Logan Airport Today

- 2,400 Acres
- Six (6) Runways
- Fifteen Miles of Taxiways
- 102 Aircraft Gate Positions
- 204 Acres of Pavement
- 12,000 Workers Employed
- Regional Economy Stimulated by $7B / year
- 88,000 Direct and Indirect Jobs
Airport Statistics

- **Passengers**
  - Logan is the *19th Busiest* Airport in the Nation
  - Logan is the *41st Busiest* Airport in the World

- **Operations**
  - Logan is the *16th Busiest* Airport in the Nation
  - Logan is the *24th Busiest* Airport in the World

- **Cargo**
  - Logan is the *19th Busiest* Airport in the Nation
  - Logan is the *60th Busiest* Airport in the World

*Based on ACI Worldwide Traffic Rankings By Passenger, Cargo and Movements 2007 (Preliminary)*
Present Passenger Loads

Logan was Built to Handle a Peak of 50-60,000 Passengers per Day

Logan Airport Averages: 77,000 Passengers/Day or 28.1 Million Passengers/Year
Background of Pavement Issues

- Prior to the 1990’s, pavements rehabbed for cracking and oxidation.

- More wide body aircraft in the 1990’s led to hot weather rutting. Tire pressures – 200 psi, weights 100,000-800,000 pounds.

- From 1995 to 2003, attempts to stiffen HMA led to moisture sensitive mixes, e.g. TLA, polymers, large aggregate.

- Stripping began in 2000.

- Started research programs to deal with stripping issues.
• **Stripping**

- Loss of cohesion between asphalt binder and aggregate.

- Combination of hot weather, moisture and traffic and/or continuous exposure to moisture can lead to stripping.

- Typically not an issue in New England.

- Georgia aggregate well known for stripping.

- Western states experience stripping due to water vapor and daily temperature variations.

- Lime is an effective anti-stripping agent.
• Stripping in Underlying Layers at Logan

  – Predominately in top 6” – 8”, layers that were installed since the 1970’s.

  – In the 1970’s, rubber tired rollers were replaced with vibratory rollers. Runways were no longer slurry sealed when grooving was introduced

  – Suspect that water is perched above the layers that were compacted with rubber tired rollers and then seal coated.

  – Baltimore airport (BWI) recently noted internal stripping in some of their pavements.
• Performance Graded (PG) Asphalt Binders


  – Performance grades higher than PG 64 require modification to increase stiffness.

  – Modification of Logan binders has resulted in moisture sensitive mixes.
Initiatives:

• **Surface Course Material Issue**
  – Develop a rut and moisture resistant mix using readily available materials.
  – Develop revisions to the FAA P-401 specification for screening out poor performing mixes.

• **Stripping Issue in Underlying Layers**
  – Investigate non-destructive methods for delineating areas of stripping within HMA.
  – Develop a protocol for evaluating the structural soundness of pavements.
Screening - Accelerated Load Test

• Needed test to identify moisture susceptible mixes under traffic at high temperatures.
  • AASHTO T283 Tensile Strength Ratio (TSR) applies to freeze-thaw, not hot/wet conditions

• Equipment choice
  • MMLS3 at Worcester Polytechnic Institute (Model Mobile Load Simulator – 1/3 Scale)
Model Mobile Load Simulator
Testing Program

• Found TSR test alone is not a good indicator of stripping performance. Recommend accelerated loading test for new mixes, e.g. the Hamburg Wheel Tracking Device or the MMLS.

• Lime additive – effective anti stripping agent, stiffens binder, and slows aging.

• Tested HMAs with local aggregates, various binders (PG 70-28, 76-28, 82-28, Citgoflex FR) and gradations (1” max and ¾” max).

• Also tested the “November” RAP mix developed in 2001 by Ron Tardiff of Aggregate Industries.
**Current Everyday Mix** ("November Mix")

- **P-401**
  - PG 64-28 - Mass Highway Dept binder
  - Latex (SBR) at 4% of binder weight
  - Lime at 1% of aggregate weight
  - RAP at 18%

- **PG 76-28 equivalent**
Citigoflex FR

• Citigoflex FR used for special applications
  • Very tough, fuel resistant
  • First 400’ of Runway 22R
  • Terminal alleyways
Terminal
B/C Alleyway
Other Mixes

• Densiphalt
• Rosphalt
• Stone Matrix Asphalt (SMA)
• Warm Mix Asphalt (WMA)
Densiphalt

• Composite semi-flexible pavement:
  • Open graded HMA (25-30% voids) placed first
  • Cementitious slurry applied to fill voids, 24 hr. cure
  • Surface treatment required

• Mixed success at Logan, requires strong subbase, time consuming.
Logan International Airport – B/C Alleyway, 4” Densiphalt
Rosphalt

- Used as wearing course on PCC bridge decks:
  - Eliminates waterproofing
  - On Tobin Bridge & Terminal E Upper Level Road
- Very expensive, $400/ton
Stone Matrix Asphalt (SMA)

- Stone on stone contact for resisting loads with high asphalt content for durability.

- Logan JMF – added lime and fiber for resisting draindown, anti-stripping agent, & latex to lessen temperature susceptibility.

- Terminal ‘D’ installation:
  - Batched hotter than normal.
  - Slight rutting initially, patch not cooled.
  - Surface is very textured.

- Warrants further investigation.
Detection of Stripping in Underlying Layers

- Test Protocol modeled after ARA GADOT study
- GPR, PSPA, cores, indirect tensile strength
- Used on 4L, Terminal C/E Alleyway and Runway 22L reconstruction projects.
RW 22L
Good Core
Bad Core
Really Bad Core!
GPR Stripping Evaluation
Logan Airport - Runway 22L

PSPA Modulus (MPa)

Visual Core Rating
- no stripping
- minor stripping
- stripping
- asphalt segregated from aggregate

Resilient Modulus/Indirect Tensile Strength
- good
- average
- poor

GPR Stripping Evaluation Sheet: 1 of 3

Analyzed by: LM Date: 06/10/06
Checked by: KM Date: 06/12/06
**Construction Issues**

• Because of internal stripping, more time is required for milling and paving to reconstruct pavements.

• Complex arrangement of Logan’s runways and taxiways limits downtime.

• Warm mix asphalt can decrease installation time.
Objectives of Stantec Research Project

• Compare three different WMA test strips constructed on a busy taxiway to our “everyday mix” to determine suitability of WMA for Logan Airport.

• Choose suitable WMA technology

• Compare compaction and grade control for 3” vs. 6” lifts

• Test field cores for rut resistance and moisture susceptibility in the lab

• Monitor the tests strips for physical defects over a three year period
WMA
Research & Development Area

Taxiway ‘A’
WMA Control Area

Taxiway ‘A’
WMA at Logan Airport

- **Set-1**: Citgoflex PG 82-22 binder+1% Lime+1% Sasobit

- **Set-2**: Citgoflex PG 82-22 binder+1% Lime+1% Sasobit+18.5% RAP

- **Set-3**: “November” Mix with PG 64-28+1% Lime+4% Latex+1.5% Sasobit+18% RAP
Test Results

- Cores from all three sets show good results in the different tests
- Set 2 is the best of the three sets of mixes
- Set 2 cores are also found to have the lowest variability of in-place air voids in most cases
TW Alpha Research & Development Contributors

- Stantec
- Worcester Polytechnic Institute (WPI)
- ATC Associates, Inc.
- McCourt Construction Co.
- Aggregate Industries, Inc.
- Sealcoating, Inc.
- Massport
Completed WMA Projects at Logan Airport

- Alpha TW test sections, C/E Alleyway, 2006, Citgoflex FR WMA surface for equipment parking
- C Alleyway, 2007, RAP WMA binder course
- 2007 – Stantec Consulting
- RW 22L reconstruction, 2008, RAP WMA
  - 5-1/2” binder course, 2-1/2 surface course
  - Batch times slower due to longer time to dry aggregate
  - On long pulls, joint heater may be required to achieve density
2009 WMA Projects at Logan Airport

• Rehabilitation of Runway 9-27
  • 50,000 tons
  • Variable depths, 3” – 7”
  • To be competed over 9 weekends

• Extension of Taxiway Delta
  • 40,000 tons
  • 10” section
Additions to FAA P-401 Specification

- Binder viscosity test
  - At 140F: unmodified, 1%, 1.5% and 2% Sasobit
  - ASTM D 2171-07 or D 4402

- Binder penetration test
  - Unmodified, 1%, 1.5%, 2%, 2.5% and 3%
  - ASTM D5-06
THANK YOU!