ACPA – Southeast Chapter
Concrete Airport Pavement Workshop

RECONSTRUCTION OF RUNWAY 18C-36C & TAXIWAY “E” AT CHARLOTTE/DOUGLAS INTERNATIONAL AIRPORT

Presented by
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W.K. Dickson & Co., Inc.

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Atlanta, Georgia
Brief History of CLT

• Originally constructed in 1938 as Morris Field and served as Army Air Corps Base in World War II
• CLT Growth really began to accelerate in the late 1970’s with international cargo service (Flying Tigers).

• First Passenger Terminal opened in 1951
Brief History of CLT

- Major Expansion included a new 10,000’ runway and new passenger terminal – Charlotte truly became an international city.
Brief History of CLT

• Charlotte as it is today – Ranked 6th busiest in the world (2011) and US Airways largest hub
Brief History of CLT

- The future plans – 4th parallel runway, international terminal, intermodal highway/rail facility
RW 18C-36C Original Construction (1977-1979)

- Environmental lawsuit stopped project between site prep and paving phases for 2 years

- Early keyway joint issues on pilot lane required mix design adjustments
After 30+ Years

- Original 20 year design life gave way to structural failures on two center paving lanes
More Problems

- Keyway failures became a frequent problem
- Added in-pavement lighting (newer high speed exit taxiway) began failing after 15 years
Interim Slab Repairs
(2003 and 2008)

- First spot repairs (56 slabs) were made in 2003
- Second spot repairs (82 slabs) in 2008

- Intended to “buy” at least 5 years so third parallel runway could be completed (2010)
1979 RW 18C Construction History

- X-Section: 15” PCC, 8” CTB,
- Transverse Joints: 25 ft spacing, 1.25” diameter dowels
- Select Fill: CH & MH; 60 - 64% Passing #200 Sieve
1979 TW E Construction History

- **X-Section:** 15” PCC, 8” CTB,
- **Transverse Joints:** 25 ft spacing, 1.25” diameter dowels
- **Select Fill:** MH; 74 - 82% Passing #200 Sieve
2010 Visual Condition Surveys

- Mapped Pavement Distresses (Cracked Slabs & Spalls)
- In-Pavement (Curved) Lights (Spalled Epoxy Patches)
2010 Nondestructive Deflection Testing

- Strength and Durability of PCC That Would Remain
- Strength and Condition of CTB
- Strength of Select Fill and Subgrade
RW 18C PCC Elastic Modulus (NDT)

The graph shows the PCC Elastic Modulus (psi) for different locations around the construction site. The modulus values range from 0 to 14,000,000 psi, with the following locations listed:

- 62.5' L of CL
- 37.5' L of CL
- 12.5' L of CL
- 12.5' R of CL
- 37.5' R of CL
- 62.5' R of CL

The NDT Pass results indicate a higher modulus at 37.5' R of CL compared to other locations.
RW 18C CTB Elastic Modulus (NDT)
Key Design & Construction Objectives

- Replace only Heavily Trafficked Keel Sections and Random Failed Slabs
- Provide a minimum 20-year PCC Pavement Design for Reconstructed Keels
- Replace Keel with 18” PCC Section and Replace Distressed Slabs Outside of Keel with 15” PCC Slabs
- Reduce Risk of Early Age PCC Cracking
- For Keel Reconstruction, Stay Out of Select Fill/Subgrade
- Meet Construction Schedule Imposed by Airport and Airlines
- Move Aircraft Main Gear Away from TW E Longitudinal Joints
## Aircraft Design Fleet Mix

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Gross Weight (lbs)</th>
<th>Design Departure Scenarios</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>All CLT Traffic</td>
<td>50 % of CLT Traffic</td>
</tr>
<tr>
<td>1. B717-200</td>
<td>122,000</td>
<td>29,288</td>
<td>14,644</td>
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<tr>
<td>2. B727-200</td>
<td>185,200</td>
<td>498</td>
<td>249</td>
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<td>3. B737-800</td>
<td>174,700</td>
<td>7,537</td>
<td>3,769</td>
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<td>4. B747-200</td>
<td>836,000</td>
<td>58</td>
<td>29</td>
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<td>5. B757-200</td>
<td>256,000</td>
<td>10,627</td>
<td>5,313</td>
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<td>6. B767-300</td>
<td>361,000</td>
<td>578</td>
<td>289</td>
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<td>7. A300-600</td>
<td>380,518</td>
<td>1,477</td>
<td>738</td>
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<td>8. A320-100</td>
<td>150,796</td>
<td>53,669</td>
<td>26,835</td>
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<tr>
<td>9. A330-300</td>
<td>509,047</td>
<td>3,128</td>
<td>1,564</td>
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<td>10. A340-300</td>
<td>608,245</td>
<td>3,101</td>
<td>1,551</td>
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<td>11. DC9-32</td>
<td>109,000</td>
<td>1,827</td>
<td>914</td>
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<td>12. DC8-73</td>
<td>358,000</td>
<td>171</td>
<td>86</td>
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<td>13. MD-11</td>
<td>633,000</td>
<td>4</td>
<td>2</td>
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<tr>
<td>14. MD-83</td>
<td>161,000</td>
<td>3,681</td>
<td>1,840</td>
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<tr>
<td>15. AN-124</td>
<td>877,430</td>
<td>2</td>
<td>1</td>
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<tr>
<td>TOTAL</td>
<td>115,646</td>
<td>57,824</td>
<td>38,549</td>
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Proposed RW 18C PCC Keel
Proposed TW E PCC Keel

EXISTING TAXIWAY 'E' SECTION
NOT TO SCALE

PROPOSED TAXIWAY 'E' SECTION
NOT TO SCALE
Proposed PCC Sections

CONCRETE PAVEMENT RECONSTRUCTION SECTION
(15" DEPTH REMOVED, 16" DEPTH REPLACED)

CONCRETE PAVEMENT, 15" DEPTH
EXISTING CEMENT TREATED BASE, 8" DEPTH, TO REMAIN

EXISTING CONCRETE PAVEMENT, 15" DEPTH, TO BE REMOVED

NOTE: EXISTING CONCRETE PAVEMENT DEPTH ON TAXIWAY "A" AND RUNWAY S-23 IS 16"
Proposed PCC Keel Layout
Construction Constraints

• No Rubblization Within 2 Feet of Joints to Remain

• Slab Saw and Liftout for Single Slab Replacements

• 15” PCC Slabs Reinforced and No Dowel Bars

• 18” PCC Keel Not Dowelled To Existing 15” PCC Wings
Bidding and Construction Scheduling

- Project Bid December 21, 2010
  - 10 Bidders
  - Low Bid $17,864,856 (Hi-Way Paving, Inc.)
  - High Bid $32,999,921 (Kiewit Infrastructure South Co.)
  - Budget $32,000,000

- Contract Schedule Limitations
  - Phasing was to allow bypass access to new third parallel runway
  - Initial construction began in April, 2011 (short Phase I)
  - Phases 2 and 3 (maximum 90 day closure) began August, 2010
Construction Phasing
2011 Construction Highlights

- Concrete removal initiated by rubblizing

- Saw cutting was used to prevent damage at joints
2011 Construction Highlights

- Inconsistent CTB depths required changing design approach
Tight schedules and saturated subgrades required undercut and rubblized PCC and CTB milling used to stabilize backfill.
2011 Construction Highlights

- Taxiway paving lane alignments were revised to take aircraft main gear tracking off longitudinal joints
Most PCC placement was done at night for cooler August & September temperatures.
2011 Construction Program Highlights

- $23,000,000 Final Construction Cost
- Completed in 70 Calendar Days
- 172,012 SY of 18” PCC on 6” CTB
- CAT II Lighting Rehabilitated including LED upgrades
- Two 11 hour shifts, 7 days a week - only break was 2 day Labor Day Weekend
- Opened to Traffic on schedule October 5, 2011
- Expected service life – 20+ years.
Construction
Observations/Recommendations

• For accelerated construction, save time by leaving pavement wings and shoulders in place

• For 15” thick PCC or greater, the contractor preferred method of rubblization and removal is the guillotine

• Double sawcuts (at joint and 12” from joint) will protect the joint from rubblization efforts

• For individual slab replacements, multiple full depth sawcuts and liftout will protect the joints

• Sawcuts at joints where new PCC meets old PCC should be single pass full depth cuts

• Bid prices confirmed that reuse of rubblized PCC as shoulder base and asphalt aggregate (state highway spec) is economical
Construction Observations/Recommendations

- For accelerated construction, installation of subsurface drainage and keel edge drains is not realistic.
- Thickness variability, bonding, or deterioration of CTB observed during removal warrants replacement totally.
- Dowels are not necessary nor required for outside longitudinal construction joints in PCC keel replacements (particularly with differing slab thicknesses).
- For individual slab replacements, reinforce with WWM and use no dowel bars.
- Sawing of all joints including outside longitudinal construction joints should be done as soon as the concrete has hardened sufficiently to avoid chipping, spalling or tearing.
- Alignment of sawcuts for joint sealant reservoirs (outside keel construction joints) is critical to avoid spalling from joint offsets.
32 Years Later
Acknowledgements

Jack Christine, A.A.E. Assistant Director – Charlotte/Douglas International Airport

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Hi-Way Paving Inc. – Construction Contractor