 99 (as of 2016)

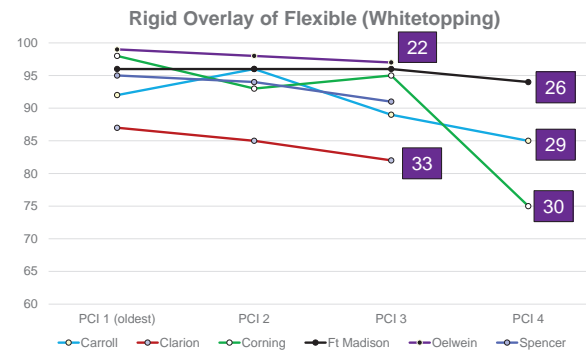


FIGURE 8. PCI MAP

- 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



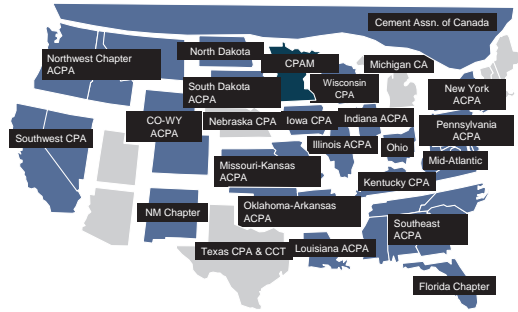
AGES 22-33

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!



Thank You!



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