Airport Paving
Changes to FAA Guidance

SEAUPG 2019 Meeting
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Asphalt Institute

Outline

• Size of Airfield Market
• Airfield Challenges
• Specs for Airfield Paving
• Recent Changes to P-401
• Cutting Back Longitudinal Joint

FAA Airport Pavements in US
National Plan of Integrated Airport Systems (NPIAS)

<table>
<thead>
<tr>
<th>AREA (million sq)</th>
<th>“14” wide Lane Mile</th>
<th>Overall %</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW 273</td>
<td>~33,000</td>
<td>59.4</td>
</tr>
<tr>
<td>TW 105</td>
<td>~13,000</td>
<td>22.8</td>
</tr>
<tr>
<td>Apron 81</td>
<td>~10,000</td>
<td>17.6</td>
</tr>
<tr>
<td>Total</td>
<td>~56,000</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Credit Doug Johnson, FAA

Approximately 80% of RWs are asphalt
- General Aviation (50%): 7:1 HMA/PCC
- Primary (38%): 2:1 HMA/PCC

For Comparison: U.S. Interstate System has 226,304 Lane Miles
FHWA Table HM-60 - Highway Statistics 2017
Airfields provide unique pavement challenges different from highways

- **Heavier Loadings**
  - Aircraft loads can exceed 1 M# vs. 160,000# max load on hwy/bridges

- **Higher Tire Pressures**
  - Can exceed 300 psi vs. semi truck = 100 psi

- **Foreign Object Debris (FOD)**
  - Must keep airfields at higher serviceability level
    - Single commercial aircraft engine = $15M

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**Airport vs Highway Tire Loads**

- **Truck Tire Load vs Aircraft Tire Load**

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**In Addition,**

- Repairing RW or TW is Major Disruption to Ops
- Can’t just close a lane and “keep traffic open”

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- Airfield HMA Specifications
  - FAA P-401
  - Tri-service UFGS 32 12 15.13
- Generally Mandated if Federal Funds Used
- Language Must Apply Across the Country
- Represent “High Wire Act” of Asphalt Paving

In Both P 401 and UFGS 32 12 15.13

Designer’s option to choose between Marshall Hammer or Superpave Gyratory Compactor as Lab Compactor

On December 21, 2018, FAA released a new version of their Airport Construction Standards
- AC 150/5370-10G (released 2014)
  - AC 150/5370-10H
- P-401 just one of many specs in this AC (700+ pgs).

- Revision process includes extensive internal, industry and legal reviews (16 months, 2200+ comments). Thus, these ACs don’t get updated very frequently.
Typical FAA Pavement Layers (for Flexible Pavements) and Their Specs in AC 150/5370-10H

- **Surface Course**
  - P-401 (asphalt mix)
  - P-403 (similar to P-401 but no PWL)
  - For pavements supporting aircraft <10,000 lbs, or shoulders, roads, blast pads, or small maintenance projects
  - P-404 (fuel-resistant asphalt mix)

- **Stabilized Base Course (typically required for aircraft > 100,000 lbs)**
  - P-403 (when used as bond-breaker)
  - P-304, P-306, P307 (various cement treated aggregate bases)

- **Base Course**
  - P-209 (crushed aggregate)
  - P-208 (aggregate, less crushed)
  - P-207 (full depth reclamation - New)

- **Subbase**
  - P-154 (coarse sand)

Significant Changes to P-401 (Dec 2018)

- **Tack coat as a separate pay item**
- **Contractor quality control**
  - greater emphasis, new requirements, separate pay item
- **Compaction now % of TMD (vs lab bulk density)**
  - matches highway industry
- **Adjusted gradation bands**
  - matching military airfield specs
- **Improved minimum lift thickness guidance**
- **New loaded wheel test requirement for mix design**
  - APAs with 250 psi hose pressure at 64C
- **New guidance on PG grade selection**
  - additional grade bump
- **Greater use of state highway standards**

Changes to P-401 Mix Gradations (Table 2)

<table>
<thead>
<tr>
<th>Sieve (mm)</th>
<th>Gradation 1</th>
<th>Gradation 2</th>
<th>Gradation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>15 - 18</td>
<td>15 - 18</td>
<td>15 - 18</td>
</tr>
<tr>
<td>No. 16</td>
<td>12 - 15</td>
<td>12 - 15</td>
<td>12 - 15</td>
</tr>
<tr>
<td>No. 200</td>
<td>6 - 16</td>
<td>6 - 16</td>
<td>6 - 16</td>
</tr>
</tbody>
</table>

Gradation bands adjusted to match UFGS 32 12.15.13, and be consistent with NMAS definition.

Gradation 2 is typical surface mix. Gradation 3 intended for leveling courses. Gradation 1 generally for non-surface mixes.
### Changes to P-401 Mix Gradations

<table>
<thead>
<tr>
<th>Table 2. Aggregate - Asphalt Pavements</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMA now listed in Table 2. Criteria unchanged (1% higher than SP)</td>
</tr>
<tr>
<td>Min. VMA</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Asphalt percent by total weight of mixture:</td>
</tr>
<tr>
<td>Stone or gravel</td>
</tr>
<tr>
<td>Slag</td>
</tr>
<tr>
<td>Recommended Minimum Construction Lift Thickness</td>
</tr>
</tbody>
</table>

### New Loaded Wheel Test Requirement as Part of Mix Design - Designer Options

- **Primary Method**—APA @ 250 psi
  - AASHTO T340, 64ºC, 250 psi hose pressure
  - Rutting must be < 10 mm @ 4,000 passes

- **Alternative Method**—APA @ 100 psi
  - AASHTO T340, 64ºC, 100 psi hose pressure
  - Rutting must be < 5 mm @ 8,000 passes

- **Alternative Method**—Hamburg Device
  - AASHTO T324
  - Rutting must be < 5 mm @ 20,000 passes

> Only Required on Projects for > 60,000# aircraft

* Per Errata published on 11/12/19

Reference: AC 150/5370-10H

### P-401 Calls for PG Grade (ASTM D 6373) and possible PG-plus test

#### Guidance in engineering note

- Determine "base grade" (based on climate only, no bumping for traffic), then bump per table:

<table>
<thead>
<tr>
<th>Aircraft Gross Weight</th>
<th>High Temperature Adjustment to Asphalt binder Grade</th>
<th>All Pavement Types</th>
<th>Pavement area with slow or stationary aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 12,500 lbs</td>
<td>—</td>
<td>1 Grade</td>
<td>2 Grade</td>
</tr>
<tr>
<td>&gt; 12,500 lbs</td>
<td>1 Grade</td>
<td>2 Grade</td>
<td>3 Grade</td>
</tr>
</tbody>
</table>

- Add PG Plus test if UTI is 92 or greater
  - Default is ER (ASTM D6084) ≥5% min*
  - Errata note (Sep 2019): *Follow procedure B on RTFO aged binder
  - Engineer may replace ER with the local state DOT’s PG-Plus test (and criteria).
  - Reference AI’s binder spec database to see what each state uses
What about RAP or RAS?

- No RAP for surface mixes, except shoulders
- Max RAP is 30% for non-surface layers & shoulders.
- When using RAP:
  - 0-20% RAP, no change in binder grade
  - 20-30% RAP, adjust to one grade softer (HT and LT)
    - PG 64-22 adjusted to 58-28.
- No Recycled Asphalt Shingles (RAS)

Expanded Opportunities to Use State Paving Specs

- On Airfield pavements < 30,000 lbs - NO FAA-approved MOS reqd. required
  - Used to be < 12,500 lbs (under ...-10G)
  - About 30% of RWs in NPIAS rated below 30,000 lbs
- Non-primary airports > 30,000 and < 60,000 lbs
  - with FAA-approved MOS
  - Due to FAA Reauthorization Act 2018
- Other pavements not for aircraft loading: shoulders, perimeter roads, blast pads, vehicle roads and parking
- Stabilized base course under PCC

P-404 Fuel-Resistant Mixture

- Per FAA, use only as surface course (1.5” - 3” thick) where fuel resistance needed
  - On aprons to replace PCC or coal tar sealers
  - Some airports have used P-404 on RWs and TWs prone to rutting
- Properties
  - 50-Blow Marshall
  - Design air Voids: 2.5%
  - 9.5mm gradation
  - Weight loss from fuel immersion test < 1.5%
- Binder
  - PG 88-22 or 92-28
  - ER > 85%
  - Separation test: max. temp diff. of 4 deg C (w/ ring and ball)

Tri-services will soon release a FR spec similar to P-404
Airfield specs require cutting back the longitudinal joint.

401-4.14 Joints
- LJs shall be cutback if exposed >4 hrs, or if surface <175 deg F, or if irregular, damaged, uncompacted, etc.
- With cutting wheel (typical) or pavement saw (not typical)
- Cut back max of 3" for clean, sound, uniform vertical face full depth
- Remove cutback material
- Tack LJ face per P-603

Cutting Back Joint
- Eliminates low density material
- Avoid tearing
  - must cut when mix still warm (temperature sweet spot)
  - watering cutting wheel may help
- Critical to cut straight (use stringline)
- Easier with long wheel base vehicle

Cutting Wheel

NO!!!
### Equipment for cutting back joint

- **Roller with cutting wheel attached to drum**
  - Operates on newly paved surface while mix is warm
- **Grader**
  - Operates on adjacent paving lane
  - Potential to cause rutting if on new mat that has not cooled
  - Some have cited easier to cut straight when cutting wheel attached to rear ripper versus blade between wheels
- **Not recommended:** short wheel base vehicles (i.e. skid steer)

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**Thule AFB, Greenland**

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**Thule AFB, Greenland (video)**

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Fort Carson, CO (video)

P-401 Joint Density

• 401.6.1 Acceptance sampling and testing
  d. (5) In-place Joint density
    • One core centered over LJ for each subplot
    • Joint density = bulk density divided by avg. TMD for lot
    • “For joints between two lots, use lower avg. TMD”

• 401.6.2 c. Acceptance criteria for joint density
  • PWL of lot >90: acceptable
  • PWL <90%: evaluate reason
  • PWL <80%: cease operations until figure out why
  • PWL <71%: lot pay factor reduced by 5%

• 401.6.3 PWL Acceptance limit for joint density
  • Lower limit: 90.5% (Table 5)
  • 90 PWL achieved when consistently producing average
    joint density of at least 92.5% with 1.55% or less variability
Two AI Courses Specific to FAA Standards

3 days on wide variety of topics, including pavement design/eval, materials, mix design, construction, preservation and rehab for airports.
- FAA’s Southeast Region: Oct/Nov 2020

1.5 days focusing on P-401
- Denver: Apr 7-8, 2020
- Nashville: May 12-13, 2020

Thanks to our Members. Questions?