Pavement Materials, Maintenance, and Specifications

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Disclaimer

This is a technical / materials presentation only. Potential impacts on funding, grants, FAA acceptance, FAA Orders, Public Law, etc. are not considered in detail.
Plantmix / Hot Mix Asphalt

• “Stiff” enough to support the anticipated loads
• “Soft” enough to be durable
  – Resist fatigue
  – Resist environmental stresses and aging
• Adequate friction
• Smooth, uniform texture
• No FOD
• Minimum Life Cycle Cost / minimal disruption
Demands Differ

- Major commercial vs. small general aviation
- Runways vs. taxiways vs. aprons
- Landside vs. airside
- Mixed use
- Different climates
- Changes over time

Thus, materials & criteria should also differ
Pavement Maintenance Starts Before Construction
Pavement Management

Typical Pavement Condition Life Cycle

- Good: $1.00 for rehabilitation here
- Satisfactory
- Fair
- Poor
- Very poor
- Serious
- Failed

Time

- Significant drop in condition
- Small % of Pavement life
- And will cost $5.00 here

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Pavement Management

- Original Pavement
- Optimal Timing (Rehabilitation Trigger)
- Pavement Preservation (i.e. Surface Treatment)
- Rehabilitation Trigger
- Rehabilitation/Reconstruction Trigger

Pavement Condition vs. Age of Pavement
Pavement Management

Typical Pavement Condition Life Cycle

1. **Good**: $1.00 for rehabilitation here
2. **Satisfactory**: Would cost $5.00 for rehabilitation here
3. **Fair**: Significant drop in condition
4. **Poor**: Small % of Pavement life
5. **Very Poor**: And will cost $5.00 here
6. **Serious**: Failed

Time
P-401 / P-403

- Guidance on binder
- Guidance based on aircraft weights
- Three gradations to choose from
- Mixture parameters designed and proven on airports (empirically)
- Material requirements and PWL are integrated
Why Not P-401 / P-403?

- Marshall mix design method becoming uncommon
- FAA Superpave is unfamiliar to many
- $2,500 to $5,000 (or more) for a mix design
- Not all producers can meet the specification
  - Voids in mineral aggregate (VMA)
- Generally results in higher prices
Why Not Caltrans Mix?

- Readily available, right?
- Lots of experience with the spec and materials, right?
- Good enough for Caltrans, right?

Maybe
The use of state highway department specifications for airfield pavements subject to aircraft loading by aircraft greater than 12,500 pounds and less than 60,000 pounds requires a modification to standards in accordance with FAA Order 5100.1.
# Airports vs. Highways

<table>
<thead>
<tr>
<th>Airports</th>
<th>Highways</th>
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<tbody>
<tr>
<td>• Fewer passes</td>
<td>• More passes</td>
</tr>
<tr>
<td>• Greater weights</td>
<td>• Lower weights</td>
</tr>
<tr>
<td>• Higher shear</td>
<td>• Lower shear</td>
</tr>
<tr>
<td>• Mixes less rut resistant</td>
<td>• Focus on high rut resistance</td>
</tr>
<tr>
<td>• Generally higher compaction requirements</td>
<td>• Generally lower compaction requirements</td>
</tr>
<tr>
<td>• Pay based on statistical evaluation</td>
<td>• Acceptance</td>
</tr>
<tr>
<td></td>
<td>– Non-statistical</td>
</tr>
<tr>
<td></td>
<td>– Different criteria</td>
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Caltrans Spec is Evolving

• 2006 Standard
  – More gradation options, but no compaction control

• 2010 Standard
  – More volumetrics, three placement types

• 2015 Standard
  – Superpave

Spec itself is complicated and difficult to understand and follow
FAA Gradation 1 vs Caltrans

Comparison of Gradation Specifications - Gradation 1 vs Caltrans

% PASSING

SIEVE SIZE, mm

Max Density Line
FAA Gradation 1

0.075  0.60  1.18  2.36  4.75  9.5  12.5  19.0  25.0  37.5  50.0
FAA Gradation 1 vs Caltrans

Comparison of Gradation Specifications - Gradation 1 vs Caltrans

Max Density Line
- FAA Gradation 1
- CT 2006 3/4" max-med

% PASSING vs SIEVE SIZE, mm

0.075 0.60 1.18 2.36 4.75 9.5 12.5 19.0 25.0 37.5 50.0
FAA Gradation 1 vs Caltrans

Comparison of Gradation Specifications - Gradation 1 vs Caltrans

% PASSING

SIEVE SIZE, mm

Max Density Line
FAA Gradation 1
CT 2006 3/4" max-med
CT 2010 3/4"
Comparison of Gradation Specifications - Gradation 1 vs Caltrans

Max Density Line

- FAA Gradation 1
- CT 2006 3/4" max-med
- CT 2010 3/4"
- CT 2015 3/4"
## FAA Gradation 1 vs Caltrans

### Comparison of Gradation Specifications - Gradation 1 vs Caltrans

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<th>SIEVE SIZE, mm</th>
<th>% PASSING</th>
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<tbody>
<tr>
<td>0.075</td>
<td>13% more passing the 3/8”</td>
</tr>
<tr>
<td>0.60</td>
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<tr>
<td>1.18</td>
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<td>50.0</td>
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</tbody>
</table>

- **Max Density Line**
- **FAA Gradation 1**
- **CT 2006 3/4” max-med**
- **CT 2010 3/4”**
- **CT 2015 3/4”**
- **CT 2015 1”**
FAA Gradation 2 vs Caltrans

Comparison of Gradation Specifications - Gradation 2 vs Caltrans

Max Density Line

FAA Gradation 2

CT 2006 1/2" max-med

% PASSING

SIEVE SIZE, mm

0.075 0.60 1.18 2.36 4.75 9.5 12.5 19.0 25.0 37.5 50.0
Comparison of Gradation Specifications - Gradation 2 vs Caltrans

Max Density Line
- FAA Gradation 2
- CT 2006 1/2" max-med
- CT 2010 1/2"

% PASSING

SIEVE SIZE, mm

0.075 0.60 1.18 2.36 4.75 9.5 12.5 19.0 25.0 37.5 50.0
FAA Gradation 2 vs Caltrans

Comparison of Gradation Specifications - Gradation 2 vs Caltrans

9.5% more passing the 3/8”

Can have material retained on the 3/4”
So What Do You Do?

• Follow FAA guidance
• Adopt the Caltrans specification
• Create your own specification
Follow FAA Guidance

**Advantages**
- Protects funding
- Proven history
- Clear guidance
- Statistical acceptance (sort of)
- High compaction requirements
- Joint compaction requirements

**Disadvantages**
- May have to create a new mix design ($$
- May have to validate an old mix design ($
- Expect increasing difficulty finding laboratories with experience and equipment for Marshall
- Mix cost is generally more expensive
Adopt Caltrans

Advantages

• Familiar to many contractors and producers (sort of)
• May be familiar to you (but probably not)
• Probably cheaper, but probably less value

Disadvantages

• May affect funding
• Which version?
• May still have to run a new mix design
• May still have to validate an old mix design
• Criteria is for highways, not airports
• Unnecessarily complicated

AAPTP 06-05 Offers Guidance
Create Your Own

Advantages

• Tailored to your:
  – Loading
  – Climate
  – Experience

• Can take advantage of:
  – The best of existing specs
  – Recent research
  – Local materials, knowledge & experience

• Can maximize pavement performance, life, and value

Disadvantages

• May affect funding
• May have to run a new mix design
• May have to validate an old mix design
• Takes some time & effort
Things To Focus On

- Binder
- Aggregate Quality
- Aggregate Gradation (Maximum Aggregate Size)
- Mixture Properties
- Placement Requirements
- Contractor Quality Control
- Acceptance Methods & Criteria
Binder

- Follow FAA Guidance
- Airport Asphalt Pavement Technology Program (AAPTP) Report 04-02
- Available binders may be limited – market usually driven by state DOT
- Low-temperature grade important for thermal cracking
- High-temp grade / polymers important for rutting resistance
Aggregate Quality

- State and FAA requirements are good
- Higher quality = higher performance
  - Increased fracture improves rutting resistance
  - Moisture sensitivity is important
  - More expensive
- Don’t buy higher quality than you need if you have the choice
Aggregate Gradation

• Gradation affects voids in mineral aggregate (VMA) which affects durability

• Maximum aggregate size affects:
  – Permeability
  – Minimum lift thickness (ROT 3 x maximum)
  – Segregation potential
  – Appearance / FOD potential
Mixture Properties

• Rutting resistance vs. durability

• Things to consider:
  – VMA requirements
  – Laboratory compaction requirements
  – Target air voids

• Richer, finer mixes tend to be less permeable, easier to compact, less likely to segregate, and be more durable, but also more likely to rut. They also tend to cost more.
Placement Requirements

• Uniformity
  – Density, thickness, appearance, smoothness
• In-place air voids
  – Highways – 8% or less
  – Airports – 5% or less
Contractor Quality Control

• Better to have those who control the process monitor the process
• Many / most already do it, so you are likely paying for it
• Tends to generate more attention and involvement
Acceptance Criteria

• Assess conformance with requirements
  • If acceptable
    – Supports payment
    – Allows you to monitor performance and adjust
  • If not acceptable
    – Provides protection
    – Provides basis for mitigation / penalty
The Desired Outcome

- Increased likelihood of a high quality pavement
- Better performance
  - Short term
  - Long term
  - Delays / reduces need for maintenance (and associated disruption)
- Some money now saves much money later.
Requires some... attention to detail
And you should...
But if you deliver a simple, consistent message...
You should have a successful project, and create a long-lasting pavement, postponing the need for maintenance.