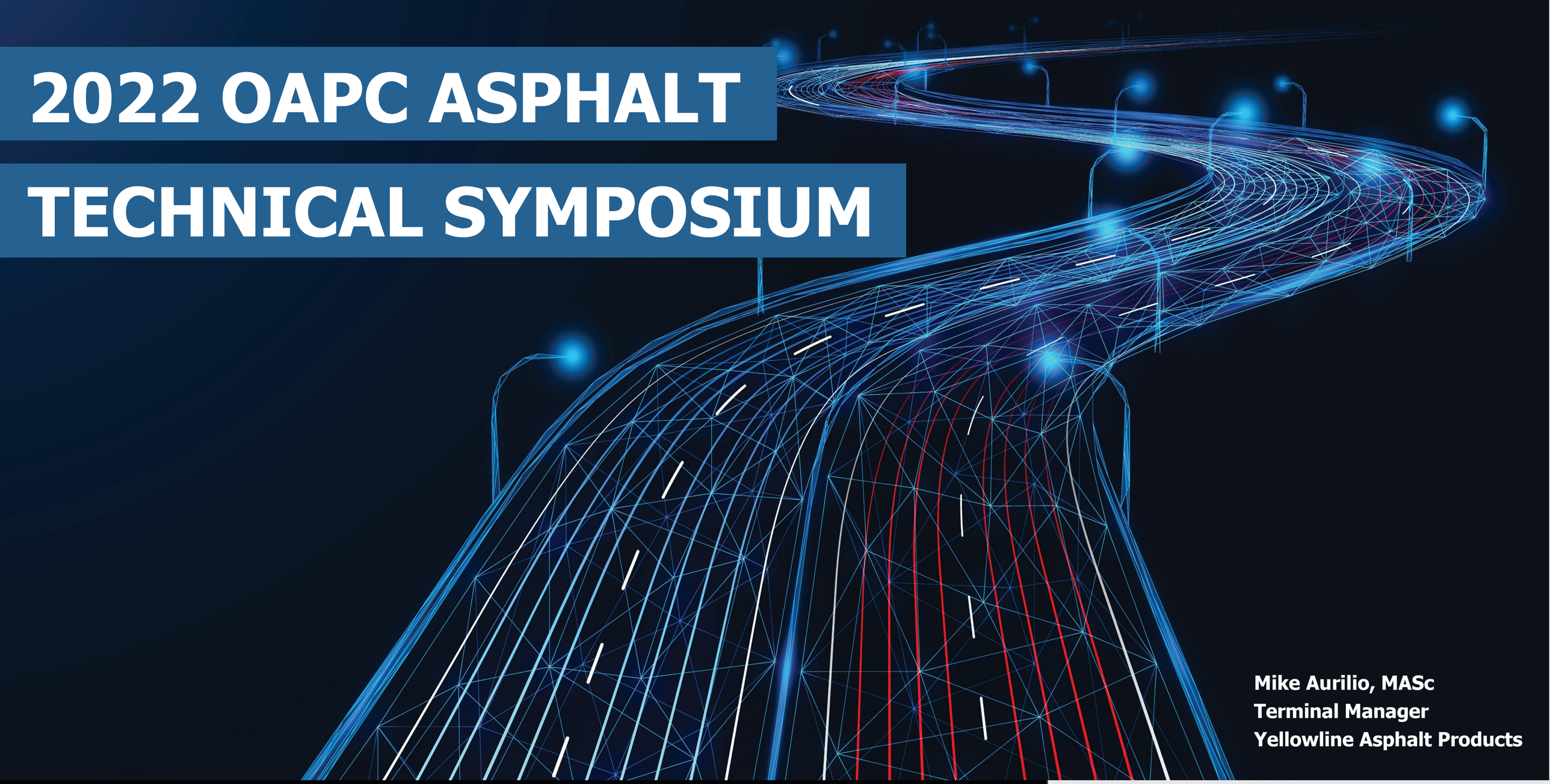
2022 OAPC ASPHALT TECHNICAL SYMPOSIUM



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ORBA

apc ONTARIO ASPHALT PAVEMENT COUNCIL

Understanding Material Behaviour…

Scenario 1:

Mix A:

Aggregate Source: Your Favorite Quarry
Binder Type: 58-28
RAP: 0%
Binder Content: 5.0%

Mix B:

Aggregate Source: Same as Mix A
Binder Type: 58-28
RAP: 0%
Binder Content: 5.5%

Understanding Material Behaviour…

Scenario 2:

Mix A:

Aggregate Source: Your Favorite Quarry
Binder Type: 58-28
RAP: 0%
Binder Content: 5.0%

Mix B:

Aggregate Source: Same as Mix A
Binder Type: 58-28
RAP: 15%
Binder Content: 5.5%

Mix C:

Aggregate Source: Same as Mix A
Binder Type: 52-34
RAP: 0%
Binder Content: 5.0%

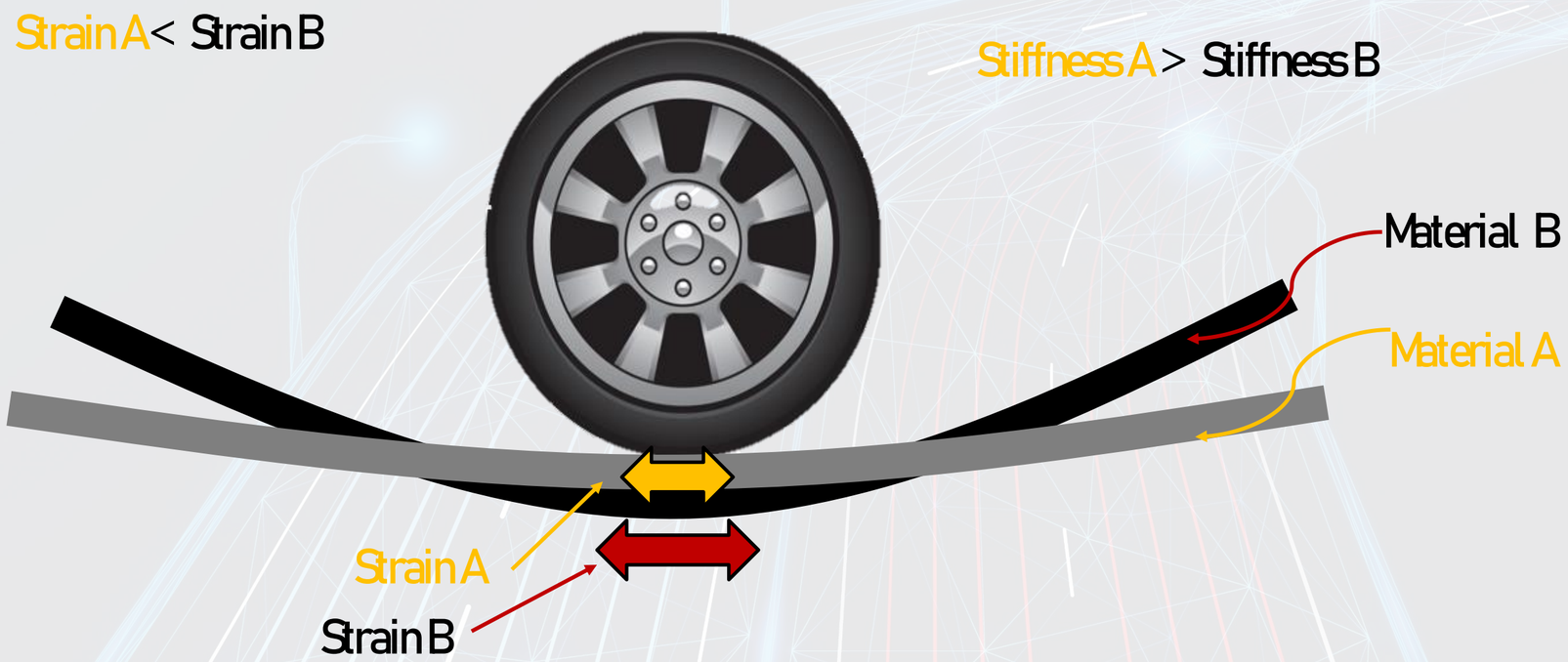
Understanding Material Behaviour…

Stiffness vs. Response to Loading

- Influenced by viscoelastic nature of binders
- Loading rate and temperature impact both properties
- Key to performance is balancing these behaviours

Low Temperature = High Frequency (Fast moving traffic)
High Temperature = Low Frequency (Low Speed Traffic)

Understanding Material Behaviour…



Understanding Material Behaviour…

Scenario 2:

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Binder Type 58-28
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Binder Type 58-28
RAP: 15%
Binder Content: 5.5%

Mix C:

Aggregate Source: Same as Mix A
Binder Type 52-34
RAP: 0%
Binder Content: 5.0%

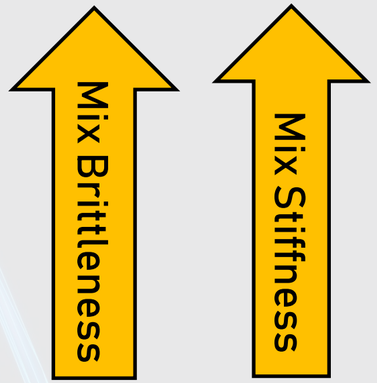
Understanding RAP…

RAP:

- Aged due to oxidation
- Stiffer than virgin material

Impact on Mix:

- Increases stiffness
- Changes response to repeated loading



Incorporating RAP…

Design Approaches:

- Performance Testing
- Mix Design Changes

Materials Approaches:

- Polymer Modified Asphalt
- Softening/Recycling Agents

RAP Management Practices:

- Fractionation
- Tracking/Reporting

State DOT RAP use Requirements

DOT RAP Use Requirements	FDOT	NDOT	NJDOT	SCDOT	WisDOT	WSDOT
% RAP Criteria	X	X	X			X[7]
RBR Criteria	X[1]			X	X	X
% RAS Criteria			X	X	X	X
Specifications Used by Others	X	X		X	X	X
Lift Location Criteria	X	X	X	X	X	
Traffic Criteria	X			X	X	X
Specialty Mixture Criteria	X		X	X	X	X
Binder Type Criteria	X	X		X		X
Softer Binder by Grade Bump	X	X	X[5]			
Softer Binder by Blending Chart			X[5]		X	X
Softer Binder by PG of Blend			X[5]		X	X
Recycling Agent Additive		X	X[5]			X
WMA Additive	X	X	X[5]	X	X	X
Additional Asphalt at Design		X	X	X	X	
Additional Asphalt at Acceptance			X	X	X	
Gsb for RAP Aggregates					X	X
Mixture Performance Test(s)			X	X[4]		X
Pay for Binder Separately		X		X		
RAP Fractionation	X[2]			X[2]	X[2]	
RAP QC Plan	X		X	X		
Dedicated RAP Stockpiles	X[3]			X[6]		

[1]Contractor option for RAP over 20 percent, but RBR may not exceed 0.20;
[2]Contractor option, use may be greater for FRAP than RAP;
[3]Contractor option;
[4]APA rutting test only;
[5]Contractor option to meet performance test criteria;
[6]If not fractionated;
[7]RAS percent specified but overruled by RBR.

New Jersey DOT

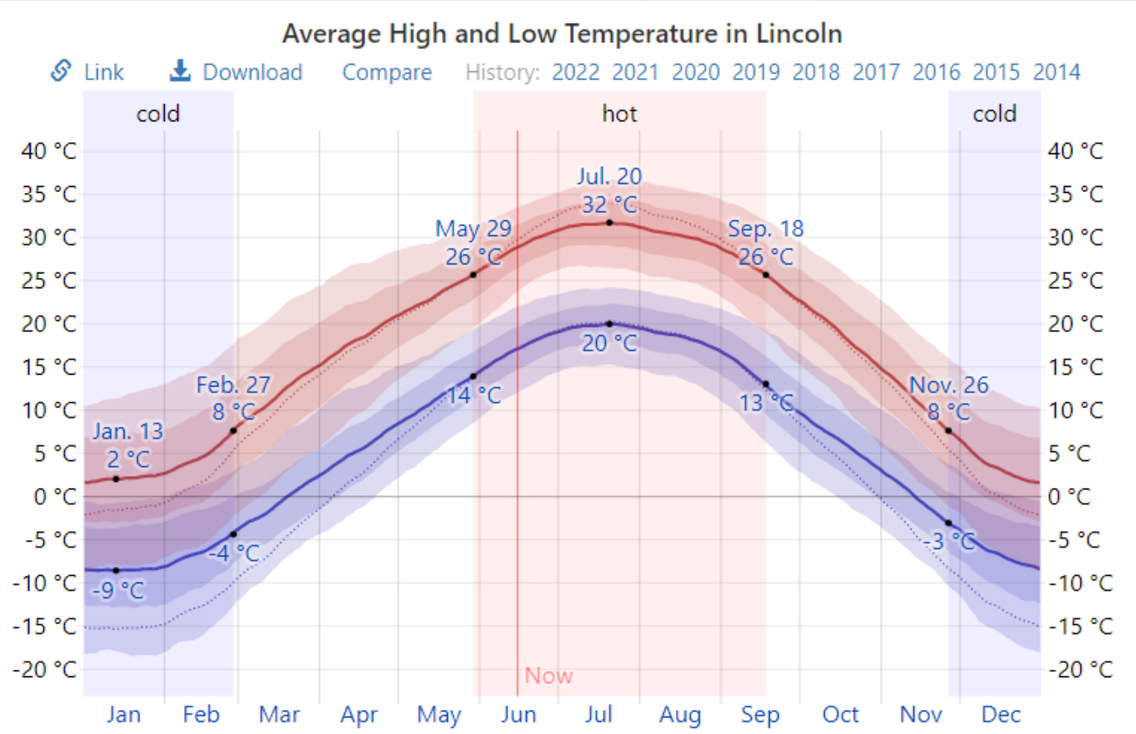
- Minimum RAP content mixes (20% Surface, 30% Coarse)

Florida DOT

- Unlimited RAP in some mixes
- Some producers use up to 40%, while one use 50% successfully

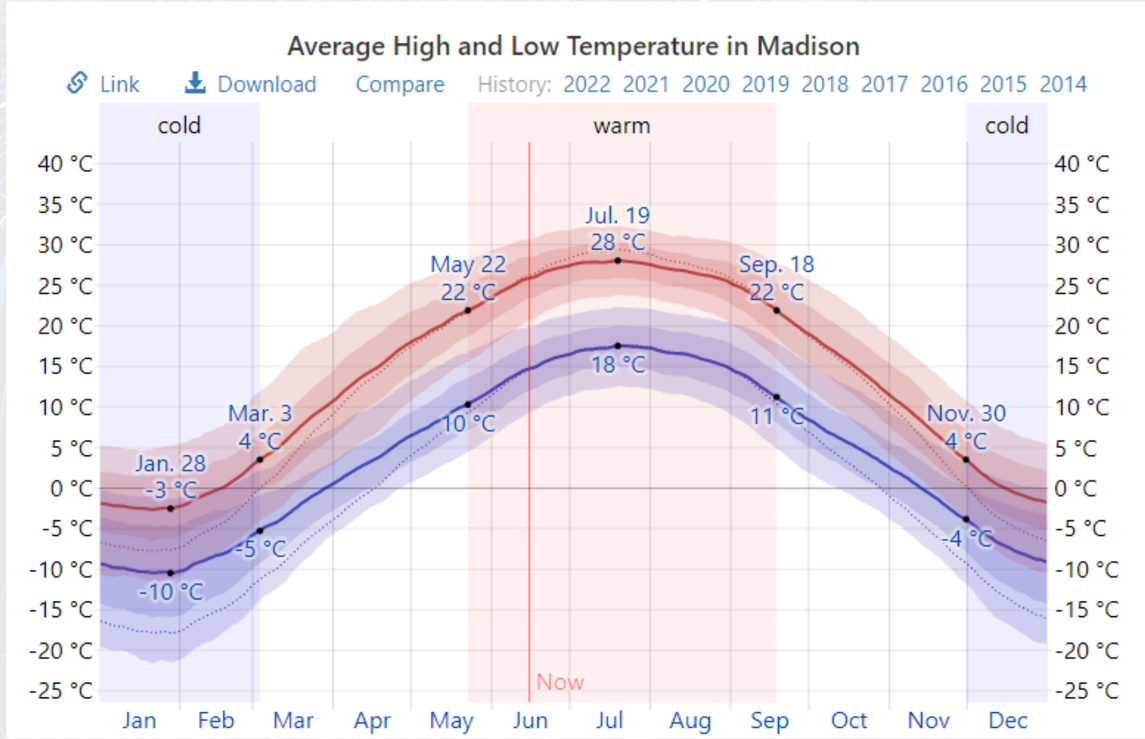
Nebraska DOT

- Averaged 39% RAP over last 6 years



Wisconsin DOT

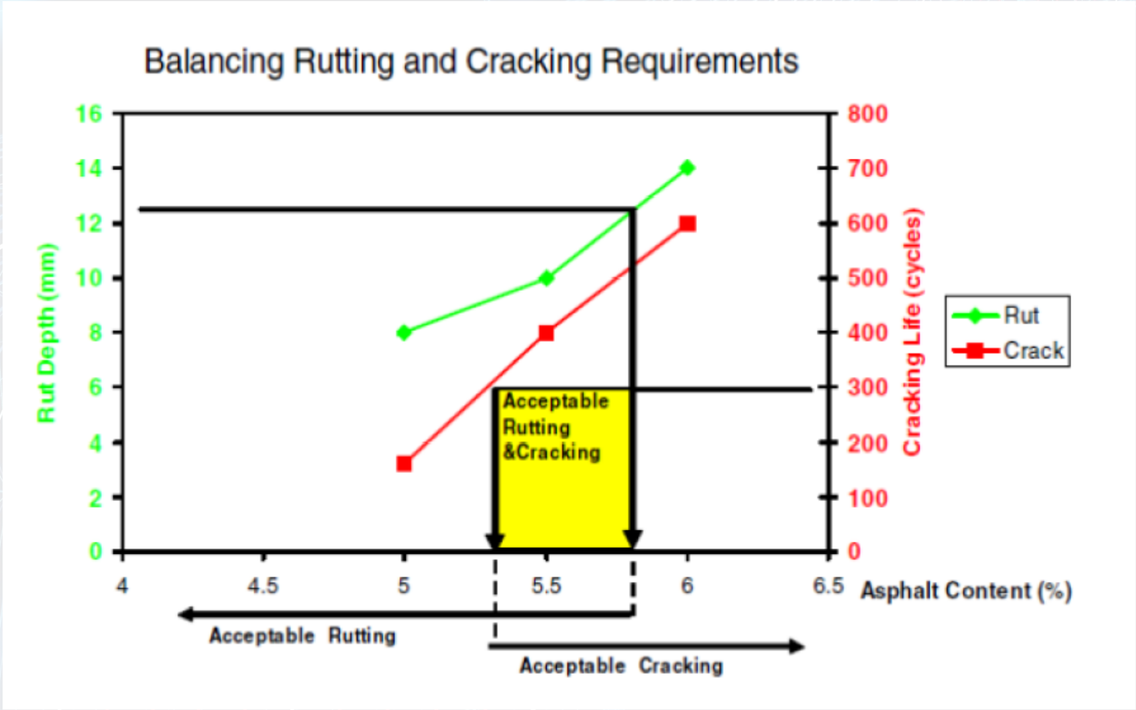
- 40% RAP Mixtures
- RAP used in 95% of pavements



Incorporating RAP with…

Performance Testing

- Emphasis on performance over volumetric properties
- Best way to understand impact of mix variables on material behaviour
- Tests are typically sensitive to RAP content among other variables



Incorporating RAP with…

Mix Design Changes

- Can be initiated with performance evaluation through mix testing
- Can be implemented into specification without performance testing requirements

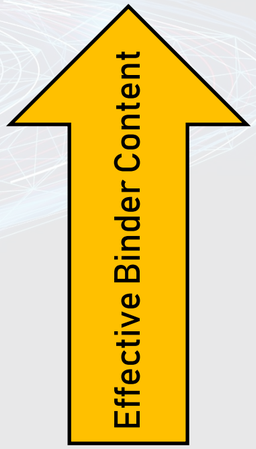
Increase Effective Binder content

- Changes mix response to loading, can decrease stiffness
- Increased film thickness
- Bonus: Better compaction

Incorporating RAP with…

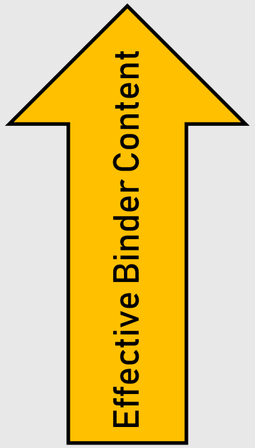
Increased VMA Requirement for mixes containing RAP

- NJDOT, VDOT have increased VMA requirement by 1%
- WisDOT has increased VMA requirement by 0.5%



Finer Mixes

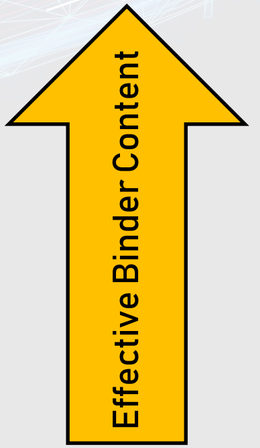
- Move towards 9.5mm SP mixes
- Changes material response to loading
- Bonus: Reduces permeability of mix, reduces long–term oxidation



Incorporating RAP with…

RAP Binder Ratio Requirements

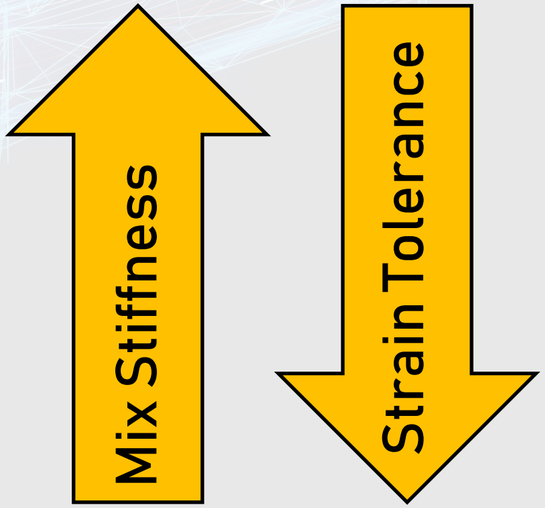
- Georgia's Example:
  - 60:40 Correct Optimum Asphalt Content for High RAP mixes
  - 25% RAP in Batch Plant, 40% RAP in Drum Plant
  - Increases total binder content
  - Verified using IDEAL-CT testing



Incorporating RAP with…

Polymer Modified Asphalt

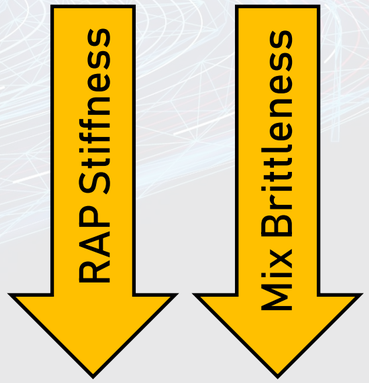
- Increases stiffness and reduces brittleness at intermediate/low temperature
- Alleviates rutting concerns with increasing binder content
- Combine with higher binder content?



Incorporating RAP with…

Softening/Recycling Agents:

- Decreases stiffness
- Rejuvenators can chemically alter aged binder
- REOB used as softening agent by Florida DOT



Warm Mix Additives:

- Reduced aging at hot mix plant intended reduce stiffness of binder
- Added benefit of further reducing emissions

Here are some ideas for High RAP…

* = subject to lab and field validation

Climatic Zone	Maximum Allowable RAP*	Nominal Maximum Aggregate Size*	Performance Testing Requirement*	VMA Requirement Change*	RAP Binder Replacement Ratio*	Use of Recycling Agent*
Zone 1 (58-28)	40%	SP9.5 Surface Mix Suggested	Intermediate (Low Optional)	+0.5%	75:25	Optional
Zone 2 (58-34)	35%	SP9.5 Surface Mix Suggested	Intermediate and Low	+1.0%	60:40	Optional
Zone 3 (52-34)	30%	SP9.5 Surface Mix Suggested	Intermediate and Low	+1.0%	60:40	Optional

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Thank You

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