Top 10 List
for
More Durable HMA Pavements

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The List

1. Do your homework.
2. Use mixes with higher AC content.
3. Use a finer gradation.
4. Use the right mixing temperature.
5. Include the right surface preparation.
6. Make sure you get bonding between layers.
7. Aim for higher density.
8. Ensure uniformity and consistency in mix.
9. Use RAP appropriately.
10. Use QA and inspection for improvement.
DO YOUR HOMEWORK

My dog ate it! The Inspector stole it!

Coach wouldn’t let me finish it!
Homework

• Use preconstruction evaluation for effective design
  – Surface defects
  – Subsurface conditions
    • Water
    • Depth of cracking
    • Weak base
    • Subgrade condition
    • Previous widening
  – Material integrity
  – Current and future traffic
  – Constructability review
Surface Defects
Surface Defects
Avg. Surface Thickness = 62 mm
Avg. Base Thickness = 150 mm
Smaller is better!

It is better to be Rich than Infamous!

USE HIGHER ASPHALT CONTENT

Don’t be dense!
Increasing Asphalt Content

• Lower number of gyrations
• Regressing to 3% air voids
  – Compact mix to 4% air voids
  – Regress the asphalt content from the 4% air void level to the 3% air void level – Design asphalt content
• Use performance tests to define asphalt content
• Use finer gradations
Lower Number of Gyrations

• High gyrations may lead to damaging aggregate structure and lowering VMA

• States with fixed number of gyrations (between 50 and 80)
  – Texas
  – Alabama
  – Iowa
  – Virginia
  – Minnesota

• SPG compactor is very harsh on mixtures
Regress to 3% Air Voids

- 5.4% Design AC
- 4.7% AC
- 96 Gmm, %
- 97 Gmm, %
- 5.5% Asphalt Content
- 5.0%
- 4.5%
- Log Gyrations
- November 29, 2018

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Performance Testing for Balanced Mix Design

Test temperature: 25°C
Loading rate: 50 mm/min.
Specimen: cylindrical specimen without cutting, gluing, instrumentation, drilling, or notching.
IDEAL Test Results – Mix 2

IDEAL Test Results for Mix 2

CT Index

4.9 + 0.4 = 5.3

% Binder Content

12/5/2018
DCT Test Results – Mix 2

4.9 + 0.4 = 5.3
Too Dense!
Lots of Room!

Graph showing percent passing vs. sieve size in both inches and millimeters.
Smaller is better!

It’s not all it’s cracked up to be!

USE FINER GRADATIONS

Be a rebel, strive for uniformity!
Advantages of Finer Gradations

• Avoid segregation
  – Physical
  – Thermal
• Easier to work
• Easier to compact
• Greater cracking resistance
• Quieter
Finer Gradations
Workability (NCAT)
DCT Results

Fracture Energy, J/m²

Asphalt Content, %

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Finer = Quieter

Maryland SMA Noise Measurements

NCAT Noise Trailer

Noise Level, dB(A)

99 98 97 96 95 94

9.5 mm (Rt. 50) 12.5 mm (I-270) 12.5 mm (I-495) 19 mm (I-83)

Hanson, James & NeSmith
(August 2004)
DON’T OVERHEAT

Keep your cool!

Aging is the enemy of performance!

Save the heat for the beach!
Aging

- Stiffening of asphalt binders and mixtures
- Key factor affecting mixture properties and pavement performance

Stiffness vs. Temp X Time

- Hotter conditions lead to increased stiffness
- Colder conditions result in lower stiffness

Diagram showing the relationship between temperature, time, and stiffness of asphalt mixtures.
Warm Mix Asphalt

• WMA Technologies – proven benefits
  – Longer haul times
  – Lower initial aging
  – Improved workability - higher density
  – Lower emissions
SURFACE PREPARATION

Smoothness is not an accident!

IT’S IMPORTANT TO BOND

Strong bonds are not shear luck!
Surface Preparation

- Advantages of Milling
  - Gets rid of surface defects
  - Create a rough interface – less slippage
  - Produce RAP
  - Create a level pavement
  - Reduced impact on profile

- Plans
  - Mill to bottom of cracks
  - Or use interlayer
  - Accommodate multiple lifts

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Bonding

- Shear Stress Cracking
  - Weak or thin surface
  - Need pavement to act as a system, not individual layers
DENSITY IS THE GOAL

Higher and higher!

It ain’t heavy it’s my bonus!
Rutting vs. Air Voids

Ref: WesTrack
Fatigue vs. Air Voids

Ref: WesTrack
Permeability

![Graph showing the relationship between in-place air voids and permeability, with different diameters indicated.]
NCHRP Report 531

Relationships of HMA In-Place Air Voids, Lift Thickness, and Permeability (NCHRP 9-27)

• Recommended minimum lift thicknesses:
  – 3 X NMAS for fine-graded mixes
  – 4 X NMAS for coarse-graded mixes

• Thin lifts cool faster
  – less time available for compaction
80°F Surface & Air Temperature, 5 mph wind
30°F Surface, 40°F Air Temperature, 15 mph wind
UNIFORMITY AND CONSISTENCY

Construction is not the time or place for REBELLION!
Good Control

**Average Density Readings %**

- Lower Limits
- Upper Limits
- QC Readings
- QA Readings

**Asphalt Content Readings**

- Lower Limits
- Upper Limits
- QC Readings
- QA Readings
Less Control

Density Readings

Asphalt Content %

Sublot Number

Density Readings

Asphalt Content %

Lower Limits  Upper Limits  QC Readings  QA Readings
USE RAP RESPONSIBLY

Need to treat like other materials!

It is a resource, not waste!
RAP/RAS and PG

RAP/RAS binder too stiff?

![Graph showing high temperature grade (°C) for Virgin A, Virgin B, Virgin C, RAP A, RAP B, and RAP C. Virgin Average PG=70 and RAP Average PG=91.](attachment:image.png)
QC/QA AND INSPECTION

The final say in quality!
Your customers pay for it!

Avoid 5-minute screw-ups!
It’s a Target, not a Limbo Bar!
5-minute Screw Up
Inspect Items that Can’t Be Measured