Pavement Management: Key to Sustainable Concrete Pavement at the World’s Busiest Airport

Concrete Airport Pavement Workshop
Right Choice, Right Now
ACPA – SE Chapter
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MR. MAX WALKER – DEPARTMENT OF AVIATION

MR. FRANK HAYES – ~40 YEARS IN NUMEROUS CAPACITIES

OTHERS TOO NUMEROUS TO LIST
ATL – World’s Busiest Airport

In 2011

- Passengers: 92 million
- Aircraft Operations: 923,000
- Concrete Pavement: 1000+ acres
- Replacement Value: $2 billion

- Enough concrete to pave a 10,000 ft runway --- Every year for 30 years
ATL – World’s Busiest Airport

![Bar Chart]

**PAVEMENT AGE --- % OF TOTAL IN 2010**

- <10 years: 24%
- 11-20 years: 20%
- 21-30 years: 33%
- >30 years: 23%

**PAVEMENT AGE IN 2010 (YEARS)**
Reasonable spread of pavement area among the age groups.

Why is Pavement Management important ----

Fast forward 5 years!!!
ATL – World’s Busiest Airport

WHAT A DIFFERENCE 5 YEARS CAN MAKE!!!!!!
Runway 8R-26L

How did the Pavement Management Program start?

…….Slowly at first…….
ATL – World’s Busiest Airport

Runway 8R-26L

- Replaced in 1969
- 40 Day Wonder

In 1984

- 15 Years old (20 year design life)
- 20 Years of traffic
- Surface cracks – cracked longitudinal joints

*Replace it before accustomed to 4 runways*
Runway 8R-26L

ATL Management Agreed To:

- Investigate/Evaluate
- Need for replacement

1984 Study

- FWD (relatively new)
- Petrographic examination of concrete cores
- Strength and modulus lab testing of pavement samples
- Remaining Life Assessment
Runway 8R-26L

FWD - 1984
Falling Weight Deflectometer

- Force = 25,000 lbs.
- Load Plate = 12” diameter
- Surface deflection across several feet
- Deflection basin – pavement surface
- Deflection across joints

HWD - 2001
Heavy Weight Deflectometer

- Force = 60,000 lbs.
- Load Plate = 18” diameter
Petrographic Examination – Cores

- Stereo-optical microscope
- 10x to 60x

- Nature of cracks
- Reactions - paste/aggregate
- Secondary deposits in voids and cracks
Runway 8R-26L

Strength – Modulus Testing of Pavement Samples

- Concrete cores
- Cement treated base
- Soil cement
- Compressive strength
- Modulus of elasticity
- Split tensile strength
1984 Findings

- Surface cracks 3” - 5” deep
- Good structural capacity
- Slight evidence of ASR
  - alkali-silica reactivity
  - translucent rims around aggregate edges
  - little disruption of paste-aggregate bond
Runway 8R-26L

1984 Recommendations

- Expect 5 more years of service
- Replace 10-15 slabs
  - Actual = portions of 2 of 800
- Repair longitudinal joints
- Seal cracks (<1/4” wide)
- Seal all joints

- Repeat program in 3 years --- Genesis of Pavement Management System
Pavement Management System

1984 Program Repeated


New techniques added with time

- Pavement Condition Index
- Resilient Modulus of Subgrade
- Laser Profilometer
- High-Speed Digital Video Imaging
- Distress Surveys with GPS & GIS
- Long Term Photo Library
- SEM & XRD Analyses
- Special Field Investigations
Pavement Management System

Pavement Condition Index (PCI) – 1990

- Corps of Engineers – 1970’s
- Quantify defects – extent & severity
  - Spalls
  - Cracks
  - Patches
  - Joint Sealant
- Process to a single value – 0 to 100

- Pavement Condition Index – PCI
  - Best = 100
  - Worst = 0
Pavement Management System

Pavement Condition Index (PCI) – 1990

- Develop performance history curves
- Predict timing of future critical conditions

![Graph showing actual and projected PCI vs. time for RW-8R (KEEL - CD LINE). The graph indicates that major rehab for KEEL is needed by 2010.](image)
Pavement Management System

Resilient Modulus Testing – 1990

- Rebound Stiffness Modulus
- Various Confining Pressures

- Utilized for Mechanistic Designs
  - Model Physical Pavement System
Pavement Management System

Laser Profilometer & Roughness / Ride Quality – 1994

- Rolling cart with light sensitive cells
- Fixed laser source
- Roll cart longitudinally along pavement
- Record elevation every 1 foot
- Develop profile
- Analyze aircraft response
- Develop Pavement Smoothness Index (PSI)
SOME DROP IN SMOOTHNESS FROM 2001 TO 2004
ENDS NOT SHOWN DUE TO LITTLE OR NO EFFECT
2001 WAS CENTERLINE ONLY
2004 INCLUDES CENTERLINE AND WHEELPATHS
Pavement Management System

High-Speed Digital Video Imaging – 2001

- Van at night – 40 to 60 mph
- 12-to 13 wide path
- Cover entire surface
- Capture hairline cracks
- Historical record
Pavement Management System

High-Speed Digital Video Imaging – 2001

Historical record – project on wall – like walking the pavement
Pavement Management System

Long Term Photo Library – 1984 Forward

- Photos of key conditions over many years
- Puts better perspective on when to replace

1990  
2004
Pavement Management System

Annual Crack Surveys with GPS and GIS - 1995

- Surveyor on foot with GPS Pole
- Distress – sound pavement surface with steel dowel bar
- General limits with GPS – so can find it again
- Photo and location --- input into GIS system
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Scanning Electron Microscope (SEM)
Energy Dispersive X-rays (XRD)

- Detailed nature of cracks
- Chemical make-up of deposits
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Special Investigations and Testing

- Taxiway with unusual corner breaks (only 7 years old)
- Corner of one slab visually deflected under gear of DC-8
- Suspected curling of slabs (16 inches thick)
- Cut 26-inch diameter core
Pavement Management System

Special Investigations and Testing

➢ Curling confirmed

Note void between bottom of slab and top of cement treated base
Pavement Management System

Special Investigations and Testing

- Slice core in sections 4-inch thick
- X-ray to see dowel and dowel socket condition
- Void above dowel on one side and below dowel on other side of joint
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Summary

- PCI
- condition

- HWD
- deflection

- PSI
- smoothness
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Summary

- Not an exact science – pavement failure is like beauty
  - It is in the eye of the beholder/user
- ATL – system development over 28 years
- Institutional knowledge retrievable in a database
- Asset worth $2 billion
Pavement Management System

Summary

- **LIFE OF 2 RUNWAYS NEARLY DOUBLED TO ~40 YEARS**
- **VALUE -- CONSERVATIVELY ESTIMATED > $100 MILLION**

—Good News – Concrete lasts a long time.