

Use of High Percentages of RAP

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Overview

- Where are we at in RAP Usage?
- What is the current practice?
- What is the future of RAP to allow greater percentages?

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Where are we at in RAP usage?

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Survey of DOT's on RAP Usage

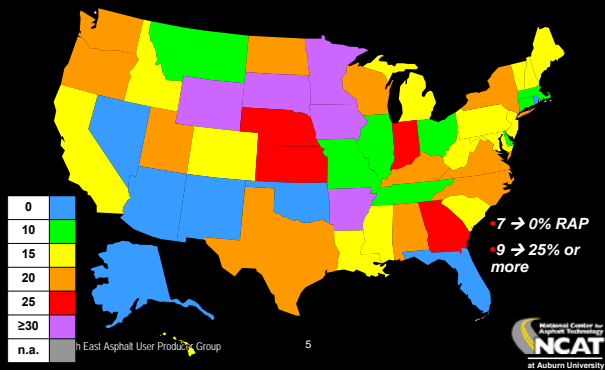
- Conducted by North Carolina DOT in 2007-2008
- How much RAP is allowed by specification for surface, intermediate, and base mixes?
- How much RAP are contractors actually using in the different mixes?
- What are the barriers to increasing RAP contents?

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Surface Mixes: %RAP Allowed



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Current RAP Usage

- Typical RAP usage is between 10 – 15% in the surface.
 - How much do you use?
- Why is the typical use between 10-15%?
- Who is interested in going higher than 15%?

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Superpave RAP Guidelines

- Tier 1: Up to 15% RAP
 - use specified grade
 - use G_{sb} of virgin material
- Tier 2: 15%-25% RAP
 - use one full grade lower, e.g., a PG 64-28 instead of a PG 70-22
 - estimate G_{sb} from G_{se}
- Tier 3: Over 25% RAP
 - use blending charts to determine required grade
 - estimate G_{sb} from G_{se}

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Characterize RAP

- Need to know RAP properties
- Asphalt Content
- Stiffness of RAP Asphalt
- Aggregate Gradation
- G_{sb}

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Asphalt Content

- Why is asphalt content of the RAP important?
 - RAP binder contribution
 - RAP binder reduces amount of virgin binder needed
 - Save money
- How is the asphalt content determined
 - Ignition oven
 - Solvent extraction

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Asphalt Grade

- Why do you want to know the grade of the RAP asphalt?
 - Estimate blended binder properties
 - Evaluate stiffness
- How is the asphalt grade of the RAP determined?
 - Recovered binder is graded unaged
 - Many only grade when RAP exceeds 25%

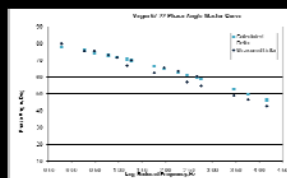
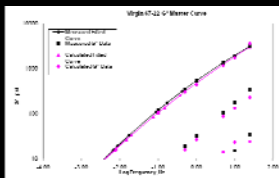
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Future of Asphalt Grade

- Back calculate binder grade



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Asphalt Grade, Cont.

- What do you do if the blended binder grade is too stiff?
 - Bump the virgin binder grade down
 - Example: PG 64-22 → PG 58-28

OR

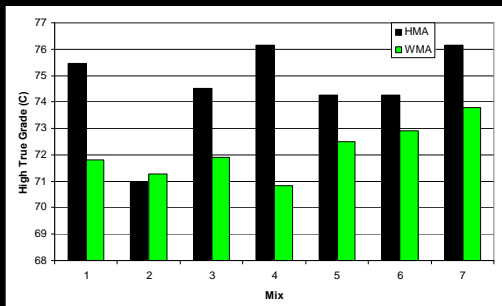
- Use a warm mix asphalt (WMA) technology
 - Reduced temperatures result in a less oxidized binder → a binder that is not as stiff after plant mixing

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High True Grade

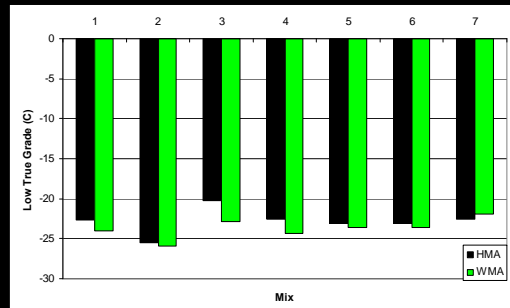


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Low True Grade



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Aggregate Properties

- Why do we need to know RAP aggregate properties?
 - Ensure that quality material is being added to the mix
 - RAP aggregate properties are as important as virgin aggregate properties
 - Combined properties of aggregates should meet consensus aggregate properties

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Aggregate Properties, Cont.

- G_{mm} Method
 - Recently extraction evaluation
 - Assume an absorption value for the area
 - Determine G_{mm} of RAP
 - Determine asphalt content from ignition oven
 - Only use ignition oven if aggregate not prone to significant aggregate degradation

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Ability to Meet Volumetrics



- Treat RAP as mix component
- Challenges: VMA and dust/asphalt ratio
 - Good processing practices can be used to overcome this issue
 - Minimize generating dust in RAP stockpiles
 - Fractionate RAP for mix design flexibility and gradation control

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Compacting Samples

- Preheat RAP
 - Activates the binder
- Prior to blending with other materials make sure chunks are broken down

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Moisture Susceptibility

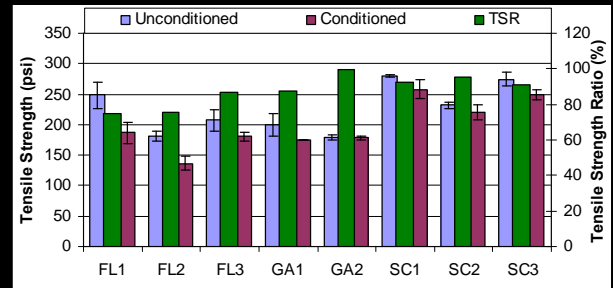
- Conduct moisture susceptibility testing in accordance with AASHTO T 283
- Typically, high indirect tensile strengths
- Not uncommon to see TSRs below 80% for high RAP
 - GA allows as low as 70 % if the ITS are greater than 100 psi

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High RAP TSR



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Do High RAP Content Mixes Perform Well?

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Existing Pavement Sections

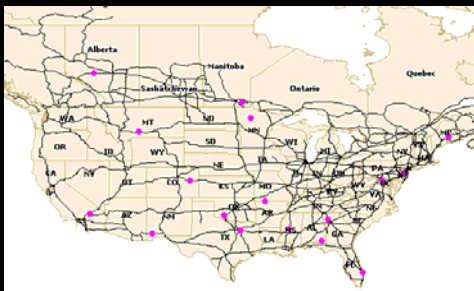
- LTPP SPS-5 sections
 - Virgin
 - 30% RAP
 - Milled and non-milled surface
 - 50 and 125 mm thick
 - Oldest is over 17 years

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SPS-5 Project Locations



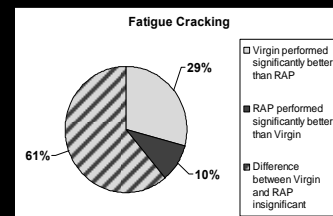
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Fatigue Cracking, Cont.

71% RAP fatigue cracking was equivalent or less than virgin



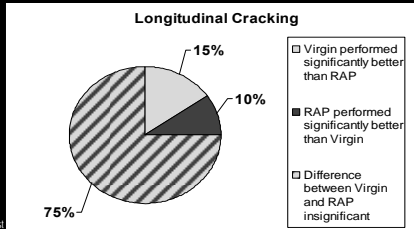
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Longitudinal Cracking, Cont.

85% RAP longitudinal cracking equivalent to or less than virgin

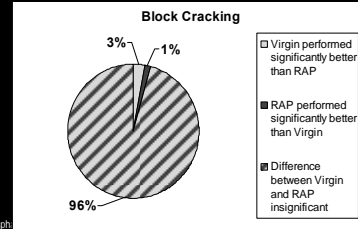


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Block Cracking, Cont.

97% RAP equivalent to or less block cracking than virgin

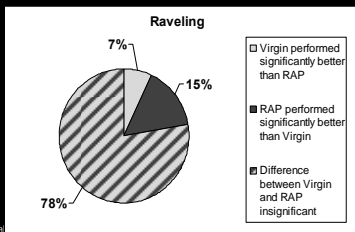


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Raveling

93% RAP exhibited raveling equivalent to or less than virgin



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Questions?

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